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Abstract

In an aging society, determining which factors contribute to the employment of older individuals is increasingly important. This paper sheds light on the impact of medical innovation in the form of Hormone Replacement Therapy (HRT) on employment of middle-aged women. HRT are drugs taken by middle-aged women to soften symptoms related to menopause. Before 2002, HRT products were among the most popular prescription drugs in America. We use the timing of the release of information of the potential hazardous effects of HRT—uncovered in 2002 by the largest randomized trials on women ever undertaken—as an instrument for the purchase of the affected drugs within a Fixed Effect Instrumental Variable framework. We find that HRT use impacts employment: namely, that HRT use increases employment by 25 percentage points among middle-aged women who would have taken HRT but who do not take HRT after the release of information of its potential hazardous effects.

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1. Introduction

The increase in labor force participation, and consequently, the increase in employment of women is one of the most striking trends in the twentieth century. Although this trend is likely due to the complex interaction of many factors, [1] available research in economics recognizes, among other causes, the important role of medical innovation in shaping labor market behavior of both men and women (Duggan and Garthwaite, 2010). There are, in particular, some medical innovations that disproportionately affected and, most likely, continue to affect, women's labor market behavior. The advent of the birth control pill, for example, by allowing women to successfully control their fertility and therefore delay marriage, allowed women to increase their human capital (Goldin and Katz, 2002) and enter the labor market (Goldin and Katz, 2002; Bailey, 2006). Also, the development of bacteriology, the introduction of sulfominydes and antibiotics, and the diffusion of blood banks dramatically decreased the death rate for women during child delivery; improved the standardization of obstetric practices; increased availability of pre-natal care and reduced the incidence of post-partum disabilities (Albanesi and Olivetti, 2009). These medical advances, by dramatically improving the health of women of fertile age who decide to have children, were crucial to the increase in labor force participation of women in childbearing years between 1920 and 1965 (Albanesi and Olivetti, 2009).

Despite evidence of the impact of medical innovations on women's reproductive health and labor market behavior, there is very little research[2] on the effect on labor market behavior of medical innovation aimed at women around the end of their reproductive years. This gap is particularly surprising because for 80 percent of women, the end of their reproductive years, commonly known as "menopause transition"—a period in which fertility progressively declines and women's hormones levels have an erratic pattern (Gardener and Shoback, 2007)—is associated with various symptoms of discomfort, sometimes severe, in the

[1] For an historical perspective, see Goldin (1990), Goldin (2006) and Acemoglu et al. (2004). Black and Brainerd (2004) and Black and Strahan (2001) focus on how globalization and deregulation trends may have reduced discrimination against women in various occupations. Greenwood et al. (2005) studies the role of household technologies in women's attachment to the labor force. For a discussion of how the shift toward a service and skill-intensive economy has increased the proportion of jobs suitable for women, see, for instance, Weinberg (2000) and Black and Juhn (2000).

[2] Only one study considers the effect of menopause transition on labor market behavior: Mvundura, (2007). Mvundura's (2007) research is summarized in Section 3.

form of vasomotor symptoms (hot flashes),[3] and genital atrophy, both considered the main cause for mood disturbances (Gardener and Shoback, 2007). The drugs effective in alleviating the symptoms of discomfort associated with the menopause transition, Hormone Replacement Therapy (HRT), have existed since 1938. In this paper we attempt to increase our understanding of the role of medical innovations in peri-menopausal and menopausal women's labor market outcomes by examining the effects HRT drugs have on the employment of middle-aged women using data from the Medical Expenditure Panel Survey. Research into the relationship between medical innovations intended to improve the health of women at the end of their reproductive years and women's labor market behavior is important for at least two reasons.

First, the issue is relevant because all women, if they live long enough to reach middle age, experience the transition marked by the end of their reproductive years, and HRT drug use for the treatment of the most common symptoms of menopause is widespread. Premarin, the most popular HRT drug used by women to overcome symptoms associated with the menopause transition in 2001, the year in which our study starts, ranked second in America for number of purchased prescriptions, with 53,789,424 prescription medications purchased.[4] HRT is the only Food and Drug Administration (FDA) approved drug for the treatment of menopausal symptoms. For over half a century, Premarin and other commercially available estrogen have been widely prescribed by doctors for treating symptoms experienced by women during the menopause transition and the early years of menopause (Watkins, 2007a). From the 1980s onwards, HRT drugs have gained popularity as a means to prevent heart disease, stroke and osteoporosis, contributing to the adoption of a culture of Hormone Replacement Therapy as miracle drugs, elixirs to be used from the menopause transition to the grave to treat and prevent the maladies of aging.

Second, there is extensive research that links poor health to lower levels of labor market behavior (Currie and Madrian, 1999). However, there is need to uncover which factors might affect health in such a way to alter labor market behavior. This need is especially relevant when considering health treatments, because health care expenditures are rising in most countries and have reached substantial levels. For

[3] For a more detailed description of vasomotor symptoms, see Section2.
[4] Data from the Medical Expenditure Panel Survey available at: http://www.meps.ahrq.gov/mepsweb/data_stats/summ_tables/hc/drugs/2001/hcdrugest_totpur2001.shtml.

example, recent data shows that health spending continues to rise faster than economic growth in most OECD countries,[5] a trend that has been observed since the 1970s. Pharmaceutical spending represents a substantial fraction of health care spending in OECD countries, and it has been estimated that over the last ten years average spending per capita on pharmaceuticals has risen by almost 50% in real terms.[6] For instance, the United States—the focus of this article—spent 17.4 percent of their GDP on health in 2009, 5 percentage points more than the next two countries, The Netherlands and France. Also in 2009, prescription drug spending reached $249.9 billion.[7] The above figures suggest that it is important to understand as much as possible how much treatments might impact the lives of people using them: there might be treatments that only marginally improve health and do not have any consequence on labor market behavior, or there might be other treatments that alter health in a way that impacts labor market behavior. Understanding which treatments impact labor market outcomes can help to better channel private and public resources.

Empirical identification of the effects of HRT use on employment is difficult because of the endogeneity in HRT use. A woman's decision to use HRT may be related to her (unobserved) preferences for work. Also, the primary link to health insurance is employment, and insurance may lower the cost to use the drug—so employment for some may be a pre-condition to HRT use. These indicate that conventional estimates of the effects of HRT use on employment may be biased. In order to address a potential endogeneity bias, we first take advantage of the panel nature of our data and implement individual fixed effects models. Our results using fixed effect models indicate that HRT increases the employment of women between 40 and 60 years of age by 1.67 percentage points, in the most conservative case.

The use of fixed effects methods controls for individual time-invariant factors, but it does not eliminate the possibility of a bias arising from time-varying unobservable determinants of employment that are also correlated with HRT use. To address this issue, we instrument for HRT use using an exogenous

[5] http://www.oecd.org/document/38/0,3746,en_21571361_44315115_48289894_1_1_1_1,00.html

[6] http://www.oecd-ilibrary.org/sites/health_glance-2009-en/07/05/index.html?contentType=&itemId=/content/chapter/health_glance-2009-71-en&containerItemId=/content/serial/19991312&accessItemIds=/content/book/health_glance-2009-en&mimeType=text/html

[7] https://www.cms.gov/nationalhealthexpenddata/downloads/highlights.pdf

change that challenges the view of estrogen as miracle drugs and severely lowers their usage. The exogenous change is represented by the release of information in July 2002 that the estrogen plus progestin trial of the Women Health Initiative (WHI), the largest randomized trial on women in history, was stopped ahead of time upon finding that HRT compared to a placebo increased risk of heart attack, breast cancer, stroke and blood clotting among healthy postmenopausal women between 50 and 79 years of age. The news spread quickly across the medical community and the general public and prescription purchases of HRT drugs plummeted. Figure 1 uses data from the Medical Expenditure Panel survey for years 1998-2004 and shows a sharp decline in prescription purchases after the release of information on the WHI trial among the group focus of our analysis: women 40 to 60 years of age, the group more likely to suffer symptoms associated with the menopause transition.[8] Figure 2 shows a decline in employment among women in this group during the same period, trends which are suggestive of a possible link between the two phenomena.

In order to control for common shock in the labor market of women not due to the release of information about the WHI we use women between 28 and 39 years of age as an appropriate control group for employment trends of women between 40 and 60 years of age. We find that stopping HRT use causes a decline in employment by 25 percentage points among women who, after July 2002 were induced not to take HRT by the results of the WHI, but who would have taken HRT otherwise. Our effect is a Local Average Treatment Effect (LATE) for the sample of compliers. Back-of-the- envelope calculations[9] tell us that compliers are 2,258,126 American women between 40 and 60 years of age between 2001 and 2003. These represent 0.0552 of women between 40 and 60 years of age between 2001 and 2003.

Our estimate represents the average effect of HRT use on employment of complier women between 40 and 60 years of age between 2001 and 2003. It is most likely that the complier population does not represent the average women undergoing the menopause transition and the first years of the menopause, but it is plausibly more representative of women experiencing symptoms that interfere with or prevent their regular activities. In fact, evidence from the medical literature suggests that women who experience more severe symptoms associated with the menopause transition and the first years after menopause are more likely to

[8] See Section 2.
[9] We use Census 2001-2003 data for the calculation, see Section 7.

seek medical help to alleviate such symptoms. For example, Avis et al. (1997) use a sample of 454 women premenopausal at baseline between 45 and 55 years of age who were interviewed 5 times at yearly intervals in the Massachusetts Women's Health Study and find that frequency of symptoms and their severity were highly related to seeking medical consultation[10] for menopause symptoms. This tendency is also found by Fentiman et al. (2006) in a sample of women aged 45 or older who identified themselves as non-users of HRT because "the symptoms were not bad enough."

In some cases, symptoms can be severe enough to prevent usual activities. For example, in the United States, the WHI measured the fraction of postmenopausal women between 50 and 79 years of age experiencing vasomotor symptoms and their severity after having imposed a three month HRT washout for those women who were using HRT before. In such sample, 12.7 percent (Hays et al., 2004) of women had vasomotor symptoms which either "interfered somewhat with usual activities" (Barnabei et al., 2005) or that were so "bothersome that usual activities could not be performed." Also, an early retrospective study of a sample of 1000 women who had their last period five years or more before the study reports that 10.3 percent of respondents recalled to have or have had such severe disturbances related to menopause that they were compelled to bed rest or to absent themselves from work (Barrett et al.,1933).

This paper's main contribution is to be the first study to attempt to causally estimate the effect of HRT use on employment. More precisely, we focus on HRT's effect on short term employment, because the short nature of the panel data used in this paper does not allow investigating whether the effect we find fades away in the long run.

The paper proceeds as follows: section 2 provides some background information on HRT and menopause as well as the history of HRT and of the WHI; section 3, a review of the literature; section 4 presents the empirical strategy; section 5 describes the data; section 6 provides some summary statistics; section 7, the results, and section 8, the conclusion.

[10] HRT drugs are prescription medicines and the position statement of the North American Menopause Society (NAMS, 2000) was very favorable in directing women towards HRT use for softening menopause symptoms, suggesting that HRT use is a likely outcome for at least some of those women (those not at risk of breast cancer) seeking medical consultation.

2. Background

2.1 HRT and Menopause

As their name suggests, HRT are drugs intended to replace hormone levels, principally estrogen levels, and are used by women approaching the end of their fertile years and beyond. Estrogen is the primary female sex hormone [11] and is produced primarily by the ovaries[12] which, during a woman's fertile years, produce the most concentrated form of estrogen, called estradiol.[13]

Estrogen levels vary during the menstrual cycle and drop dramatically with the starting of the menopause transition. The menopause transition starts with increased variability in menstrual cyclicity and ends with the final menstrual period. Menopause, which ends the menopause transition, is a clearly defined event starting twelve months after a woman's last period. The median age at menopause is 51 (North American Menopause Society, 2006) and has remained remarkably stable over time (North American Menopause Society, 2006). Most women experience menopause from age 40 until age 60 with very few exceptions experiencing menopause at younger ages (Broekmans et al., 2006). During the menopause transition estradiol levels are quite variable, with chaotic patterns and occasionally very high or very low levels (Gardener and Shoback, 2007). It has been calculated that 95 percent of estrogen is derived from the ovaries. For that reason, when a woman ages and her ovaries cease to function, estrogen levels dramatically drop. Moreover, the estrogen produced during menopause is weaker than its counterpart produced during reproductive years, with a biological potency of approximately one third. This dramatic variability may lead to an increase in symptomatology during the perimenopause years (Gardener and Shoback, 2007). The disorders associated with changes in estrogen levels include vasomotor symptoms and urogenital atrophy. Vasomotor symptoms are commonly denoted as hot flashes if they occur during the day and are known as

[11] However, men also synthesize estrogen, albeit to a much lower extent than women, (Gardener and Shoback, 2007).
[12] Additionally, the corpus luteum, the placenta, the liver, the adrenal glands, the breast and fat cells also contribute to the production of estrogen.
[13] Estrone is the name of the estrogen most prevalent during menopause and estriol is produced during pregnancy (Gardener and Shoback, 2007).

night sweats if they occur during the night. Symptoms associated with hot flashes include: a feeling of warmth spreading through the upper body and face; a flushed appearance with red, blotchy skin; rapid heartbeat; perspiration, and a chilled feeling when hot flashes subside. Nighttime hot flashes can wake the subject from sleep and, over time, cause chronic insomnia. These sleep disturbances eventually can lead to memory problems, anxiety and depression in some women (Gardener and Shoback, 2007).[14] Vasomotor symptoms are experienced with greatest frequency during the stages in which the menstrual cycle becomes erratic[15] and can occur during a period lasting up to five years after the last period.

The urogenital tract (Strurdee and Panay, 2010) is also sensitive to the decline in estrogen and it is estimated that about half of postmenopausal women experience symptoms related to urogenital atrophy. Although some symptoms, like vaginal dryness, start early in the postmenopausal years (Strurdee and Panay, 2010), vaginal atrophy becomes clinically apparent 4 to 5 years after menopause.

Hormone Replacement Therapy is the best therapy for hot flashes and urogenital atrophy (Gardener and Shoback, 2007). Once started, HRT takes only two weeks to effectively reduce symptoms mostly experienced during the menopause transition (Watkins, 2007a), making HRT drugs quite a fast ally to women's wellbeing during that time.

In the next section we describe the history of HRT as rooted in the passion of scientists for endocrinology. We also recall the origin of HRT and the consequent medicalization of female menopause in its relationship to the relatively easier technology of estrogen production, compared to production of testosterone. Furthermore, we describe the WHI and the release of information on HRT hazards.

[14] Description of hot flashes symptoms can be found at the Mayo clinic web-site: http://www.mayoclinic.com/health/hot-flashes/DS01143/METHOD=print&DSECTION=all

[15] Erratic is defined as two skipped cycles and an interval of amenorrhea equal to 60 days, (Gardener and Shoback, 2007).

2.2 Historical Background

The birth of HRT is best framed within the interest of scientists for endocrinology.[16] The field of reproductive endocrinology itself, an established field of study by the 1910s, is rooted in the assumption that glandular extracts have curative powers, assumptions held by biochemists and physicians in the late nineteenth and early twentieth centuries. These scientists had recourse to very few remedies, often inappropriate ones, to attempt treating diseases (Watkins, 2007a). Back then, the use of glandular extracts, a biological and therefore natural remedy, was considered a logical way to augment the patient's own production of those substances and to help cure illnesses.

This attitude framed the latest years of the nineteenth century and witnessed the popularity of the so-called "organotherapy", a practice that saw doctors use several different organs to extract some active principle that would cure disease, heal maladies of middle age and, even more ambitiously, rejuvenate. It was popular, for example, to use the thyroid gland to treat hypothyroidism; brain for neurasthenia; pancreas for diabetes; kidney for uremia; muscle for muscular therapy; heart for heart disease; testicles for debility, epilepsy, cancer, cholera, tuberculosis, leprosy, asthma; ovarian extracts to treat the discomfort of natural or surgical menopause.[17] Only the thyroid extract was proven to be effective in treating hypothyroidism and adrenal extracts had useful blood vessel-constricting effects (Watkins, 2007a). Eventually the popularity of organotherapy faded out. However, interest for rejuvenation persisted and endocrinology became the field to pursue to find methods to reverse maladies of middle-aged adults. Both men and women were recognized to undergo a "change of life" in middle age. For both sexes, doctors noticed that middle age brought about several psychological and physical symptoms. Both genders were seen as more irritable, with increase in fatigue, decrease in enjoyment of life, decline in sexual drive. For women, the transition was also accompanied by hot flashes while men lamented increased problems with impotence. For women, differently

[16] This section draws heavily on the fascinating history of HRT written by Watkins, 2007a.
[17] From the 1870s until the end of the century, thousands of women were subject to the removal of both ovaries (ovariotomy) so experienced the symptoms of menopause, like hot flashes, in their 20s, 30s and 40s. Doctors performed the surgery to treat menstrual disorders such as painful menstruation or the absence of menstruation and other conditions somehow linked to ovarian problems like mania and epilepsy (Watkins, 2007a). One in five of the women undergoing ovariotomy did not survive the surgery (Watkins, 2007a).

than for men, there was a clear time that physicians could identify- the end of women's reproductive years- to mark the transition, whilst for men the timing was more blurred. Despite the recognition that both genders underwent some "struggle" in middle age, until the 1930s the focus of rejuvenation was on men (Watkins, 2007a, 2007b).

Women did receive several preparations for treating conditions presumably related to ovarian failure, but those remedies were given as ailments for symptoms rather than as means to restore vitality partially lost due to aging. Ovarian-derived preparations treated these conditions: hysteria, chlorosis, menstrual disorders, and menopause.[18] Some doctors also performed surgeries on women where they inserted a donor's ovary into the abdominal wall. However, this surgery did not become very popular both because transplanted ovarian tissue degenerated over time and because popular opinion held that indefinitely delaying the onset of menopause was wrong and ultimately even hazardous to women's health. [19]

Parallel to the surgeries, scientists were also exploring ways to extract hormones in the lab. The most successful of these efforts was the isolation of insulin from the pancreas, accomplished by Frederik Grant Banting and Charles Herbert Best at the University of Toronto in 1921. Other scientists focused on isolating hormones produced by ovaries and testes. In 1929, Edgar Allen and Edward Doisy isolated in the United States the first pure sample of estrogen from the urine of pregnant women. A few months later, in Europe, Adolf Butenandt in Germany and Ernst Laqueur in the Netherlands independently reported the isolation of estrogen (Watkins, 2007a). The second female hormone, progesterone, was isolated in 1934 by George Corner and Willard Allan in the United States and by Butenandt in Germany. Testosterone, the main male hormone was first isolated in 1935 by three independent teams of scientists: Laqueur working for Organon; Butenandt working for Schering; Ruzika and Wettstein working for Ciba. These discoveries opened the doors for hormone replacement therapy for both men and women. However, the focus on male menopause, renamed

[18] Those preparations containing ovarian-derived products were, for instance, solutions of ovarian extract consumed in water, glycerin and alcohol; dried ovarian material compressed into edible tablets, and fresh sow or cow ovaries, minced and served in sandwiches (Watkins, 2007a).

[19] Alternately, the focus of the rejuvenating efforts for men was explicitly targeted to improve the quality of middle-aged men's remaining lives and in the 1920s thousands of men in Europe and in the United States underwent transplantations in which the sex glands of animals were transplanted into men's testicles in the hope that in so doing the production of hormones would increase and restore men's vitality.

"andropause" in the 1990s, faded away,[20] and scientists, physicians, and pharmaceutical companies concentrated on women. The estrogen isolated by Doisy was named theelin or estrone and was licensed first to be manufactured by Parke Davis and later to Abbott Laboratories and Eli Lilly. However, theelin was not the only estrogen product available on the market. In 1929, E.R. Squibb and Sons began to sell Amniotin, derived from the fetal fluids of cattle (Watkins, 2007a). Already in 1932, two more estrogen products were available to the American public: Menoform, produced by the Dutch company Organon, and Progynon, made by Schering. Two years later, in 1934, the Canadian firm of Ayerst, McKenna, and Harrison started selling in the American market Emmenin, an estrogen product extracted from human placenta. Emmenin had the initial advantage of being available in pill form. By mid century, theelin also was available in different formats, namely capsules and solutions for injection.

At the time, commercially available estrogen preparations were rather expensive. Companies were able to cut costs by replacing the urine of pregnant women with the urine of pregnant mares as the primary material from which to extract estrogen. Companies also pursued the production of synthetic steroidal estrogen. In 1938 in England, Edward Charles Dodds and his colleagues from the Courtauld Institute of Biochemistry at Middlesex Hospital in London synthesized diethylstilbestrol, known as DES that could be manufactured at a fraction of the cost of other estrogen products and was more concentrated. DES came with several side effects, so it is no surprise that in 1942, when Ayerst introduced Premarin, a highly concentrated solution of estrogen, to the American market, physicians and patients were willing to try it.

Premarin, whose name comes from *pre*gnant *ma*res' ur*ine,* was at least twice as potent as theelin and almost as strong as DES,[21] but without the side effects carried by DES such as nausea, vomiting, dizziness and headaches. In 1992 Premarin became the best selling drug in America, and maintained that position for

[20] Several reasons are behind what has been called "the disappearance of male menopause" (Watkins, 2008). First, testosterone was not particularly effective in treating impotence, which was often the main reason men in their middle-aged years visited their doctors (Watkins, 2008). Second, testosterone was expensive. Third, the most effective way of supplementing testosterone was via injection, meaning that men needed to visit their physician three times a week, which was inconvenient.

[21] DES had a quite tumultuous story. In the 1940s DES was prescribed to pregnant women hoping to reduce miscarriages and toxemia. In 1971, DES was found to increase the incidence of a very rare cancer of the vagina among women who were exposed to DES in their prenatal years. Later research found additional heath risks for DES-exposed daughters and sons, together with increased risk of breast cancer in the mothers who took DES. DES remains in use only as palliative treatment of advanced prostate cancer and metastatic cases of breast cancer.

several years (Watkins, 2007a). At the beginning, from 1930 until the 1950s, estrogen products were used by physicians as temporary remedies to the symptoms of menopause.

However, prominent scientists in the 1960s, especially William Masters, E. Kost Sheldon and Robert Wilson, believed that estrogen should be used as a long-term cure to prevent the onset of osteoporosis, cardiovascular disease and senility.[22] Other physicians were influenced by major scientists in the field like these researchers and were also subject to the massive advertising efforts of estrogen manufacturers, which were not permitted to advertise to the public, but could target physicians. In the 1960s, Ayerst was spending a million dollars a year to advertise Premarin (Watkins, 2007a). The combined effect of prominent scientists advocating long-term use of estrogen and the aggressive advertising of pharmaceutical companies most likely contributed to the increase in prescriptions of estrogen products. The popularity of estrogen products was seriously compromised upon the publication of retrospective studies during the 1970s that found that users of estrogen carried greater risk of developing endometrial cancer [23] compared to nonusers. In July 1977, the FDA mandated an estrogen patient package label. According to the FDA mandate, manufacturers needed to supply, and pharmacists to distribute, a leaflet indicating the increased risk of endometrial cancer as well as potential risk of breast cancer, bladder disease, and blood clotting. In 1980, the number of prescriptions for Premarin was half the number of prescriptions in 1975 (Watkins, 2007a). Estrogen regained popularity when two retrospective studies claimed that estrogen could prevent osteoporosis and that taking progesterone, the other female sex hormone, for the last seven-to-ten days of the twenty-to-thirty days of estrogen taken each month caused the uterine lining to shed, thereby counteracting the proliferative effect of estrogen on the

[22] Masters conviction was supported by some data he collected from a study based on a small group of elderly women residents of the City Poorhouse, an institution maintained for the poor who could not afford private nursing care. These women were administered hormones and periodically weighed, measured, photographed, questioned, subjected to blood analysis, periodic vaginal smears and so on. No record remains as to whether these women were reluctant participants in the study or even whether they understood their involvement in the study. Another prominent scientist, Robert Wilson was advocating the long term use of estrogen for middle-aged and older women in his best selling book "Feminine Forever" in 1966.

[23] This is a cancer of the uterine lining.

endometrium.[24] In 1980, about 2 million prescriptions for progestin were dispensed; that number rose to 3.2 million in 1983, 5 million in 1986, and 11.3 million in 1992 (Wysowski et al., 1995).[25]

Ultimately, the Federal Register reported a modified classification of estrogen as "effective for the treatment of postmenopausal osteoporosis" in 1986. After bottoming out at 14 million prescriptions in 1980, the oral estrogen market reversed its trend, growing to 17.8 million in 1983, 20 million in 1986, and 31.7 million in 1992 (Kennedy, 1985;Hemminki et al, 1988;Wysowski et al.,1995). Most women receiving prescriptions for estrogen were between the ages of 40 and 59, accounting for 60-63 percent of the total in the 1980s (Hemminki et al, 1988). The percentage of this age group accounting for progestin use increased significantly, from 42 percent in 1984 to 62 percent in 1992 (Wysowski et al., 1995).

In 1994, the NIH funded the first large-scale randomized double blind, placebo-controlled trial known as Postmenopausal Estrogen/Progestin Interventions, (PEPI) which enlisted 875 women between the ages of 45 and 64 to take estrogen alone, estrogen plus progestin, and a placebo to determine the effect of hormone regimes on risk factors for heart disease. At the end of the study women who took estrogen or estrogen plus progestin had lower cholesterol and lower fibrinogen (a marker for blood clotting) than women on the placebo. In 1995 Wyeth-Ayerst launched Prempro, which combined estrogen and progestin in a single tablet. These positive results for estrogen products made them increasingly popular drugs among women.

2.3 WHI and 2002 release of information of HRT potential hazardous effects on health

In an attempt to provide evidence on the causal effect of HRT on heart disease, the National Institute of Health set up the WHI study. The WHI had its roots in the early 1990s with the creation of the Office of Research on Women's Health (OWH). Located within the Office of the Director of the NIH, the OWH is in

[24] The way progesterone works is by making the woman's body think it is pregnant. Progesterone is the main component of the birth control pill. By taking progesterone, ovulation is prevented. Removing progesterone causes the uterine lining to shed, thereby causing some bleeding that although not representative of true menstruation, since no ovum is expelled, at the time of release of the pill the existence of monthly bleeding helped women to better accept the pill as it kept a "similar to a menstrual cycle" each month, which felt natural (Watkins, 1998). Beside progesterone, the birth control pill also has a small dose of estrogen in order to prevent break-through bleeding, (Watkins, 2007a).

[25] In 1979, 18% of progestin was prescribed for menopausal indications; by 1986, that figure had more than tripled, so that menopausal reasons accounted for 59% of all progestin prescriptions (Hemminki et al, 1988)

charge of promoting, coordinating and monitoring research on women's health and ensuring that women were included in clinical trials (Watkins, 2007a). In April 1991 the director of the NIH presented the WHI before the Senate. The WHI was federally funded, started recruiting women in 1998 and had 161,800 participant postmenopausal women between 50 and 79 years of age. The time table of the WHI scheduled follow-up and close-out visits were planned to be completed by March 2005. The study was composed of four clinical trials and one observational study. The observational study involved 100,000 women who were not asked to take any medication or modify their lifestyle. The main goal of the observational study was to provide additional knowledge about risk factors for a range of conditions, such as cancer, fractures and cardiovascular diseases (The Women's Health Initiative Study Group, 1998). The first trial—and the one watched the most closely—was the trial involving 16,608 women randomized into the estrogen-progestin versus placebo trial, conducted to determine whether indeed HRT prevented heart disease. The other participants were sorted into the estrogen-only trial (for women without uteruses, also to test whether estrogen prevents heart disease), the trial which tested whether calcium and vitamin D reduced fractures, and finally the trial involving dietary modification, the goal of which was to test whether a low-fat diet prevents breast and colorectal cancer.

The surprising results of the estrogen-progestin trial were released to the medical community on 9 July 2002 when the *Journal of the American Medical Association* posted on-line the article by The Writing Group for the Women's Health Initiative Investigators. The article released the results of the estrogen-progestin trial in both relative and absolute terms. Women in the treatment group had an increased risk of breast cancer (26 percent higher than the control group), coronary heart disease (29 percent higher), stroke (41 percent higher) and blood clotting (213 percent higher). The treatment group also had a decreased risk of colorectal cancer (36 percent), endometrial cancer (17 percent) and hip fracture (34 percent).

The above numbers in absolute terms implied eight more breast cancers; seven more coronary heart disease events; eight more strokes; eight more blood clotting, but six fewer colorectal cancers and five fewer hip fractures per ten thousand women each year (Watkins, 2007a).

The results were widely reported in the popular media, with a diverse degree of accuracy (Watkins, 2007a). As a consequence of the results, the estrogen-progestin trial of the WHI was stopped ahead of

schedule.[26] The FDA took notice and in early January 2003 mandated that all estrogen and estrogen-progestin products for menopausal use had to include a boxed warning on their labels about the increased risk of heart attacks, strokes, blood clotting and breast cancer among postmenopausal women.

3. Literature Review

Our paper is related to three strands of literature. First, there are clinical trials estimating the effects of pharmaceuticals against a placebo on selected measures of health. For estrogen, Greendale et al., (1998) study the effect of estrogen and estrogen-progestin regimes against placebo on vasomotor symptoms. The study by Greendale et al. (1998) involves 875 postmenopausal women aged 45-64 years of age randomly assigned to placebo and four different regimes of estrogen and estrogen plus progestin. Symptoms are self reported at one and three years from the start of the trial. After one year each treatment option demonstrates a marked positive effect against vasomotor symptoms compared to placebo. Additional evidence comes from Lennan et al., (2001) who conducted a meta–analysis of twenty one trials ranging from three months to three years with the primary objective to determine whether HRT regimes are effective in treating vasomotor symptoms. According to Lennan et al.'s (2001) results, HRT is highly effective in reducing the frequency of weekly hot flashes compared to placebo: a 77 percent reduction. Lennan et al. (2001) also finds that HRT is effective in reducing the severity of vasomotor symptoms compared to a placebo. Cardozo et al. (1998) conduct a meta analysis using results of clinical trials, and in their study highlight the effectiveness of estrogen in the treatment of urogenital atrophy.

The second strand of the literature relevant to our study relates health to labor market outcomes. Currie and Madrian (1999) provide a review of several studies showing that health has a direct effect on labor

[26] Results for the WHI were not the first warnings on potential hazardous effects of HRT. In fact, in August 1998 a different randomized trial, the Heart and Estrogen/Progestin Replacement Study (HERS), using a sample of 2763 women, found that hormone replacement therapy (estrogen plus progestin) did not reduce the rate of heart attacks in women who had coronary disease (Watkins, 2007a). Researchers involved in the HERS trial also concluded that HRT almost tripled the risk of a blood clotting. HERS research group also published the results of their study in the *Journal of the American Medical Association*. However, results of HERS were taken very cautiously both by the medical community and by the public at large. As a matter of fact, the number of HRT prescriptions continued to rise after HERS released the results of the trial.

force participation. More recently, researchers have started looking at women-specific biological factors that impact labor market behavior of women. For example, Ichino and Moretti (2009) have the merit to be the first to investigate whether part of the earnings gap between men and women might be driven by differences in biology. To this end, the authors focus on women of fertile age and use personnel data from a large Italian bank to show that absences from work of women below 45 years of age follow a 28 day cycle, whereas absences of men below 45 years of age and absences of men and women above 45 years of age do not. Ichino and Moretti (2009) interpret this finding as evidence that the menstrual cycle increases female absenteeism. However, Rogoff and Hermann (2010) challenge the results of Ichino and Moretti's (2009) paper. Rogoff and Hermann (2010) find that Ichino and Moretti's (2009) results are not robust to the correction of coding errors or small changes in specification. Moreover, Rogoff and Hermann (2010) use data on teachers in New York and do not find evidence that absence for women of fertile age follow a 28 day cycle. Further evidence on the matter is needed, because results so far only focus on two occupations in two different countries, and it is not excluded that there could be absenteeism or other labor market consequences (like hours of work, just to mention a possibility) due to the menstrual cycle in other occupations and different institutional settings.

The last strand of literature focuses on labor market effects of pharmaceuticals. A common finding in this literature is the fast response in labor market behavior of individuals taking pharmaceuticals. For example, within this strand of the literature, Thirumurthy et al. (2008) using longitudinal data, found that Anti-Retroviral[27] increases labor force participation of treated individuals by 20 percent after six months and increases weekly hours worked equal to 35 percent.

Pharmaceuticals used to treat mental health are associated with increased workplace productivity. For example, Berndt et al. (1998) used a clinical trial involving 635 clinically depressed patients to assess subjective measures of work performance based upon treatment with antidepressants within a twelve week framework. Berndt et al. (1998) find that the use of antidepressants was associated with increased subjective measures of work performance.

[27] Medications for the treatment of infection by retroviruses, primarily HIV.

Garthwaite (2011) focuses on older individuals with joint conditions and studies the effect of Vioxx—the primary prescription medicine taken by individuals with joint conditions before its removal in 2004—on the labor supply of older Americans. Using the removal of Vioxx from the market in 2004 as an instrument for Vioxx use within a panel framework Garthwaite (2011) finds that Vioxx is associated with a large increase in employment for older Americans with joint conditions who would like to take Vioxx but who cannot take the medication because of its removal from the market in 2004.

The most relevant study within this line of literature for our research is the work by Mvundura (2007) who looks at the effect of the menopause transition and HRT use on labor market outcomes. Mvundura uses data from the National Longitudinal Survey of Young Women for the period 1995 to 2003 and a fixed-effects strategy with labor force participation as an outcome. For Mvundura's study, different menopause transition dummies provide explanatory variables; menopause transition dummies interact with a dummy variable equal to one if the woman is currently using hormones. Mvundura (2007) divides women into several groups: women in premenopause if respondents report that they have had a menstrual cycle within the 12 months prior to the survey and have reported that they are not going through menopause. Respondents are classified as perimenopause if they have had a menstrual cycle within the previous 12 months and report that they are going through menopause. Respondents are classified as having surgical menopause if they report lack of menstrual cycle within the previous 12 months or if they have had surgery to remove both ovaries. Finally, respondents are classified as being naturally post menopause if they report that they have not had any menstrual cycle within the previous 12 months, have not had any surgery to remove their ovaries and report that they have gone through menopause. Mvundura's study shows that HRT use increases the labor force participation of those in induced menopause (i.e. surgical menopause) by 3.5 percentage points compared to women in natural post menopause. Mvundura (2007) does not find any effect of HRT use during other menopause transition phases. However, the standard errors associated with the interaction of hormone use with other phases of the menopause transition are very large, so no further inference can be drawn on HRT use and labor market outcomes. A possible reason for the large standard errors could be the measurement error associated with the classification of these phases of the menopause transition.

Also, the FE methodology can only account for the unobserved characteristics of women that are constant over time. This may be problematic if there is reverse causality (e.g. women decide to work to have health insurance) or unobserved time-varying determinants of employment that are also correlated with HRT use. In this study, we employ a fixed-effects instrumental variables strategy to isolate the causal effect of HRT use on employment, overcoming this limitation of the fixed effects analysis.

4. Empirical Strategy

In this section we illustrate the empirical framework we adopt to understand the effects of HRT use on labor market behavior of middle-aged women. For each model below, we state the assumptions needed to identify the causal effect of HRT on the outcome variables. We start with modeling the relationship between HRT use and employment [28] with a simple OLS model. We then increasingly relax the identifying assumptions exploiting the panel nature of the data, the technology of HRT and the institutional settings of the information released by the WHI.

Consider first a simple OLS specification:

$$y_{it} = \alpha_0 + HRT_{it}\alpha_1 + X_{it}\alpha_2 + year_t\alpha_3 + \varepsilon_{it} \qquad (1)$$

where the unit of observation is woman i in interview round t, where t represents roughly a period of 5 months and where y_{it} is a dummy variable equal to 1 if the respondent woman i is employed in t and HRT_{it} is a dummy equal to 1 if woman i at time t uses HRT. X_{it} are exogenous covariates, such as a panel-specific linear time trend, cubic in age and region-specific dummy variables; $year_t$ are dummy variables equal to 1 in year t and are equal to 0 otherwise. The panel-specific linear time trend controls for learning within each

[28] In our analysis we also estimate the effect of HRT on deflated hourly wages (using the same deflators used by Autor et al., 2008) and hours on the sample of workers, that we define as composed by women who never left employment in the period under study, but our estimates were very imprecise.

panel. In other words, there might be some changes in answering questions because the process of getting a person accustomed to taking surveys makes him/her change the way of answering the questions over time. We model the effect of HRT use in period t as affecting the outcome variable in period t because of evidence in the medical literature (Watkins, 2007a) of the quick response to the drug—a decrease in the severity of symptoms experienced during the menopause transition and the first years after menopause. In the OLS framework above, α_1 identifies the causal effect of HRT on employment if there are no other unobserved factors that are correlated with woman i taking HRT in period t. Because we are estimating Equation 1 using panel data, the OLS assumption of uncorrelated disturbances across periods is especially unrealistic in this context, so that all estimates of Equation 1 above, presented in the next section, are calculated with errors clustered at the woman i level.

If HRT was randomly assigned among middle-aged women, then it would be possible to believe that α_1 represents the causal effect of HRT on employment of middle-aged women. However, it is entirely possible to imagine that HRT use among middle-aged women is heterogeneous perhaps because HRT use is likely influenced by person-specific factors that are fixed over time and that are not measured in our data. For example, different women might have different beliefs on the effectiveness of HRT drugs to begin with. One way to overcome the time invariant nature of heterogeneity across women is to use panel data models and remove the constant component of bias in the estimate of α_1 in Equation 1.

The estimating equation in this case is:

$$y_{it} = \gamma_i + HRT_{it}\delta_1 + X_{it}\delta_2 + year_t\delta_3 + \eta_{it} \quad (2)$$

where δ_1 identifies the causal effect of HRT use in period t on employment in t if there are no time varying omitted determinants of employment that are correlated with taking HRT.

More formally, the identifying assumption for interpreting δ_1 as the causal effect of HRT use on the outcome of interest requires that the following holds:

$$E(\eta_{it} \mid HRT_i, X_i, \gamma_i, year) = 0, \qquad \text{t=1,2,...,T} \tag{3}$$

meaning that the expected value of the idiosyncratic error term in period t is equal to 0 once conditioning on the individual fixed effect, HRT use, and the value of Xs for observation i not only at time t but also in every other time period. In the next section we present estimates of Equation 2 by clustering the standard errors at the individual level. Although Equation 2 represents a step forward compared to Equation 1, an absence of time-varying omitted factors, correlated with HRT use, should not be assumed, even after conditioning on the fixed effects and other time-varying, observed variables. A possible solution to this issue is to use an instrument that, after conditioning on the individual fixed effect and the other exogenous variables, is correlated with HRT use, but does not belong to the structural Equation 2. A first possibility is to use the timing of the release of information of potential hazardous effects of HRT use in July 2002 as an instrument for HRT use among older women. Because employment is influenced by several time-varying factors, we first identify a group that faces the same shocks in the labor market outcomes faced by older women but that does not use HRT. The identifying assumption here is that, after conditioning on the fixed effect and the other control variables, data from the control group control for the part of employment trends that are due to factors other than the release of information from the WHI. We identify such control group in women between 28 and 39 years of age. To make sure that pre-trends in the outcome variables, in a conditional sense, are the same for women between 28 and 39 years of age and women between 40 and 60 years of age, we use the March Current Population Survey from 1998 through 2002, which has the strength of a very large sample size and therefore allows us to use a high power test for the equality of pre-trends in employment between older and younger women. We decided to test young women from their late twenties (28-39) as a control group because by that age most women have completed their education.

In order to test the equality of the pre-treatment trends in employment between younger and middle-aged women, we use the following specification:

$$y_{it} = a + \Sigma_{t=2}^{T} b_t \; year_t + c \; youngerfemale_{it} + d \; X_{it} + \Sigma_{t=2}^{T} g_t \; year_t \; youngerfemale_{it} + \omega_{it} \qquad (4)$$

where $youngerfemale_{it}$ is a dummy variable equal to 1 if the woman is between 28 and 39 years of age and it is equal to 0 otherwise, and X_{it} is a series of variables that matches as closely as possible the variables in equation (1) and (2), namely a cubic in age and region dummies. The test of equality of pre-trends in employment between women between 40 and 60 years of age and women between 28 and 39 years of age is a test that the g_t coefficients in Equation 4 are jointly not statistically significantly different from zero.

We find that we cannot reject the joint equality to 0 of the g_t coefficients,[29] so we can conclude that women 28-39 are a good control group for women 40-60 for employment. We therefore implement the Fixed Effect Instrumental Variable (FEIV) framework explained below.

The first stage, the reduced form, and the structural equations are given by the following specifications, respectively:

$$HRT_{it} = \theta_{1i} + Post_t * Older_{it}\lambda_1 + X_{it}\psi_1 + year_t\rho_1 + \xi_{1it} \qquad (5)$$

$$y_{it} = \theta_{2i} + Post_t * Older_{it}\lambda_2 + X_{it}\psi_2 + year_t\rho_2 + \xi_{2it} \qquad (6)$$

$$y_{it} = \theta_i + HRT_{it}\lambda + X_{it}\psi + year_t\rho + \xi_{it} \qquad (7)$$

We propose to use as an instrument for HRT use the interaction of two dummy variables, a dummy variable equal to 1 for the period after July 2002 and 0 for the period before July 2002, namely $Post_t$ and a dummy variable equal to 1 if the observations is between 40 and 60 years of age, namely $Older_{it}$.

To be a valid instrument for the endogenous variable of interest, the interaction of $Post_t$ and $Older_{it}$ in Equation 5 must be correlated with HRT use once conditioning on the Fixed Effect and on the other exogenous variables. Equation 6 explicitly highlights the exclusion restriction (Angrist and Imbens, 1994) assumption, i.e. the instrument $Post_t * Older_{it}$ is valid if, conditional on the fixed effect and the other covariates, the only mechanism through which the timing of the release of the information on potential

[29] The p value of the F test of equality to 0 of the coefficient g_t is between 0.1970 and 0.2561 depending on the specification.

hazardous effects of HRT is significant in the reduced form equation is due to the effect of the timing of the release of information on HRT use among older women. Equation 6 is akin to a difference in differences framework where the data from the sample of women between 28 and 39 years of age control for the part of changes in employment due to factors *other than* those due to HRT use.[30] Finally, Equation 7 is the structural equation.

A sufficient exogeneity condition for consistent estimation of λ in Equation 7 within a Fixed Effect Instrumental Variable framework requires (Wooldridge, 2010):

$$E(\xi_{it} \mid Post * Older_i, X_i, year, \theta_i) = 0 \qquad t=1,2,..,T \qquad (8)$$

Under the above assumptions, the FEIV estimate of the structural parameter λ in Equation 7 identifies the causal effect of the use of HRT among middle-aged women.

The framework above can still seem too unrealistic, because it assumes a common response to the information from the WHI. The assumption is rather unrealistic because different women might respond differently to the same information, or their physicians might do so. Because HRT drugs are prescription medicines, HRT purchase and presumably HRT use are the results of a joint decision making process involving the woman's decision and her prescribing physician's decision. Although the medical literature consistently highlights the benefits of HRT use to soften menopause-related symptoms (Watkins, 2007a), there is large variability in doctors' prescribing patterns even when evidence based medicine leaves little doubts on the efficacy of a drug. A famous example is the lack of universal prescription patterns of beta blockers following a heart attack (Skinner and Staiger, 2005).

To take into account this heterogeneity, here we extend the above framework by allowing the heterogeneous response of older women to the release of information of potential hazardous effects of HRT drugs. We have a binary instrument and a binary endogenous variable in our setting. We can then think about

[30] We took out women between 28 and 39 who took HRT in our sample as those reaching menopause at such young age are rare. There were only 180 observations among women 28-39 taking HRT in our sample.

dividing older women in four hypothetical groups, depending on their response to the instrument $Post_t * Older_{it}$. We borrow the jargon of Angrist and Imbens., (1994) to identify four groups that respond differently to the instrument. First, the group of "compliers" in our application are women who, in absence of the release of information of potential hazardous effects of HRT, would take HRT drugs, but who respond to the release of information of potential hazardous effects of HRT use by not taking HRT. The second group of women, the "always takers", are women who respond to the same information by continuing to take the hormones after July 2002. The third group, the "never takers", are those women who, independently on how helpful or hazardous HRT drugs are, would never use HRT. Finally, the last group, who Angrist and Imbens (1994) call "defiers", are women who increase HRT use after the release of information of potential hazardous effects of HRT. Here we think it is reasonable to assume that there are no defiers, namely we assume that if the instrument changes the probability of HRT use for some older women, it does so for all in the same direction (this is the monotonicity assumption of Angrist and Imbens, 1994). Finally, we assume the existence of compliers. Within the above framework, the IV estimate of the structural parameter λ in Equation 7 can be interpreted as a Local Average Treatment Effect, i.e. the causal effect of HRT use on the outcome variable of interest for the sample of compliers. It is this interpretation that we support in our application.

5. Data

We use two sources of data to conduct the empirical analysis. The first one is the Household Component of the Medical Expenditure Panel Survey (MEPS), a comprehensive, nationally representative survey of the U.S. civilian non-institutionalized population. Respondents in MEPS are surveyed about their medical care use, health related behavior, perceived health status and expenditures over a period of two years through five interview rounds. Moreover, MEPS surveys respondents on their labor market behavior, so that information on employment, hours of work and wages are available in MEPS in each interview round. For our study we use MEPS Household component for panels 6 and 7, spanning years 2001-2003, because the

two panels are the ones that have information on respondents before and after the release of information of potential hazardous effects of HRT. Our sample is the sample of women between 28 and 60 years of age. The sample of women between 28 and 39 years of age serves as a control group and we are mostly interested in the effect of HRT on employment of between 40 and 60 years of age,[31] recalling that the medical literature view that age range as the period in which the symptoms of discomfort due to the menopause transition and early years of menopause are most likely to happen. We link the annual Full Year Household Component consolidated data files of MEPS with the separate annual files with information on the prescription medicines purchased by the respondent in each round together with the three digit International Classification of Disease Codes 9 (ICD9) denoting the medical classification codes of the conditions for which each prescription medicine is purchased by the respondent. The unit of analysis of the prescription medicine component of MEPS is the individual prescription for each respondent in the calendar year. In our analysis we count respondents as using HRT if at any time during the round respondents report to have purchased at least once HRT products.

In order to successfully link HRT prescriptions with the MEPS household component we need to identify which are the HRT prescription medicines available on the market during the period considered. We find this information in the Physician's Desk Reference Companion Guide (PDRCG), regarded as one of the most respected and used handbooks by physicians (Watkins, 2007a) to select medications for their patients. The PDRCG is an annual publication that lists under the 'Therapeutic Indications Index' the medications according to the conditions for which they are indicated. Under the label "Menopause, Vasomotor Symptoms of", brand names and generics for drugs that contain hormones to treat menopause are listed.

The final dataset contains information for each respondent on labor market behavior and HRT prescriptions. As such, it is a very suitable data source to explore labor market behavior of middle-aged women following the release of information on the results of WHI.

[31] http://familydoctor.org/online/famdocen/home/women/reproductive/menopause/125.html.

6. Summary statistics

Table 1 reports summary statistics for selected variables for the pre July 2002 period for women aged between 40 and 60 years of age and women aged between 28 and 39 years. Table 1 shows that the two groups of women have similar employment levels and educational attainment. Also, the fractions of married women are similar for the two groups. Table 1 also shows that 15.7 percent of observations among women 40 and 60 take HRT in the period before July 2002. Table 2 reports information on the three digit ICD9 codes of the conditions associated with HRT prescriptions we identified in the PDRCG. Table 2 highlights that 25.3 percent of observations of women between 40 and 60 years of age report the use of HRT for menopause syndrome. Also, 6 percent of women indicate the use of HRT associated with the three digit ICD9 code "need for isolation and other prophylactic measures", which in the more detailed category includes a 4 digit ICD9 code that associates HRT use to post menopausal prescriptions and "other endocrine disorders". Finally, a substantial fraction of observations, 36 percent, indicate the use of HRT associated with the three digit code v68 "encounters for administrative purposes", a code that does not really reveal much about the conditions for which the drug was purchased. A search for the 4 digit ICD9 codes associated with v68 reveals that codes v68 might include, for example, the code v68.1 called "issues of repeated prescriptions", which is consistent with HRT being a medication that is repeatedly purchased rather than a prescription purchased only once by the respondents. Because we looked at the PDRCG to identify the drugs prescribed for menopause symptoms and because the 3 digit ICD9 codes in MEPS are not inconsistent with the prescribing of HRT for disturbances related to the menopause transition, in our analysis we include HRT use independently on the conditions for which the respondent reported the medication was prescribed.

7. Estimation Results

7.1 Employment, all Sample

Estimation results for all models discussed in the previous section are presented in Tables 3, 4, and 5. OLS estimates of α_1 from Equation 1 in row 2 in Table 3 are very different, depending on the control variables included in the estimating equation. The only statistically significant estimate at conventional levels is the estimate of α_1 in column 2, row 1 of Table 3. The point estimate is negative, suggesting that the use of HRT drugs is associated with a decline in employment among middle-aged women. The magnitude of the point estimate suggests that the use of HRT drugs is associated with a decline in the fraction of middle-aged women working equal to 4.7 percent.[32] However, OLS estimates that include a cubic in age, and a cubic in age and region dummies, change the picture. From the point estimates and associated standard errors of the HRT-use dummy presented in columns 3 and 4, row 1 of Table 3, it is impossible to understand whether, once conditioning on the exogenous variables, there is any effect of HRT use and labor supply among middle-aged women. In fact, even if the estimates are positive, the large standard errors do not allow us to exclude a potentially negative effect of HRT use on employment.

The above scenario changes when we estimate Equation 2. The point estimates of the HRT dummy δ_1 are reported in columns 2 to 4, row 1 of Table 4. Independently on the specification, is δ_1 very precisely estimated and the magnitude of the estimates, under the Fixed Effect identifying assumptions, suggest that HRT use causes an increase in the fraction of middle-aged women who are employed equal to 2.33 percent, in

[32] In Table 1, column 2 row 1 the fraction of women 40-60 employed during the period considered is 71.62. Therefore, the point estimate on HRT of column 2 of Table 3 translates to a decline equal to 4.7 percent (100/71.62 *3.37=4.7) in the fraction of women 40-60 who are employed.

the most conservative case. [33] Under the Fixed Effect assumption then, HRT drugs appear to contribute to keep middle-aged women at their jobs, although the effect seems to be quite small.

Turning now to the enriched framework of the Local Average Treatment Effect estimates, Table 5 in row 2, columns 2 to 4 reports the point estimate and the standard error of the first stage. From Table 5 we see that the release of information of potentially hazardous effects of HRT drugs is negatively and statistically significantly related to HRT use among older women. The F-statistics associated with the excluded instrument is equal to 57.33, in the most conservative case in column 4. The IV estimates are presented in the bottom part of Table 6 and are all statistically significant at the 10 percent level. The sign of the IV estimate is the same of the FE estimate, namely HRT drugs have a positive causal effect on the relevant population. In our preferred interpretation of the IV estimate as a Local Average Treatment Effect, the relevant population is the population of compliers, i.e. those women who would take HRT but who refrain after the release of results from the WHI study. Therefore, the FE and the LATE estimates presented in Table 6 are not directly comparable. The most conservative LATE estimate reported in column 4, row 7 of Table 6 suggests that HRT use increases employment among the sample of compliers by 25 percentage points, which is a quite substantial effect. In order to calculate the fraction of women between 40 and 60 years of age who are compliers we first introduce some notation.

Let us define HRT_{1i} dummy equal to 1 when the instrument $Post_{it} * Older_{it}$ is equal to 1 and 0 otherwise and let us define HRT_{0i} a dummy variable equal to 1 when $Post_{it} * Older_{it}$ is equal to 0. HRT_{1i} tells us whether an observation would use HRT after the release of information of potential hazardous effects of HRT, and HRT_{0i} tells us whether an observation would use HRT before the release of information of potentially hazardous effects of HRT use. The monotonicity assumption says that although some people might not be affected by the instrument, all those who are affected are affected the same way. Using the above notation, in our application the monotonicity assumption means that $HRT_{1i} \leq HRT_{0i}$ for all i. Given

[33] 100/71.62*1.67=2.33

monotonicity, the size of the complier population among observations between 40 and 60 years of age can be calculated using the following formula (Angrist and Pischke, 2008):

$$P[HRT_{0i} > HRT_{1i}] = E[HRT_{0i} > HRT_{1i}] = E[HRT_{0i}] - E[HRT_{1i}] = \\ E[HRT_{0i} \mid Post_{it} * Older = 0] - E[HRT_{1i} \mid Post_{it} * Older = 1] \quad (9)$$

Using the notation above, $E[HRT_{0i} \mid Post_{it} * Older = 0]$ is equal to 0.1571 of observations of women between 40 and 60 years of age, and $E[HRT_{1i} \mid Post_{it} * Older = 1]$ is equal to 0.1019 of observations of women between 40 and 60 years of age; namely compliers are 0.0552 of observations of women between 40 and 60 years of age. Combining this estimate with data from the Census taken between 2001 and 2003, of 40,908,095 women between 40 and 60 year of age, we calculate that the size of compliers women between 40 and 60 years of age is equal to 2,258,126 women between 40 and 60 years of age.

To conclude this section, we must stress that we are measuring the short term impact of HRT use on employment for complier women and this effect can be very different from the longer term effect. For example, women who stop using HRT after July 2002 might find menopause symptoms very hard to manage without the help of the drug in the short term but might be able to cope with menopause symptoms over a longer period of time than the one in our data. Consequently, women might not be employed in the short run but might be employed in the longer run. Also, in our data we do not know whether women who are not employed are actually unemployed or are out of the labor force. Perhaps women who are not employed within the time frame of our data are looking for a new, less demanding job. If these women have not found the new job within the time frame of our data, then they are recorded as not employed in our data, but their status as not employed might only be temporary.

7.2 The Health Channel

Why did middle-aged women decrease their employment after the WHI results were released?

We support the idea that the health of the complier group of women declined after July 2002 and forced women out of employment.

We find support for this interpretation mainly in the medical literature in a study published in 2005 in the *Journal of the American Medical Association* (Ockene et al., 2005) that interviewed the study participants in the Women Health Initiative Study eight to twelve months after stopping HRT use and investigated a variety of health outcomes, including vasomotor symptoms, pain and stiffness, depression, feeling tired, difficulty sleeping and bloating or gas. Ockene et al. (2005) find that 21.2 percent of former HRT users and only 4.8 percent of placebo group respondents experienced moderate to severe vasomotor symptoms. The results were even more striking when conducting the analysis on women who—at the start of the WHI trial-more than five years before the Ockene et al. (2005) study—reported moderate-to-severe vasomotor symptoms: 55 percent of women in this group compared to 21.3 percent of women on placebo experienced moderate to severe vasomotor symptoms 8 to 12 months after they stopped using HRT. Women studied by Ochene et al. (2005) are older than the typical women who begin HRT use for symptom management, so results on those women are not immediately applicable to complier women between 40 and 60 years of age. However, women in the group studied by Ochene et al. (2005) who experienced moderate-to-severe vasomotor symptoms at the beginning of the WHI are more likely to be comparable to the typical woman starting HRT use for vasomotor symptoms management. This fact suggests that findings on relapse of moderate-to-severe vasomotor symptoms among women who experienced moderate-to-severe vasomotor symptoms at the beginning of the WHI are suggestive of a likely similar outcome among complier women between 40 and 60 years of age, the focus of our study. Ochene et al. (2005) also find that especially younger women in the sample, those between 55 and 60 years of age, were also more likely than older women to report more frequent emotional or neurological symptoms, headaches, breast tenderness and vaginal symptoms.

We also find some evidence on health deterioration among women 40-60 by looking at health related variables in MEPS and in the National Health and Nutrition Examination Survey (NHANES). In MEPS, we

find that there is an increase in the fraction of women between 40 and 60 years of age that report to be in fair or poor mental health equal to 5.3 percent in the period after July 2002 (from 9.23 to 10.1). Alternatively, there is a slight decline in the same variable among women between 28 and 39 years of age (from 6.4 to 6.23 percent of women between 28 and 39 years of age reporting to be in fair or poor mental health).[34] More to the point, data from the NHANES[35] from 1999-2004 suggests that 16.55 percent of women between 40 and 60 years of age had a physical, mental or emotional problem keeping them from working at a job or business after July 2002, compared to 15.35 percent before July 2002. Yet, only 5 percent of women between 26 and 39 years of age had physical, mental or emotional problems keeping them from working at a job or business compared to a virtually unchanged statistics (5.25 percent) before July 2002. Also, there has been an increase after July 2002—from 7.26 percent to 10.29 percent—in the fraction of women between 40 and 60 years of age who feel limited because of difficulty remembering or because they experience periods of confusion. On the contrary there has been a *decline* after July 2002—from 3.73 percent to 3.24 percent—among women between 28 to 39 years of age who feel limited because of difficulty remembering or because they experience periods of confusion.

7.3 Effects on Employment by Specific Health Conditions

In this section we try to understand whether there was a differential effect of HRT use according to a specific health condition. Keeping in mind that the WHI found that HRT use increased risk of heart disease, breast cancer, stroke and blood clotting, we investigate whether the group of compliers, i.e. women that

[34] We do not study health as an outcome because data in MEPS are not particularly suitable for that. This is mainly due to two reasons. First, there is a question asked to everybody in all rounds in the period we study that asks respondents to report their general health status, but the wording of the questionnaire reads: "I'd like to talk about (PERSON)'s health. In general, compared to other people of (PERSON)'s age, would you say that (PERSON)'s health is excellent, very good, good, fair, or poor?" We believe that the wording of the question might not allow us to detect meaningful changes in health. Consider for example the case of a person who before July 2002 reports to have good health but who does feel worse after July 2002 compared to the period before. If she perceives that people of her own age have also worse health she might simply (as the question instructs her to do) incorporate the worsening of other people's health in her reference point and still report that she feels in good health.
Second, MEPS does ask other health related questions, but those are asked only in two rounds and the wording of the questionnaire changes between rounds, making those questions unusable for us. Differently, NHANES questions we use here are consistent across survey years.

[35] NHANES data are described in the Appendix.

stopped taking HRT because of the WHI but would have continued taking HRT otherwise, is more numerous among women with a condition that makes them more prone to breast cancer, heart disease, stroke and blood clotting (both independently increasing the risk factors for heart attack). This group should also have been particularly attentive to the results from WHI, because they have a condition associated with breast cancer, heart disease stroke and blood clotting, so they might have perceived that taking HRT for them is particularly dangerous. If this is true, then it is reasonable to expect that compliers are more numerous among this group of women. For breast cancer the main risk factors are a family history of breast cancer or having had breast cancer before. In the Medical Condition file of MEPS we can identify whether the person has a personal history of cancer or whether the person has breast cancer during the rounds of the panel we consider. We find information on women who have had strokes, or who have been told by a doctor that they may have heart conditions in the Household Component file of MEPS. In the same dataset we are able to identify whether a woman has ever been told by a doctor that she suffers from hypertension, a major risk factor for heart disease, stroke and blood clotting. The Household component of MEPS also identifies people who have been told by a doctor that they have emphysema. Emphysema is a type of lung disease characterized by shortness of breath. Emphysema is called an obstructive lung disease because the destruction of lung tissue around smaller sacs, called alveoli, makes these air sacs unable to hold their functional shape upon exhalation. It is often caused by smoking or long-term exposure to air pollution. Many people with emphysema also have chronic bronchitis. Complications of emphysema can include pneumonia, collapsed lung, and heart problems; therefore we include people with emphysema among people with a condition that makes them prone to develop heart disease.

We also can identify in MEPS people who take aspirin every other day. Taking aspirin every other day is not an innocuous preventive care measure in itself, because aspirin can cause gastric hemorrhage, so it is quite likely that people who take aspirin regularly have been identified as those particularly at risk of heart attack. Because the Full Year Household Component of MEPS does not have information on other important conditions that represent major risks for heart disease, stroke, and blood clotting, we use the Medical Condition file of MEPS to look for them. The Medical Condition file of MEPS is an annual file, where

respondents report any medical condition they have during the year. The file can be linked to the other MEPS files via the person identifier. Table 6a shows the fraction of people with a series of conditions that make respondents particularly at risk of heart attack, stroke or blood clotting. For all three outcomes (heart attack, stroke, blood clotting), having had a previous episode of the outcome increases the chance of experiencing it again. Unfortunately, the information on whether the person has ever suffered a blood clot is not available in the Household Component file of MEPS, so we can only rely on the information reported in the Medical condition file where we can see those who reported to have had a blood clotting during the time frame of the panel they belong to. Actually, none of the observations of women between 40 and 60 years of age reports to have ever had a blood clotting in the time frame of the panels we use. Other conditions that increase the risk of heart attack, stroke or blood clotting are also not listed in Table 6a because there was neither anyone in the sample with the condition within the time frame of our sample, nor a sufficient number of people suffering from each condition.[36] About half of the sample, 47.9 percent of women between 40 and 60 years of age, suffer from any of the conditions listed in Table 6a or report that they take aspirin every other day. The most common condition is hypertension, but a large fraction of women also report to take aspirin every other day. The fraction of women between 40 and 60 years of age with any of the conditions in the Table 6a who were employed before 2002 is 65.91 and the median age is 51. Differently, 77.67 percent of women without any of the condition reported in Table 6a were employed before 2002. Perhaps, at least in part, the higher employment rate of this group of women compared to the group of women without any of the conditions reported in the table is due to age. In fact, the median age of the group of women without any of the health conditions listed in Table 6.a is only 46.

Table 6c reports the estimates of Equation 1 on the sample of women with any of the conditions reported in Table 6a where women aged 28-39 are used as a control group. Columns 2-4 of Table 6c report

[36] For example, the main condition associated with increased risk of blood clotting,-besides having had a previous episode of blood clotting- is Deep Vein Trombosis (DVT) (http://www.nhlbi.nih.gov/health/dci/Diseases/pe/pe_risk.html). There are only 15 observations in our sample with such a condition in the time frame of the sample. Similarly, atrial fibrillation, atherosclerosis, fibromuscular dysplasia and Patent Foramen Ovale (PFO) are conditions that increase the risk of stroke. These are all chronic conditions (http://www.stroke.org/site/PageServer?pagename=risk). Only 5 observations had atherosclerosis; none had fibromuscular dysplasia and none had PFO.

OLS estimates and, as it was the case for estimates on the entire sample of women 28-60 reported in Table 3, only the simplest specification is statistically significant at the 5 percent level. However, the magnitude of the OLS estimate for this group is larger than the OLS estimate presented in the previous subsection. In fact, the OLS baseline model estimate says that HRT use is associated with a decline in employment equal to 7.17 percentage points, or 10.88 percent[37] in employment for women between 40 and 60 years of age with any of the conditions in Table 6a. When we add other control variables OLS estimates are very imprecise. Alternatively, when Equation 1 is estimated on the sample composed of women aged 40-60 without any of the conditions reported in Table 6a and women aged 28-39, the baseline OLS estimate reported in columns 2-4 row 2 of Table 6f is positive and statistically significant, suggesting that HRT is associated with an increase in employment for this group of women equal to 2.4 percentage points. The fixed effect estimates for the sample composed of women aged 40-60 with any of the conditions in Table 6a and women 28-39 are reported in Table 6d and are always positive and statistically significant at the 5 percent level. The point estimate for the Fixed Effect model for the sample composed of women aged 40-60 without any of the conditions in Table 6a and women aged 28-39 reported in Table 6g are positive but are never statistically significant. This, to our interpretation, is suggestive that, once conditioning on the fixed effect and the other control variables, the effect of HRT use is stronger for the sample of women between 40 and 60 who suffer from a condition that make them particularly at risk of heart attack, stroke or blood clotting.

Table 6e reports the estimates of the main parameters of Equations 5-7 where the sample is composed of the sample of women aged 40-60 with any of the conditions listed in Table 6a and women aged 28-39. The first stage is very precisely estimated , suggesting that after July 2002 there has been a decline in the fraction of women using HRT equal to 4.21 percentage points in the most conservative case of column 4. The only LATE estimate that is statistically significant, reported in Table 6e, column 1 and suggests that HRT causes an increase in employment for complier women aged 40-60 equal to 26.7 percentage points.

Table 6h reports estimates of Equations 5-7 for the sample of women aged 40-60 without any of the conditions in Table 6a and the sample of women aged 28-39.The first stage is very precisely estimated. All

[37] (100/65.91)* 7.17=10.88

estimates of Equation 5 are statistically significant at the 1 percent level, suggesting a decline in HRT use. However, the LATE estimates are never statistically significant for this sample.

Using Equation 9, we can provide an estimate of the size of the complier population among women between 40 and 60 years of age who suffer from any of the conditions listed in Table 6a. In this case $E[HRT_{0i} \mid Post_{it} * Older = 0]$ is equal to 0.1979, and $E[HRT_{1i} \mid Post_{it} * Older = 1]$ is equal to 0.1291, which says that 0.0688 of observations of women between 40 and 60 years of age with a condition are compliers. From Table 6a we see that 0.4779 of women between 40 and 60 years of age possess the conditions listed in Table 6a; namely, using Census data between 2001 and 2003, 19,594,977 women between 40 and 60 years of age suffer from any of the conditions listed in Table 6a. We count that 1,348,134[38] women between 40 and 60 years of age with any of the conditions listed in Table 6a are compliers.

We can perform the same calculation for women between 40 and 60 years of age who did not suffer from any of the conditions listed in Table 6a. We know that 0.521 women between 40 and 60 years of age did not suffer from any of the conditions listed in Table 6a. Using Census data, this means that 21,313,116 women between 40 and 60 years of age did not suffer from any of the conditions listed in Table 6a. The estimates of $E[HRT_{0i} \mid Post_{it} * Older = 0]$ and $E[HRT_{1i} \mid Post_{it} * Older = 1]$ are, respectively 0.1187 and 0.0747: namely 0.044 of women between 40 and 60 years of age without any of the conditions listed in Table 6a are compliers, namely 937,777.[39]

8. Conclusion

All women, if they reach a certain age, experience the end of their reproductive years. During that time a large fraction of them experience unpleasant symptoms that, in some cases, last for several years. An affordable and effective treatment for those symptoms has existed since 1938 in the form of HRT. How does HRT impact the employment behavior of middle-aged women? We find a large effect of HRT use versus non-

[38] 0.0688*19594977=1,348,134.
[39] 0.044*21,313,116=937,777.

HRT use on short-term employment of women between 40 and 60 years of age who stop taking HRT after July 2002 but who would have continued to take it absent negative results of the WHI. The evidence suggests that, at least in the short run, HRT helps women to stay employed.

Given the shrinking of cohort sizes and the focus on trying to keep older workers in the labor market as long as possible, uncovering the effects that medical treatments on achieving this goal is a major topic in the research agenda.

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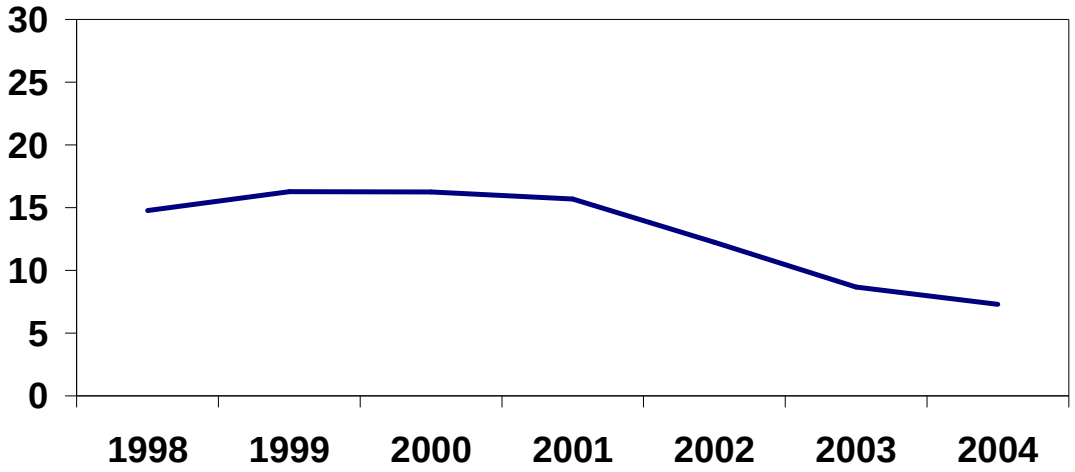
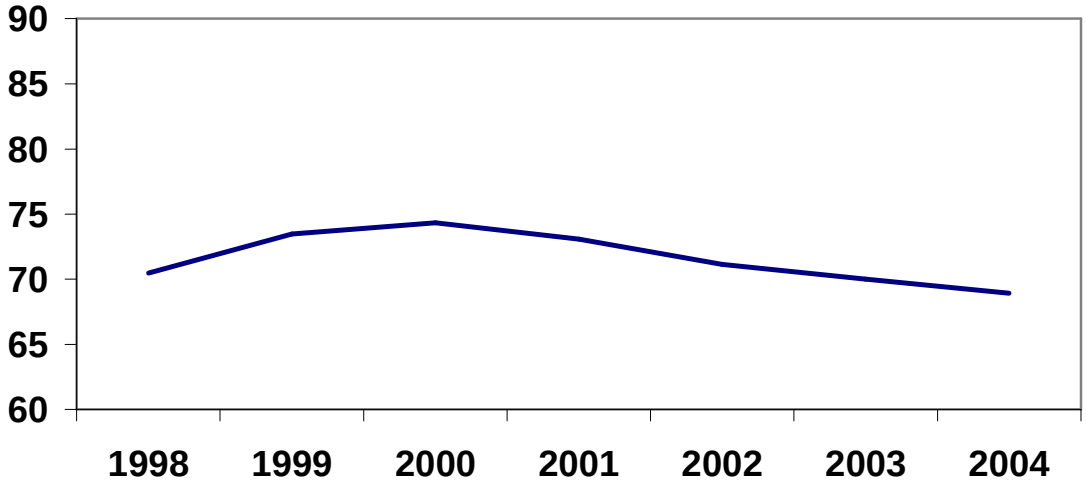
FIGURES

Figure 1: Fraction of Women 40-60 Taking HRT



Note: Data are from the Medical Expenditure Panel survey, years 1998-2004. A woman is counted as taking HRT in year t if in any interview round in year t she reports any HRT purchase.

Figure 2: Fraction of Women 40-60 Employed*



Note: Data are from the Medical Expenditure Panel survey, years 1998-2004. A woman is counted as employed in round t in year t if she results employed either at the interview date or is employed during the round t reference period or has a job to return to at the interview date.

Table 1

Summary Statistics for Selected Variables before July 2002,

Women Aged 40-60 and Women Aged 28-39, MEPS 2001-2002

	Women Aged 40-60	**Women Aged 28-39**
Fraction employed	71.64	72.41
Fraction Married	63.25	65.02
Fraction with No degree*	18.94	19.61
Fraction with High School Degree or Equivalent	50.17	48
Fraction with a College degree	14.13	18.11
Fraction with More than a College degree	16.33	14.06
Fraction Taking HRT	15.7	0

Fractions are weighted using longitudinal weights.* The education categories refer to the highest degree the woman has obtained when she first entered MEPS.

Table 2

Conditions associated with HRT use, Women Aged 40-60, MEPS 2001-2003

ICD9 code	Condition associated to each ICD9-3 digit code	Fraction of conditions associated with purchase of HRT among observations of women who are 40-60 in panels 6-7	Fraction of conditions associated with purchase of HRT among observations of working women who are 40-60 in panels 6-7
259	Other endocrine disorders	15	14.15
627	Menopausal and postmenopausal disorders	25.3	27.82
v.07	Need for isolation and other prophylactic measures*	6	6
v.68	Encounters for administrative purposes**	36	37.5

*one of the 4 digit codes associated with this condition is postmenopausal HRT.
** includes the 4 digit code v.68.1 that are issues of repeated prescriptions.

Table 3

OLS estimates for employment, Women Aged 28-60, MEPS 2001-2003

HRT_{it}	-0.0337823***	0.0017099	0.0074715
	(0.0087704)	(0.0091641)	(0.0091438)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	41182	41182	41182

All estimates use the panel longitudinal weights. Standard errors are in parenthesis. Standard Errors are clustered at the individual level.***denotes significance at the percent level

Table 4

Fixed Effect estimates of Employment, Women Aged 28-60, MEPS 2001-2003

HRT_{it}	0.0180757**	0.0167548**	0.017367**
	(0.0073862)	(0.0073998)	(0.007416)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	41182	41182	41182

All estimates use MEPS longitudinal weights. Standard errors are in parenthesis and are clustered at the individual level.**denotes significance at the 5 percent level.

Table 5
Local Average Treatment Effect Estimates of Employment, Women Aged 28-60, MEPS 2001-2003

First Stage			
$Post_t$*$Older_{it}$	-0.0355311***	-0.035534***	-0.0356523***
	(0.0042729)	(0.0047041)	(0.0047086)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
Reduced Form			
$Post_t$*$Older_{it}$	-0.0105573**	-0.0092022*	-0.0089313*
	(0.0053773)	(0.0049658)	(0.0049531)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
Local Average Treatment Effect			
HRT_{it}	0.2971296*	0.2589683*	0.2505103*
	(0.155165)	(0.143857)	(0.1422627)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	41182	41182	41182

***1% significance, **5% significance, *10% significance. All estimates use MEPS longitudinal weights. Standard Errors are in parenthesis and clustered at the individual level.

Table 6a

Fraction of Women Aged 40-60 and Women Aged 28-39 with health conditions associated with heart disease or heart disease risk and stroke, MEPS 2001-2003

	Women 40-60	Women 28-39
Hypertension	0.3138	10.16
Coronary Heart Disease	0.0219	0.0031
Angina	0.0235	0.0029
Heart Attack	0.02	0.0029
Other heart condition	0.089	0.0414
Stroke	0.0257	0.0054
Emphysema	0.0132	0.0021
Take aspirin every other day	0.207	0.0647
Diabetes	0.0315	0.0112
High cholesterol	0.0296	0.0061
Breast Cancer^	0.03	0.009
Any of the above	0.4790	0.1944
N	25543	15510

Data are from the Full Year Household Component of MEPS.
Fractions are weighted using longitudinal weights.^ Indicates that the woman has breast cancer or a family history of cancer.

Table 6b

Fraction of Women 40-60 with health conditions associated with heart disease or heart disease risk and stroke or breast cancer risk who take HRT before and after July 2002

	Before July 2002	After July 2002	N before	N after
Hypertension	0.1945	0.1254	5343	2762
Coronary Heart Disease	0.164	0.165	372	187
Angina	0.2141	0.1324	397	204
Heart Attack	0.1273	0.1381	330	181
Other heart condition	0.24	0.18	1474	808
Stroke	0.1763	0.1627	448	209
Emphysema	0.2462	0.1068	233	103
Take aspirin every other day	0.244	0.1393	3359	1946
Diabetes	0.0688	0.0467	509	200
High cholesterol	0.2348	0.1169	511	248
Breast Cancer^	1.54	7.69	65	13
Any of the above	0.1979	0.1291	8,028	4,207

Data are from the Full Year Household Component of MEPS. Fractions are weighted using longitudinal weights. ^Indicates that the woman has breast cancer or a family history of cancer.

Table 6c

OLS estimates for employment, Women Aged 28-60, with Women Aged 40-60 with any of the conditions listed in Table 6a MEPS 2001-2003

HRT_{it}	-.0716823** (.0117864)	-.0133863 (.0125482)	-.0103736 (.0124991)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	27776	27776	27776

All estimates use the panel longitudinal weights. Standard errors are in parenthesis.
Standard Errors are clustered at the individual level.***denotes significance at the 1 percent level.

Table 6d

Fixed Effect estimates of Employment, Women Aged 28-60, with Women Aged 40-60 with any of the conditions listed in Table 6a, MEPS 2001-2003

HRT_{it}	.0183872** (.0081718)	.0164997** (.0081323)	.0165339** (.0081488)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	27776	27776	27776

All estimates use MEPS longitudinal weights. Standard errors are in parenthesis and are clustered at the individual level.**denotes significance at the 5 percent level.

Table 6e

Local Average Treatment Effect Estimates of Employment, Women Aged 28-60, with Women Aged 40-60 with any of the conditions listed in Table 6a, MEPS 2001-2003

First Stage			
$Post_t$*$Older_{it}$	-.0464515***	-.0421466***	-.0421389***
	(.006969)	(.007271)	(.0072722)
Panel specific linear trend	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
Reduced Form			
$Post_t$*$Older_{it}$	-.0124293*	-.0095847	-.0093692
	(.0070748)	(.0067066)	(.0067631)
Panel specific linear trend	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
Local Average Treatment Effect			
HRT_{it}	.2675756*	.2241678	.2223395
	(.1565211)	(.1645985)	(.1646065)
Panel Specific linear trend	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	27776	27776	27776

***1% significance, **5% significance, *10% significance. All estimates use MEPS longitudinal weights. Standard errors are in parenthesis and clustered at the individual level

Table 6f

OLS estimates for employment, Women Aged 28-60, with Women Aged 40-60 without any of the conditions listed in Table 6a MEPS 2001-2003

HRT_{it}	.0242748** (.0124037)	.0217999* (.0129888)	.0212636 (.0130202)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	28902	28902	28902

All estimates use the panel longitudinal weights. Standard errors are in parenthesis. Standard Errors are clustered at the individual level.**denotes significance at the 5 percent level.

Table 6g

Fixed Effect estimates of Employment, Women Aged 28-60, with Women Aged 40-60 without any of the conditions listed in Table 6a, MEPS 2001-2003

HRT_{it}	.0176478 (.0131442)	.016904 (.0131906)	.0177252 (.0131941)
Linear trend for round for each panel	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	28902	28902	28902

All estimates use MEPS longitudinal weights. Standard errors are in parenthesis and are clustered at the individual level

Table 6h

Local Average Treatment Effect Estimates of Employment, Women Aged 28-60, with Women Aged 40-60 without any of the conditions listed in Table 6a, MEPS 2001-2003

First Stage			
$Post_t$*$Older_{it}$	-.0251669***	-.0265358***	-.02673***
	(.0050205)	(.0057673)	(.0057757)
Panel specific linear trend	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
Reduced Form			
$Post_t$*$Older_{it}$	-.0081651	-.0056603	-.0051109
	(.0073803)	(.0070242)	(.0070161)
Panel specific linear trend	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
Local Average Treatment Effect			
HRT_{it}	.3244394	.2080514	.1912035
	(.3002066)	(.2687402)	(.264799)
Panel Specific linear trend	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Cubic in Age	No	Yes	Yes
Region dummies	No	No	Yes
N*T	28902	28902	28902

***1% significance, **5% significance, *10% significance. All estimates use MEPS longitudinal weights. Standard errors are in parenthesis and are clustered at the individual level.

Appendix: National Health and Nutrition Examination Survey (NHANES) 1999-2004

The NHANES is a survey conduced by the Center for disease control and prevention designed to assess the health and nutritional status of adults and children in the United States .There are several questions asked in NHANES that are of particular interest for our study.

The NHANES questionnaire does not change for the chosen questions during the time frame of our study. Having the same questionnaire during the time frame of our study is a particularly appealing characteristic because we are measuring changes in the fraction of people that experience some form of discomfort over time and we want to make sure that if we find any change in the fraction of people that experience symptoms of discomfort, that change is not due to the change in the questionnaire over time.

We use the answers to two questions from NHANES:

1) Does a physical, mental or emotional problem now keep {you/SP} from working at a job or business?
2) Are {you/SP} limited in any way because of difficulty remembering or because you experience periods of confusion?

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