Do Menstrual Problems Explain Gender Gaps in Absenteeism and Earnings? Evidence from the National Health Interview Survey

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Abstract: Menstrual problems are a controversial explanation for gender gaps in absenteeism and earnings. This paper provides the first evidence on this issue using data that contains information on health. We find that menstrual problems could explain around 30 percent of the gender gap in reported illness-related absences among U.S. workers, though this hinges on whether menstrual problems are the cause of, or the result of, other health conditions—a question on which the medical literature is inconclusive. Nevertheless, menstrual problems, and reported absenteeism in general, explain very little of gender gaps in full-time, full-year earnings.

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Most women of reproductive age experience some form of symptoms related to their menstrual cycles. These symptoms include fatigue, bloating, irritability, depression, bothersome cramping, or heavy bleeding and, for a small fraction of women, may be severe enough to interfere with social or occupational functioning. It is currently estimated that 3 to 8 percent of women of reproductive age meet the clinical criteria for a severe form of premenstrual syndrome (PMS) known as premenstrual dysphoric disorder (PMDD), and around 15 to 20 percent of women meet criteria for sub-threshold PMDD, or severe PMS with significant functional impairment (Pearlstein (2007)).[1]

Since menstrual problems only affect women, they provide an interesting and provocative explanation for gender gaps in the labor market. Ichino and Moretti (2009) develop a model of statistical discrimination to illustrate how menstruation could generate gender gaps in earnings. In their model, the main channel through which menstrual problems affect wages is absenteeism, which is observed and sends a signal about productivity at work.[2] Ichino and Moretti (2009) present evidence from a large Italian bank that menstrual cycles could explain one third of the gender gap in absenteeism and 14 percent of the gender gap in wages, but Rockoff and Herrmann (forthcoming) show that their evidence, based on 28-day cycles of absence spells, is not robust to small changes in coding or specification and may be driven by changes in absence patterns that manifest at multiples of 7 for employees who work 5 days per week.

[1] PMS refers to a set of physical, behavioral, or emotional symptoms that typically occur for several days to 2 weeks before and remit during menses. These symptoms can include: abdominal bloating, breast tenderness, constipation or diarrhea, food cravings, headache, difficulty concentrating, fatigue, feelings of sadness or hopelessness, anxiety, tension, irritability, mood swings, and sleep problems (A.D.A.M. Medical Encyclopedia 2011b). PMDD is a condition in which a woman has severe depression symptoms, irritability, and tension before menstruation (A.D.A.M. Medical Encyclopedia 2011a). Estimates of PMS prevalence can range widely depending on the diagnostic criteria. Using various diagnostic criteria, Dean et al. (2006) arrive at a prevalence of between 19 and 30 percent.

[2] Although absenteeism is simply a signal in their model, Ichino and Moretti note that absenteeism could have a direct effect on productivity.

At this point in time, there is little robust evidence on the extent to which menstrual problems might explain gender gaps in absenteeism and earnings. One major obstacle for research in this area is the need for a dataset with information on individual earnings, absenteeism, and, for women, the presence of menstrual problems.[3] As it turns out, several waves of the National Health Interview Survey (NHIS), a nationally representative sample of adult males and females, contains all three pieces of information.

We estimate standard "Mincer" regressions of gender gaps in illness-related absenteeism and earnings, treating menstrual problems as an omitted variable. We assess whether these estimated gender gaps are reduced when we include menstrual problems as an additional control variable, similar to work on how pre-market factors explain earnings gaps between Black and White workers (Neal and Johnson 1996). We estimate that menstrual problems explain 28 percent of the gender gap in absences due to illness among U.S. workers, with 95 confidence intervals between 12 and 43 percent. However, we find that the addition of information on menstrual problems, and illness absenteeism in general, explains only a very small fraction of the U.S. gender gap in full-time, full-year earnings, i.e., less than 2 percent at the upper bound of our 95 confidence interval.

Since the NHIS is a cross-sectional dataset, we cannot use panel-data methods to exploit the coincident timing of menstrual-related health problems and work absences or control for other aspects of individual heterogeneity. Given the lack of evidence on the effect of menstrual problems on labor market outcomes for women (and gender gaps), an observational analysis with rich cross-sectional data provides an important first step in addressing this question.

[3] This parallels a problem in the development literature, where researchers were unable to address how menstruation affects girls' school absenteeism until Oster and Thornton (2010) collected data on both girls' menstruation and absenteeism. In contrast to prior studies, they conclude this biological mechanism explains a tiny fraction of girls' school absences.

This paper continues as follows: Section 2 describes the data; Section 3 presents the econometric strategy; Section 4 presents the results; and Section 5 concludes.

2. Data

The primary data used in this paper is from the NHIS, a nationwide, representative survey that provides a rich set of information on the health and demographic characteristics of the U.S. civilian, non-institutionalized population. What is crucial for our study is that the 2002 and 2007 NHIS waves included a question about menstrual problems. Specifically, women aged 18-55 were asked whether they "had any menstrual problems, such as heavy bleeding, bothersome cramping, or premenstrual syndrome (also called PMS)" during the past 12 months. Our main explanatory variable for menstrual problems is coded as 1 for women who responded "yes" to this question and is coded 0 for women who responded "no" and for all men.

We analyze two main outcomes: absenteeism and income. Absenteeism is measured as the number of days of work the person missed in the last year due to illness or injury, excluding maternity leave. Income is measured as the person's total earnings last year and is reported in 11 income brackets, which cover $5,000 to $10,000 intervals and are top-coded at $75,000.[4] We assign each person's income as the midpoint of her income bracket or as $80,000 if she is top-coded.[5] The NHIS also reports information on employment (e.g., the number of months worked last year, the number of hours worked in the last week/usually, occupation, industry) and demographic characteristics (sex, age, race, education, marital status, number and age of

[4] These are <$5000, $5000-$9999, $10000-$14999, $15000-$19999, $20000-$24999, $25000-$34999, $35000-$44999, $45000-$54999, $55000-$64999, $65000-$74999, $75000+.

[5] About 4% of observations aged 18-55 in the NHIS report top-coded income. In the CPS, the average wage of individuals in the >$75,000 income bracket is about $100,000. Our results are robust to assigning individuals in the NHIS the mean income from the CPS for their income interval, gender, and year cell without trimming the top and bottom 1% of income observations. Because men are more likely to have top coded income, this assignment increases the estimate of the gender earnings gap to -0.32 log points with a standard error of 0.12, but the coefficient on menstrual problems remains a statistically insignificant -0.002 with a standard error of 0.021.

children). In addition, it provides information on other health conditions (e.g., pregnancy, frequent anxiety or depression, headaches) and behavioral risk factors (e.g., smoking, exercise, and body mass index) that might be correlated with menstrual problems, absenteeism, and earnings.[6]

We also use data from the Current Population Survey (CPS), a nationwide, representative survey that provides information on the employment, earnings, and demographics of the U.S. civilian, non-institutionalized population; specifically, we use the March Supplements from the years 2002 and 2007.[7] These data serve two functions: First, the CPS contains information on the absenteeism of full-time workers (>35 hours per week). For workers who usually work full-time but worked fewer hours in the last week, the CPS asks the reason for the discrepancy in hours. Our measure of absenteeism is the number of hours of work missed for vacation or personal days; own illness, injury, or medical problems; child care problems; other family or personal obligations; or maternity/paternity leave.[8] We also separately examine the number of hours of worked missed specifically for own illness, injury, or medical problems. While the CPS does not have information on whether women experience menstrual problems, these data are still useful to examine overall gender gaps in absences. Second, the CPS data provide a check on the validity of NHIS estimates of the gender gaps in earnings, which are based on income reported in intervals rather than as a continuous variable.

We impose a number of restrictions on our sample. Due to the age limits and the 12-month reference period on the question about menstrual problems, we focus on individuals

[6] Using data from the 2002 NHIS, Strine et al. (2005) find that women who experience menstrual problems are also significantly more likely to report frequent anxiety and depression, insomnia, excessive sleepiness, and pain over the last 12 months. They also find that these women are more likely to smoke, drink heavily, and be overweight or obese.

[7] These data were downloaded from the IPUMS-CPS database.

[8] Other reasons for missing work that we exclude from our measure of absenteeism are: temporary layoff, indefinite layoff, slack work/business conditions, waiting for a new job to begin, labor dispute, weather affected job, school/training, and civic/military duty.

between the ages of 18 and 55 and exclude women who might not have experienced menstrual problems due to pregnancy (i.e., they are currently pregnant or gave birth in the last year).[9] We also limit the sample to full-time full-year (FTFY) workers, which we define as workers who worked more than 35 hours in the last week (or usually) and 12 months in the last year in the NHIS, and those who worked more than 35 hours per week and at least 50 weeks in the last year in the CPS.[10] We drop those who are self-employed, working without pay, or who have missing or imputed earnings.[11] Finally, we also drop observations in the NHIS that report more than 150 days of absence in the past year. This restriction affects less than 1 percent of the FTFY observations in NHIS, and including these observations does not substantively change the results.

3. Econometric Strategy

To examine the extent to which menstrual-related problems might contribute to gender gaps in absenteeism and earnings, we estimate the following two equations using OLS:

$$Y_{it} = \alpha + \beta F_{it} + X_{it}\gamma + \delta_t + \varepsilon_{it} \quad (1)$$

$$Y_{it} = \alpha + \beta_m F_{it} + \lambda m_{it} + X_{it}\gamma_m + \delta^m{}_t + v_{it} \quad (2)$$

where Y_{it} represents the outcome for individual i in year t (i.e., number of days (or hours) absent from work or log earnings), F_{it} is an indicator for female, and m_{it} is an indicator for whether the individual experienced menstrual problems in the past year. X_{it} is a vector of control variables, which includes race dummies (black, Hispanic, other), region dummies (South, Midwest, West),

[9] We can only drop pregnant women in the NHIS since the CPS does not ask about pregnancy.
[10] Despite slight differences between the variables in the CPS and NHIS, these definitions for FTFY capture similar fractions of individuals in the data, about 68% of men and 47% of women between the ages of 18 and 55 in the CPS and about 66% of men and 46% of women between the ages of 18 and 55 in the NHIS. Later in the paper we present results showing that there is no significant relationship between menstrual problems and FTFY work.
[11] About 22% of individuals between the ages of 18 and 55 do not report income in the NHIS. In the CPS, we also trim the top 1% and bottom 1% of full-time, full-year wage earners to reduce the influence of outliers. The influence of outliers is minimized in the NHIS due to reporting in intervals.

education dummies (less than HS Grad, Some College, College or More), a quartic polynomial in potential experience, an indicator for married, and an indicator for having children under 6.[12] δ_t and δ^m_t are year fixed effects, and ε_{it} and v_{it} are error terms.

Our coefficients of interest are β and β_m, which represent the gender gap in outcomes, and λ, which represents the difference in outcomes between women who experience menstrual problems and women who do not. The difference between the estimate of β from equation (1) and β_m from equation (2) represents the amount of omitted variable bias caused by failing to control for menstrual problems.

Whether the ratio $(\beta - \beta_m)/\beta$ can be interpreted as the amount of the gender gap that is explained by menstrual problems depends primarily on the channels through which menstrual problems affect wages. This ratio is the correct measure if workers are paid their marginal product, and productivity is observed by the employer but not by the econometrician.

However, there are two reasons why it might *underestimate* the amount of the gender gap explained by menstrual problems: First, it does not capture general equilibrium effects where employers pay all women lower wages because some women experience menstrual problems. For example, if employers do not observe productivity, they might pay all women a pooling equilibrium wage based on women's expected lower productivity. We argue this is unlikely to be the case because even if employers do not perfectly observe productivity, they may still learn about it, causing workers' wages to become more closely related with whether they experience menstrual problems over time.[13] We also find no evidence that menstrual problems are significantly related to earnings among individuals who have been with their current employer

[12] We define potential experience as the max between 0 and age minus years of education minus 7.
[13] Literature on employer learning (e.g., Altonji and Pierret (2001)) finds that, over time, wages become more correlated with characteristics that are unobserved by the employer at the time of hire but are observed by the econometrician (e.g., AFQT score). At the very least, employers should observe absenteeism.

for at least two years, ample time for employers to learn about any productivity effects of this health condition.[14]

Second, the 12-month reference period for menstrual problems could cause measurement error in the explanatory variable, resulting in attenuation bias. Income is measured over the previous calendar year, so measurement error could be a problem if menstrual problems are not persistent. However, medical studies find that PMS and PMDD diagnoses are somewhat stable over time, and we find no evidence that menstrual problems explain earnings gaps to a greater extent among individuals interviewed in the first quarter, where the overlap between the reference periods for income and menstrual problems is the greatest.[15]

On the other hand, this ratio may *overestimate* the amount of omitted variable bias caused by menstrual problems if women who experience these problems are negatively selected relative to those who do not. For example, women with negative attitudes may be more likely to report menstrual problems and may have lower earnings because of their pessimistic personalities. It is also well-known that women who experience menstrual problems are more likely to have other health conditions or behavioral risk factors that may affect wages, e.g., anxiety or depression, insomnia, excessive sleepiness, pain, smoking, heavy alcohol consumption, and being overweight or obese (Strine et al. 2005). While these conditions may be endogenous to having menstrual problems, evidence from the medical literature is ambiguous on the direction of

[14] The coefficient (standard error) on menstrual problems in the sample of FTFY workers with at least 2 years at their current job is -0.003 (0.020).

[15] Wittchen et al. (2002) find that PMDD symptoms are relatively stable across 48 months, with fewer than 10% of baseline PMDD cases having complete remissions. Van der Ploeg and Lodder (1993) find more variability in the stability of PMS symptoms over a 2 year period. Roca et al. (1999) find that PMS is a stable diagnosis in a 5- to 12-year follow up on a small sample. The coefficient (standard error) on menstrual problems in the sample of FTFY workers in the first quarter is -0.023 (0.037). Another concern could be that menopausal women may not report having menstrual problems in the last 12 months but may have experienced them earlier in life; whether this leads to bias depends on the channels through which menstrual problems affect wages, but we also find no evidence in the FTFY under 45 sample that menstrual problems reduce earnings. The coefficient (standard error) on menstrual problems in this sample is -0.005 (0.023).

causality.[16] Nevertheless, we also estimate specifications that control for these confounding, but potentially endogenous, health conditions and risk factors. We also compare estimates for menstrual problems to those of other health conditions that may result in absenteeism or lowered productivity at work (i.e., hypertension; diabetes; inflammatory bowel disease (IBD), irritable bowel, or severe constipation; and frequent anxiety or depression).[17]

4. Results

Table 1 presents summary statistics for the main analysis samples from the CPS and NHIS. Gender gaps in income are of a similar magnitude in the two datasets– about $13,500 in the CPS and $10,000 in the NHIS – and the characteristics of the samples are otherwise quite similar.[18] About 18 percent of women in the NHIS are classified as having menstrual problems based on their survey responses, slightly lower than estimates from the medical literature on the prevalence of PMS, which range from 19 to 30 percent (Dean et al. 2006). To facilitate comparison between the absence data in the two samples, we rescale reported hours of absence in the last week in the CPS to obtain the implied number of absences per year.[19] Both data sets suggest that women are more likely to be absent from work due to illness than men, although the implied annual gender gap in absences in the CPS (0.8 days) is lower than the reported gap in the

[16] Freeman (2007) notes that "there are numerous conditions whose symptoms may be confused with PMS or may be exacerbated premenstrually…It can be difficult to determine whether the symptoms are an exacerbation of a comorbid condition or PMS symptoms…superimposed on another condition."
[17] Druss et al. (2001) find that the percent of workers who report missing workdays due to hypertension is 8.1, due to diabetes is 10.0, and due to mood disorders is 18.4. Among telephone customer-service agents, Burton et al. (1999) find that digestive disorders, including irritable bowel syndrome, are responsible for the greatest losses in productivity, compared to other diseases; most of this is due to reduced productivity while at work.
[18] Average income is somewhat lower for men in the NHIS ($48,464) than in the CPS ($52,197), but this is due to differences in top-coding; if we recode income in the CPS sample in the same way as the NHIS sample, income is actually slightly lower for men in the CPS ($46,640) than in the NHIS ($48,464).
[19] We obtain the fraction of the week absent by dividing the total hours of absence by the usual hours of work per week and multiply this by the number of weeks worked in the last year. We then multiply this by 5 day per week to obtain the implied days of absence per year, under the assumption that most workers work 5 days per week.

NHIS (1.2 days). This is likely due to the one-week reference period in the CPS, which may miss some episodes of illness.[20]

4.1 Illness-Related Absenteeism

Table 2 reports the regression results for work absenteeism. The first two columns use CPS data to estimate the gender gaps in the implied annual number of work absences. Column (2) shows that about 40 percent of the estimated 1.8 day gender gap in absenteeism is driven by absences due to illness. The following columns use NHIS data to examine the extent to which menstrual problems explain gender gaps in absence due to illness. In the NHIS, the estimated gender gap in absences due to illness is 1.14 days per year (Column 3), which falls to 0.82 when we control for the existence of menstrual problems (Column 4). These results suggest that menstrual problems could account for close to 30 percent of the gender gap in illness-related absences. We also find that women who experience menstrual problems miss an average of 1.8 days more than women who do not, which is roughly consistent with medical literature on work absenteeism due to PMS/PMDD.[21] Columns (5) and (6) check that the results are robust to the inclusion of a coarse set of controls for industry and occupation and indicators for having paid sick leave or employer-provided health insurance, which could affect workers' incentives for

[20] The CPS asks about absenteeism in each month, but only the March Supplement contains detailed questions on income. Table 1 also illustrates women are more likely than men to receive sick pay when they are absent (77 vs. 69 percent). There is not comparable information on paid sick leave from the CPS, since it only asks people who were absent whether they were still paid. This may reflect the higher concentration of women in white-collar occupations, but could also explain why women take more sick days than men. Of course, it is also possible that women sort into these occupations and accept lower wages in exchange for increased time off.

[21] Our calculations from the estimates reported in Dean and Borenstein (2004) suggest that women who experience PMS may miss between 1.4 and 2.3 more workdays per year than women who do not. Similar calculations from reported estimates yield differences of 0.86 days (Hylan et al. (1999)) and 0.374 days (Hienemann et al. (2010)) (See the Appendix for more details on these calculations.) One of the reasons for the discrepancy between these estimates is that, with the exception of Hylan et al., yearly estimates are extrapolated from data on absences during one or two menstrual cycles. Another reason is that there are large differences between studies in sample selection, (e.g., whether women with psychiatric illnesses are excluded from the sample).

absence and their knowledge about and treatment of health conditions.[22] The final columns address the concern that women who experience menstrual problems miss more work merely because they are more likely to have other health problems. Columns (7) and (8) add controls for other health conditions and behavioral risk factors (e.g., whether the person has experienced frequent anxiety or depression in the past 12 months) but should be interpreted under the caveat that they are potentially endogenous to menstrual problems.[23] The inclusion of these controls significantly reduce both the estimated gender gap in absences due to illness, which falls from 1.3 to 0.95 days, and the gap in absences between women with and without menstrual problems, which falls from 1.7 to 0.8 and loses statistical significance. Nonetheless, the coefficients in Columns (7) and (8) still suggest that menstrual problems play some role in explaining gender gaps in absences due to illness.

To evaluate whether the extra 1.8 days missed due to menstrual problems is large, we compared it to estimates of absenteeism associated with other health conditions. We ran similar specifications to Column (4) where we replaced the indicator for menstrual problems with indicators for other health conditions (hypertension, diabetes, IBD/irritable bowel/constipation, and frequent anxiety/depression) excluding women who experience menstrual problems from the sample.[24] All of the coefficient estimates for these conditions are significant at the 1 percent level: 1.2 days for hypertension, 3.1 days for diabetes, 3.3 days for IBD/irritable

[22] The controls for industry and occupation are rather coarse because of the sample size. There are controls for 14 industry categories and 12 occupations. This coding was complicated by a change between years in industry and occupation codes; details on the industry/occupation groups and the matching across years can be found in the Appendix.

[23] The complete set of health and behavioral risk factor controls are: smoker, overweight (body mass index (BMI) more than 25 but less than 30), obese (BMI more than 30), get recommended exercise (more than 20 minutes of vigorous exercise at least 3 days per week *or* more than 30 minutes of moderate exercise at least 5 days per week), heavy drinker, fatigue, pain, insomnia, anxiety or depression, and headaches.

[24] With the exception of diabetes, where the question asks about ever being diagnosed, the reference period for these conditions is the past 12 months.

bowel/constipation, and 3.0 days for anxiety/depression.[25] Thus, the effect of 1.8 days for menstrual problems lies on the lower end of these estimates for effects of persistent health conditions on work absence due to illness.

The estimated effect of menstrual problems is largest in Column 4, Table 2. Using this point estimate, which assumes menstrual problems are the cause, rather than the effect, of any co-morbid conditions, we can reject at the 95 percent level a coefficient of 2.7 days on menstrual problems. This implies an upper bound of 43 percent on the amount of the gender gap in absences due to illness attributable to menstrual problems. Of course, the effect on total absences may be lower if women who experience menstrual problems compensate for extra absences due to illness by taking fewer absences for other reasons.[26]

4.2 Earnings

Having established that women who experience menstrual problems have more absences due to illness, we examine the relation between earnings, absenteeism, and menstrual problems. Table 3 reports results from our log earnings regressions. Columns (1) and (3) present estimates of the gender gap in earnings from the CPS and NHIS. Despite the differences between the income variables, these estimates are strikingly similar, around 0.27 log points. Columns (2) and (4) provide estimates of earnings penalty associated with illness-related absences, so we can assess how much the absences induced by menstrual problems might be expected reduce earnings. The estimates in these specifications are small and insignificant, -0.0001 and -0.0003

[25] The percent of individuals with hypertension, diabetes, IBD/irritable bowl/constipation, and anxiety/depression for this regression sample are 12 percent, 3 percent, 2 percent, and 9 percent, respectively.

[26] For example, Herrmann and Rockoff (2010) find that while school teachers who live farther away are more likely to be absent on bad weather days, they do not have higher total numbers of absences than teachers who live closer by, suggesting that teachers may substitute between absences due to bad weather and for other reasons. We cannot examine substitution between different types of absence because the NHIS only asks about absences from work due to illness.

log points for each absence, respectively, and suggest that the extra 1.8 days of absence caused by menstrual problems might only lead to an earnings reduction of 0.0005 log points. However, it is worth noting that these estimates are likely attenuated by measurement error since the reference periods for absences and earnings do not perfectly overlap, and absences in the CPS are only measured for a one-week period. It is also plausible that workers mitigate the earnings cost of absence by taking the financial incentives of absence into account or substituting between different types of absence.[27]

Since absences are measured with error, menstrual problems could be used as an instrument for absenteeism to generate an unbiased estimate of the effect of absenteeism on earnings. Of course, menstrual problems could affect earnings through other channels besides absenteeism, such as by reducing the productivity of present workers. As this channel would violate the exclusion restriction of an instrument variable approach, we simply report reduced form estimates for menstrual problems, the first of which is in Column (5). Notably, even though women who experience menstrual problems have more illness-related absences, they do *not* have significantly lower earnings than other women. The coefficient on menstrual problems is larger than would be expected from the coefficient on illness absences in Column (4) and the results of Table 2, suggesting that women with menstrual problems earn may earn less on average due to factors other than absenteeism. Nevertheless, the coefficient on menstrual problems is very close to zero (-0.006) and its inclusion in the earnings regression reduces the estimated gender gap only slightly, from 27.4 to 27.3 log points. Given our standard errors, we can reject at the 95 percent level a coefficient of -0.03 log points on menstrual problems, implying an upper bound of roughly 2 percent on the fraction of the gender gap in earnings that

[27] A number of papers find that financial incentives affect worker absence (e.g., Winkler (1980), Jacobson (1989), Ehrenberg et al. (1991), Barmby et al. (1991), Brown and Sessions (1996), and Lindeboom and Kerkhofs (2000)).

could be explained by menstruation. Including controls for job characteristics causes the coefficient on illness-related absences to become marginally significant (-0.0009 log points) and provides suggestive evidence that absenteeism may be higher in occupations with lower financial incentives to avoid absence. However, adding controls for job characteristics and other health conditions and risk factors has very little impact on the estimates for menstrual problems.

We address two potential problems with drawing conclusions from these results. The first is that the NHIS is not typically used in research on earnings, and we may lack power for discerning effects of chronic, non-severe, health conditions more generally. To address this issue, we estimated regressions that included indicators for diabetes and anxiety/depression using the same log earnings specification in Column 3 (excluding women who suffer from menstrual problems). Both coefficients are statistically significant at conventional levels, with coefficients (standard errors) of -0.07 (0.03) for diabetes and -0.07 (0.02) for anxiety/depression.

Another potential issue is that we limit our sample to individuals working full-time full-year. A review of the literature by Currie and Madrian (1999) finds that health conditions are commonly found to have greater effects on labor force participation than on wages. Thus, while we show that menstrual problems are not significantly related to earnings conditional on FTFY employment, one might expect them to affect labor force participation. Table 4 investigates this question by estimating linear probability models using FTFY employment as the outcome. The gender gaps in full-time, full-year participation are similar between the two samples, around 20 percent, and we find no evidence that women with menstrual problems are less likely to participate in full-time, full year employment than women without these conditions (Column 3). For comparison, we estimated whether FTFY participation was related to a number of other health conditions, again excluding all women who reported having menstrual problems. We find

coefficients of -0.05 for hypertension, -0.11 for diabetes, -0.13 for IBD/irritable bowel/constipation, and -0.21 for anxiety/depression, all significant at the 1 percent level.

5. Conclusion

Nationally representative data from the NHIS indicate that around 20 percent of women experience menstrual problems such as heavy bleeding, bothersome cramping, or PMS. Using regression analysis, we measure whether women reporting these menstrual problems also have higher rates of absenteeism and lower earnings than similar women who do not face this health condition. We find that menstrual problems can explain about 30 percent of gender gaps in *illness-related* absenteeism—the only type of absenteeism reported in the NHIS. However, despite evidence of increased absenteeism, we find no evidence that menstrual problems affect the earnings of FTFY women or FTFY employment, and our estimates suggest an upper bound of 2 percent on the fraction of the earnings gender gap explained by menstrual problems. One possible explanation for the lack of an earnings effect is that the additional number of illness-related absences caused by menstrual problems is relatively small – 1.8 days – and could be fully offset by workers reducing other types of absenteeism or compensating for higher illness-related absences in another way, e.g., staying extra hours on other days.

Our analysis provides new evidence on role of menstruation in explaining gender gaps in earnings. While it is possible that other empirical strategies (e.g., an analysis of panel data) might produce contrasting results, our results suggests this biological difference between men and women plays a very minor part in explaining differences in labor market success.

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Appendix

Medical Literature Absenteeism Calculations

Dean and Borenstein (2004) study women for two menstrual cycles:

	No PMS	PMS in 1 cycle	PMS in both cycles
Percent of Sample	71%	18%	11%
Average Absences	1.3 days	2.5 days*	2.2 days

*The difference between the average for women with PMS in 1 cycle and the average for women with no PMS is statistically significant.

If you only use the statistically significant difference, the estimated difference is: 0.18(2.5-1.3)(365/(28*2)) = 1.4 days

Otherwise, the estimated difference is: 1.4 days + 0.11(2.5-1.3)(365/(28*2)) = 2.3 days

Hienemann et al. (2010) study women with moderate-to-severe PMS/PMDD (35% of the sample), who were 8.2% more likely to report >8 hours of absenteeism during 1 cycle. Assuming that this equates to 1 day of missed work, the estimate for moderate-to-severe PMS/PMDD is: 0.082*1*(0.35)(365/28) = 0.374

Hylan et al. (1999) study women over a one year period. Absenteeism is reported for the 21% of U.S. women who report ever missing work due to PMS symptoms and that symptoms interfere with work:

Number of Days Missed	0	1-7	8-14	>14
Percent	23%	67%	5%	5%

Using the midpoints of each interval and 18 days for the >14 category, the estimated number of days missed due to PMS is: 0.21(0.23*0+0.67*4+0.05*11+0.05*18) = 0.86.

Table 1: Summary Statistics

	CPS		NHIS	
Variable	Male	Female	Male	Female
Income ($2007)	52197	38744	48464	38457
Hispanic	0.16	0.12	0.15	0.09
Black	0.10	0.15	0.10	0.14
Other Race	0.06	0.06	0.05	0.05
Midwest	0.23	0.23	0.25	0.26
South	0.36	0.37	0.37	0.37
West	0.23	0.21	0.21	0.18
Children Under 6	0.20	0.13	0.24	0.15
Married	0.62	0.55	0.64	0.52
Less than HS	0.11	0.07	0.11	0.06
Some College	0.27	0.31	0.29	0.34
College or More	0.30	0.33	0.33	0.34
Potential Experience	17.7	18.2	17.3	17.8
Menstrual Problems	-	-	0.00	0.18
Absences (Days)*	4.82	6.75	-	-
Illness Absences (Days)*	1.28	2.05	2.68	3.89
Have Paid Sick Leave	-	-	0.69	0.77
Employer-Provided Health Insurance	0.79	0.83	0.84	0.85
Smoker	-	-	0.24	0.23
Overweight	-	-	0.46	0.27
Obese	-	-	0.27	0.25
Recommended Exercise	-	-	0.38	0.34
Heavy Drinker	-	-	0.06	0.05
Fatigue	-	-	0.06	0.08
Pain	-	-	0.27	0.32
Insomnia	-	-	0.11	0.18
Anxiety/Depression	-	-	0.08	0.14
Headaches	-	-	0.08	0.22
N	64479	48258	7707	6601

Notes: Means for each sample are calculated using sample weights. The CPS sample inclues full-time, full-year (FTFY) workers between the ages of 18 and 55, trimming the top 1% and bottom 1% of FTFY wage earners. It excludes women who were pregnant in the last year - there is no variable for currently pregnant in the CPS - and people who are self-employed or who work without sick pay. The NHIS sample includes FTFY workers between the ages of 18 and 55. It excludes women who are currently pregnant or who were pregnant in the last year and people who are self-employed or who work without pay or who report more than 150 days of absence. *In the CPS, the implied annual days absent are calculated from hours reported absent in the last week. See the text for more details.

Table 2: Absenteeism and Menstrual Problems

	CPS		NHIS					
	All	Illness	Illness	Illness	Illness	Illness	Illness	Illness
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female	1.7886**	0.7079**	1.1430**	0.8195**	1.2781**	0.9675**	0.9548**	0.8157**
	(0.4583)	(0.1254)	(0.2055)	(0.2088)	(0.2151)	(0.2169)	(0.2444)	(0.2466)
Menstrual Probs				1.7629**		1.7158**		0.8008
				(0.4652)		(0.4682)		(0.4922)
Job Controls					X	X	X	X
Health Controls							X	X
R-squared	0.00	0.00	0.01	0.01	0.02	0.02	0.04	0.04
N	112737	112737	14308	14308	14308	14308	13822	13822

Notes: All specifications are weighted by sample weights and control for race (black, Hispanic, other), education (Less than HS, Some College, College or More), a quartic polynomial in potential experience, married, children under 6, region (south, midwest, west), and a year indicator. Job controls include: industry and occupation dummies and indicators for having paid sick leave and employer-provided health insurance. Health controls include: smoker, overweight, obese, get recommended exercise, heavy drinker, fatigue, pain, insomnia, anxiety or depression, and headaches. For the CPS, standard errors are clustered at the state by year level. For the NHIS, standard errors are clustered by the strata by primary sampling unit by year level. Significance levels are +0.10, *0.05, **0.01.

Table 3: Log Earnings, Absenteeism, and Menstrual Problems

	CPS		NHIS								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Female	-0.2719**	-0.2718**	-0.2738**	-0.2738**	-0.2731**	-0.2477**	-0.2466**	-0.2460**	-0.2439**	-0.2431**	-0.2441**
	(0.0079)	(0.0079)	(0.0101)	(0.0101)	(0.0108)	(0.0102)	(0.0102)	(0.0108)	(0.0106)	(0.0106)	(0.0111)
Illness Absences		-0.0001		-0.0003			-0.0009+			-0.0008+	
		(0.0001)		(0.0005)			(0.0004)			(0.0005)	
Menstrual Probs					-0.0056			-0.0096			0.0014
					(0.0190)			(0.0176)			(0.0175)
Job Controls						X	X	X	X	X	X
Health Controls									X	X	X
R-squared	0.36	0.36	0.36	0.36	0.36	0.47	0.47	0.47	0.47	0.47	0.47
N	112737	112737	14308	14308	14308	14308	14308	14308	13822	13822	13822

Notes: All specifications are weighted by sample weights and control for race (black, Hispanic, other), education (Less than HS, Some College, College or More), a quartic polynomial in potential experience, married, children under 6, region (south, midwest, west), and a year indicator. Job controls include: industry and occupation dummies and indicators for having paid sick leave and employer-provided health insurance. Health controls include: smoker, overweight, obese, get recommended exercise, heavy drinker, fatigue, pain, insomnia, anxiety or depression, and headaches. For the CPS, standard errors are clustered at the state by year level. For the NHIS, standard errors are clustered by the strata by primary sampling unit by year level. Significance levels are +0.10 *0.05 **0.01.

Table 4: Selection into FTFY Employment and Menstrual Problems

	CPS	NHIS			
	(1)	(2)	(3)	(4)	(5)
Female	-0.1978**	-0.2021**	-0.1992**	-0.1761**	-0.1783**
	(0.0034)	(0.0069)	(0.0071)	(0.0073)	(0.0074)
Menstrual Probs			-0.0151		0.0121
			(0.0118)		(0.0120)
Health Controls				X	X
R-squared	0.15	0.15	0.15	0.18	0.18
N	199142	28531	28531	27041	27041

Notes: All specifications are weighted by sample weights and control for race (black, Hispanic, other), education (Less than HS, Some College, College or More), a quartic polynomial in potential experience, married, children under 6, region (south, midwest, west), and a year indicator. Health controls include: smoker, overweight, obese, get recommended exercise, heavy drinker, fatigue, pain, insomnia, anxiety or depression, and headaches. For the CPS, standard errors are clustered at the state by year level. For the NHIS, standard errors are clustered by the strata by primary sampling unit by year level. Significance levels are +0.10, *0.05, **0.01.

Appendix Table A1: Crosswalk between 2002 and 2007 Simple Industry Codes

2002 Industry		2007 Industry	
Code	Label	Code	Label
1	Agriculture, Forestry/Fisheries	1	Agriculture, Forestry, Fishing, and Hunting
2	Mining	2	Mining
3	Construction	4	Construction
4	Manufacturing	5	Manufacturing
5	Transporation, Communications & Public Utilies	3,8,9	Utilities, Transportation and Warehousing, Information
6	Wholesale Trade	6	Wholesale Trade
7	Retail Trade	7,18	Retail Trade,
8	Finance, Insurance, and Real Estate	10, 11	Finance and Insurance, Real Estate and Rental and Leasing
9	Business and Repair Services	13,14	Management of Companies and Enterprises, Administrative Support and Waste Management and Remediation Services
10, 12	Personal Services/Professional and Related Services	12, 15, 16, 19	Professional, Scientific, and Technical Services, Education Services, Health Care and Social Assistence, Other Services (except Public Administration)
11	Entertainment and Recreation Industries	17	Arts, Entertainment, and Recreation Industries
13	Public Administration	20	Public Administration
15	Armed Forces	21	Armed Forces
97,98,99	Refused, Classified, Etc./Not Ascertained/Don't Know	97,98,99	Refused, Classified, Etc./Not Ascertained/Don't Know

Appendix Table A2: Crosswalk between 2002 and 2007 Simple Industry and Occupation Codes

2002 Occupation		2007 Occupation	
Code	Label	Code	Label
1	Executive, Administrative, and Managerial	1	Management
2	Professional Specialty	2,3,4, 5,7,8,9 ,10	Business and Financial Operations, Computer and Mathematical, Architecture and Engineering, Life, Physical and Social Science, Legal, Education, Training, and Library Occupations, Arts, Design, Entertainment, Sports, and Media, Health Care Practitioners and Technical
3	Technicians and Related Support	11	Healthcare Support
4	Sales	16	Sales and Related
5	Administrative Support, Including Clerical	17	Office and Administrative Support
6,8	Private Household/Service, Except Protective and Household	13, 14,15	Food Preparation and Serving, Building and Grounds Cleaning and Maintenance, Personal Care and Service
7	Protective Service	6,12	Community and Social Service, Protective Service
9	Farming, Forestry, and Fishing	18	Farming, Fishing, and Forestry
10, 11, 13	Precision Production, Craft and Repair/Operators, Fabricators, and Laborers/Handlers, Equipment Cleaners, Helpers, and Laborers	19,20, 21	Construction and Extraction, Installation, Maintenance, and Repair, Production
12	Transportation and Material Moving Occupations	22	Transportation and Material Moving
16	Military	23	Military Specific
97, 98, 99	Refused, Classified, Etc./Not Ascertained/Don't Know	97, 98, 99	Refused, Classified, Etc./Not Ascertained/Don't Know