How Powerful Was the Pill? Quantifying a Contraceptive Technology Shock

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Abstract

This paper quantifies how differences in the provision of the birth control pill influenced women's labor supply decisions in Sweden. We use variation in the prevalence of pharmacies in a locality to instrument for that part of Pill demand that is shifted due to exogenous supply factors. The period of study corresponds with the nationalization and reorganization of of the retail pharmacy sector in Sweden which provides a rich source of exogenous variation in the nonpecuniary costs of using the Pill. Using detailed individual panel data we estimate earnings elasticities that range from 0.6 to 3.7. We find significant labor supply responses to the Pill for women throughout the lifecycle, suggesting that the introduction of the Pill affected women at many stages of their careers. We also find significant short run effects of the Pill on labor force participation and marriage.

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1 Introduction

What forces led to the increase in women's employment in Sweden, Europe and the U.S. over the past half century? Little compelling evidence exists to discern among the blizzard of theories regarding the mechanisms that set this profound shift in motion. Aggregate analyses of women's labor force participation in the U.S. have emphasized the role of gender/skill specific demand factors, declining discrimination as reflected in convergence in men's and women's wages, and

increasing returns to experience for women.[1] But what forces led to increased parity in wages and shifted the returns to experience profile for women? A latent factor that may drive both phenomena is the spread of more effective birth control technologies which changed employment patterns for women, and the returns to investing in what Goldin and Katz (2000) describe as "career jobs."

I evaluate how the provision of the birth control pill influenced women's labor supply decisions in Sweden. Empirical studies have argued that increases in women's employment and education can be attributed in large part to innovations in contraception such as the birth control pill.[2] Quantitative studies such as Heathcote, Storesletten and Violante (2010) suggest the narrowing of the gender wage gap resulted in significant welfare gains, while Knowles (2007) argues that the pill was more important than increased availability of market substitutes for home production in explaining the rise of women's employment in recent decades.

While Bailey (2010) has argued that the fertility effects of the pill have been significant, in particular with regard to the timing of fertililty, long run declines in fertility had been underway for many decades in Sweden before oral contraceptives were introduced. These long run trends, common across many countries, have led Becker (1991), Guinnane (2011), and others to conclude that the pill may have only represented a shift along the technological frontier, rather than an improvement in contraceptive technology. If this view is correct, and

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[1] See McGrattan, Jones, and Manuelli (Minneapolis Federal Reserve, 2003), and Black and Juhn (AER, 2000).
[2] See for exampl Goldin and Katz (2000), Goldin and Katz (2002), and Bailey(2006).

the pill did not represent a substantial improvement in contraceptive technology, we would expect that the diffusion of the pill would have little impact on women's economic decisions.

The experience of other O.E.C.D. countries is much like that of Sweden.[3] Figure 1 summarizes the striking changes in women's participation over the lifecycle for four cohorts of Swedish men and women. While little changed for subsequent cohorts of men, their lifecycle participation profiles overlapping for subsequent cohorts at similar points in the lifecycle, for women the picture is quite different. The labor force participation rates for each subsequent cohort of women jumps up, as more and more women enter the labor force. Women born in 1955 have labor force participation rates that are on par with men of their age. These women, who were the first generation to come of age in the era of the pill, have lifecycle labor profiles that share more in common with the men of their age (high and relatively flat participation profiles) than women just ten years older (who have initially low and then increasing participation profiles).

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[3] Juhn and Murphy (1997), Black and Juhn (2000), Jones, Manuelli and McGrattan (2003), McGrattan and Rogerson (2008) among others describe these trends for the U.S.
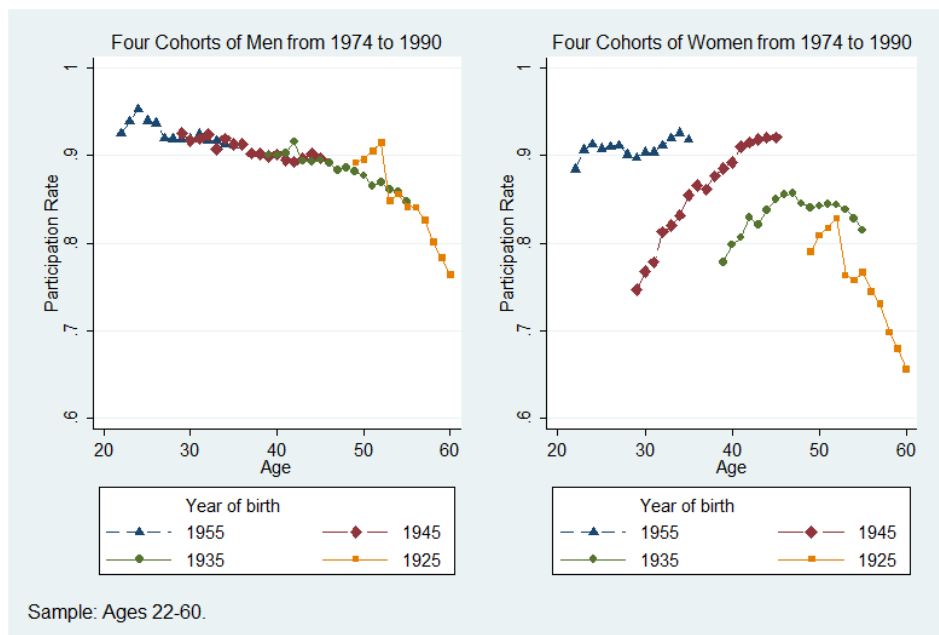
Labor Force Participation of Men and Women in Sweden

Despite the potential importance of the pill as a fundamental technological innovation that could jointly explain the rise in women's employment and wages during the post-War period, there are very few evaluations of the impact the pill has had on women's participation in the labor market and their human capital accumulation decisions. This dearth of direct evaluation stems from the difficulty of quantifying contraceptive use. We use unique data on contraceptive use in the years just after the pill was introduced paired with detailed individual level data on earnings, education, demographic characteristics, as well as household level data. This data offers the possibility to evaluate directly how the pill affected women's labor supply decisions using panel data methods to control for unobserved individual characteristics, controls that go far beyond the cohort or

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region level characteristics considered in earlier studies.

Previous studies of oral contraceptives have focused on the U.S. and how changes in consent laws allowed young women to obtain medical care without explicit parental consent. While these studies argue that they have identified the effect of the pill, it is difficult to conclude that the pill, and not a general liberalization of access to contraception among young women, was at play. Our analysis is more focused, we are able to isolate the specific channel of the pill, as separate from other medical contraceptive technologies. The instrument I use to identify how exogenous difference in the supply of the pill affect the use of this new contraceptive technology, and in turn women's career choices, specifically shifts access to the pill and not other close subsitutes like the IUD or diaphragm. In this regard, our estimates may understate the impact of the contraceptive revolution that took place a half century ago. Most important, relative to earlier studies, our instrument shifts the supply of the pill for *all* women in a locality, not only for unmarried women between the ages of 18 and 21. In this regard we can trace out the effect of the pill on women of all ages and stages of their careers. We find that the pill had a significant positive effect on women's labor force participation, but this effect appears to be concentrated among young women. The effect of the pill on earnings is large and significant, and the effect exists for all age groups of fecund women. The pill also appears to have had a significant negative effect on the time women spend in marriage from 1970-74.

2 Literature Review

This paper closely complements papers on the economic impact of the pill such Goldin and Katz (2002) and Bailey (2006) which have focused on the U.S. Both of these studies use variation in state level consent laws which granted some unmarried women between the ages of 18 and 21 the right to consent to medical care to identify how differential access to the pill among single women influenced their marriage and career decisions.[4] State level variation in laws regulating single women's access to contraception and medical care was due to reductions in the age of majority across U.S. states from 1969 to 1974, the adoption of judicial doctrine regarding "mature minor" status and, in some states, specific provision of family planning services to minors without parental consent. In 1969 only nine states allowed women aged 18 to obtain the pill, while by 1974 only two states had an age of majority greater than 18 with no legal or judicial recognition of emancipating minors.[5]

Goldin and Katz (2002) show how women's first use of of the pill prior to the age of 20 is significantly higher in states where access to the pill is less restricted among minors.[6] Establishing a relationship between use of the pill by young single women and state level restrictions on access to family planning services, the authors evaluate how differences in state/year level restriction on access to birth control and abortion affected women's decisions to marry before

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[4] Some states allowed access to contraceptive services at earlier ages for unmarried women. See Goldin and Katz (2002) for a detailed review of laws regulating access to contraception across U.S. states.

[5] See Goldin and Katz (2002) pp. 739-743 and Table 2 for a detailed account of legal reforms pertaining to family planning access for minor women.

[6] See Goldin and Katz (2002) Table 3 for details regarding the specification and data from the National Longitudinal Survey of Young Women, 1971.

the age of 23, finding that more liberal access to contraception and abortion reduce the likelihood of early marriage. Similar state level variation in access to contraception and abortion access is combined with state/age group level data on women's career and marital status to show how both aggregated survey evidence on pill use as well as state level indicators of women's access to medical care increase the share of women in professional careers and the share that never marries, while reducing the married and divorced share among women aged 30-49 in census data from 1970-1990.[7]

The same variation in consent laws described by Goldin and Katz (2002) is used by Bailey (2006) to analyze how liberalized access to contraception induced changes in fertility and employment, using within cohort variation across states. Bailey finds that access to the pill before the age of 21 reduced the likelihood of being a mother before age 22 by 14 to 18 percent, and increased later employment between the ages of 26 and 30 by 8 percent. These results support the conclusions of Katz and Goldin (2002), but Bailey argues that the mechanism through which the pill operated was improved ability to time births, allowing not only for delay of marriage to pursue a career, but also to work more during ages associated with childrearing. Bailey (2006) argues that the

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[7]Goldin and Katz (2002) emphasize that the impact of the pill on women's decisions operated through both direct and indirect channels. The pill allowed women to delay marriage and pursue careers that required advanced study at less personal cost, the direct effect. By inducing a critical mass of women with greater "career ability" to delay marriage this reduced the cost of delaying marriage for all women by thickening the marriage market for those who delay, the indirect effect. This second channel would lead to better matches not only for career women, but all women who delay marriage, regardless of whether they choose to pursue careers or not. Several empirical predictions follow from Goldin and Katz (2002), such as an increase in professional careers for women, an increase in the age of first marriage and age of first birth, and an increase in positive assortative mating on earnings capacity and better marriage market matches. Match quality is difficult to infer and cannot be proxied for by divorce as the mitigating effect of children on divorce must be taken into account.

pill affected young women's employment decisions across all education groups, not only those occupations with significant educational investment, emphasized by Goldin and Katz (2002). Early access to the pill delayed the age of first birth and only these women who delayed childbearing worked more in the paid labor market during the "fertility dip" ages of 26-30. Bailey concludes that early access to the pill affected women's labor force participation primarily through their education and career choice decisions, and once this is taken into account there does not appear to be any additional impact of early access to the pill on women's labor force participation over the lifecycle.[8] According to Bailey's estimates early access to the pill can account for 14 percent (3 of the 20 percentage points) of the increase in labor-force participation rates and 15 percent of the increase in annual hours worked (67 of the 450 hour gain) among women ages 16 to 30 year olds.

The empirical literature has emphasized how the pill allowed women to delay marriage and invest in careers, as well as time births so as to minimize early career disruptions. The importance of reduced career disruptions especially as related to fertility has been emphasized in the quantiative literature, most notably by Attanasio, Low and Sanchez-Marcos (2008) and Knowles (2007). Knowles (2007) argues that returns to experience in the labor market are strongest for those aged 24-33, as shown by Light and Ureta (1992), an age where contraceptive technology would be highly relevant, and which the identification strategy

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[8] As noted by Bailey (2006), variation in early access to the pill does not allow the effects of access to the pill at age 21, or beyond, to be estimated. Within-cohort comparisons do not allow for the estimation of the effects of greater access to the pill across cohorts within states or within cohorts across states, for example altered norms regarding women's labor market participation.

used in the empirical literature would be of little help in quantifying precisely. Olivetti (2006) argues that increasing returns to experience drive the increasing employment of married women with children, and shows how women's returns to experience have increased significantly, and increase of 25% from 1970 to 1990, while the growth in returns to experience for men has been flat, increasing only 6%. Changes in returns to experience account for 96% of the observed variation in women's hours of work. What forces led to the striking increase returns to experience for women, and not men, during the last four decades is an open question of quantitative importance, and it is reasonable to conclude, as does Knowles (2007), that improvments in contraceptive technology likely played an important role.

Many quantitative papers have emphasized the role technological improvements in home production as a driving force for aggregate changes in women's employment. Technological innovation has long been hypothesized to play a role in the entry of women in the labor market. Most of this literature has focused on general improvements in household production technology as in Greenwood, Seshadri and Yorukoglu (2005) or gender equalizing technologies such as baby formula investigated by Albanese and Olivetti (2007). Erosa, Fuster, Restuccia (2005) argue that fertility decisions, in particular changes in the age-pattern of women's work experiences and the stochastic nature of fertility timing that give rise to the observed gender wage gap, but what role improvements in contraceptive technology play in explaining these differences in fertility and how this relates to labor force participation and career choice have not been widely

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studied. While several specific technological channels have been invesitgated to account for the entry of women into the labor market and narrowing of the gender wage gap, many investigations take these changes as given, attributed to unmeasured changes in discrimination as in Jones, Manuelli, McGrattan (2003). Heathcote, Storesletten and Violante (2010) evaluate the welfare implications of a closing gender wage gap, but they do not analyze the source for such changes in wage dynamics. Changes in contraceptive technologies that allowed women to accumulate human capital and experience on the job could be one reason behind the narrowing gender wage gap, that studies like Jones et al (2003) find necessary to generate employment patterns consistent with those observed among women in the U.S.

We will show that in the short run, improvements to contraceptive technology have the largest impact on women early in their career paths. This is consistent with the model Knowles (2007) develops where women decide to pursue a skilled or unskilled career, where the returns to experience are strongest in the skilled career path, and the primary effect of the pill works through the career decision. Quantifing the effect of technological advances in contraception on the labor supply decisions of women fecund in the 1970s as well as the decisions of later cohorts of women, is a question that has only been analyzed indirectly in the previous literature. Both empirical and quantitative studies make a persuasive case for the important role of increasing returns to experience for women for explaining the dramatic changes in women's employment patterns in the U.S. in recent years. The estimates presented below aim to quantify how

important the pill was in the short run for setting in motion changes in Swedish women's employment and earning over the lifecycle.

3 Institutional Setting

It is not only the availability of data on contraceptive decisions that is unique to Sweden, but also the institutional setting that allow for tractable study of these questions.[9] The institutional setting in Sweden when the pill was introduced was unique, and offers a valuable laboratory for evaluating the economic consequences of advances in contraceptive technology on women's earnings and human capital investment decisions. This setting will allow us to evaluate how important local health care infrastructure was for women's take-up of this new contraceptive technology. Ragan (2011) has shown that access to pharmacies was a significant determinant of women's demand for the pill. Here we extend this result and use differences in this exogenous supply shifter to analyze how the pill affected women's employment and marriage decisions.

Studies of the impact of different institutions across states in the U.S., such as the existence of laws prohibiting the sales of birth control pills have found these institutional factors to be important determinants of pill demand and in turn women's fertility and career decisions (Bailey, 2010). The assumption of uniform institutions may be difficult to support in some settings, but in the context of Sweden this assumption is accurate in both the *de jure* and *de facto* sense.

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[9]Even if similar data could be constructed in the U.S. it would not be difficult to control for a whole host of factors regarding the provision of health care, in particular the role of private insurance that are arguably constant in Sweden.

The laws regulating the sales of contraceptives do not differ by jurisdiction and are set by national regulatory bodies. In addition, the medical and retail pharmaceutical sectors in Sweden are highly regulated, and almost entirely operated by public entities that are subject to uniform central administration. Not only are legal institutions uniform, but so too are pharmaceutical distribution and pricing, as well as the provision of medical care and treatment information.[10] Pharmacies in Sweden have been subject to uniform pricing since 1686, and the first official price list was published in 1698. Pharmacies were initially established by royal order, and the financing and establishment of pharmacies was undertaken by a medical board that determined where need was greatest, and instituted a profit sharing arrangement among pharmacists to share revenues and support pharmacies in less populated areas. During the 1970s the pharmacy system was under the formal administration of the government operated company Apoteket, which undertook an extensive reorganization of the pharmacy system in Sweden. During this period a pharmacy was closed, opened, or moved roughly every five days. An Apoteket executive described these reforms as a "revolution" in Sweden's retail pharmacy sector. Efficiency was the motivation for the extensive reallocation of pharmacies in Sweden, the aim being to move pharmacies closer to health care providers. There was also a move to reduce and ultimately cease the operations of pharamacy storage outlets, a non-professionally staffed category of pharmacies that provided limited retail services. The pharmacy reform was extensive affecting the location, operating

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[10] In addition to these features of the legal and medical environment, it should also be noted that sex education has been compulsory in Sweden since 1956, and that the guidelines for the sex education curriculum are set at the national level.

hours, and service availability of hundreds of pharmacies throughout Sweden.

I consider the earliest period for which sales data is available following the approval of oral contraceptives for sale in Sweden and before the reform of the sex education curriculum and legalization of abortion that took effect in 1975.[11] By 1967 the pill had already become the third most popular mode of contraception, accounting for 14 percent of those contracepting. The two more popular methods were withdrawal and condoms. While oral contraceptives were popular, it should be noted that their sales accounted only 1.3 percent of pharmaceutical sales in Sweden during this period, much less than sales of antidiabetic treatments which accounted for 2.6% of pharmaceutical sales, or dermatological treatments that accounted for over 6 percent of sales. The 1970-1974 time period also preempts the Swedish Abortion Act of 1974 that allowed for women to have access to abortions without being subject to the review and approval of two physicians or a medical board. With the liberalization of abortion laws many measures were taken to increase the use of contraceptives by women, including a universal subsidy on oral contraceptives that took effect in 1975. The figure below illustrates the large response in demand for the pill following the subsidy.[12]

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[11] In May of 1964 the Svenska medicinalstyrelsen approved the use of oral contraceptives in Sweden.

[12] Evaluating the price responsiveness of demand for the pill is beyond the scope of this study, but as the aggregate figure illustrates the spike in pill use after the introduction of the subsidy suggests that demand for oral contraceptives may be highly responsive to price.
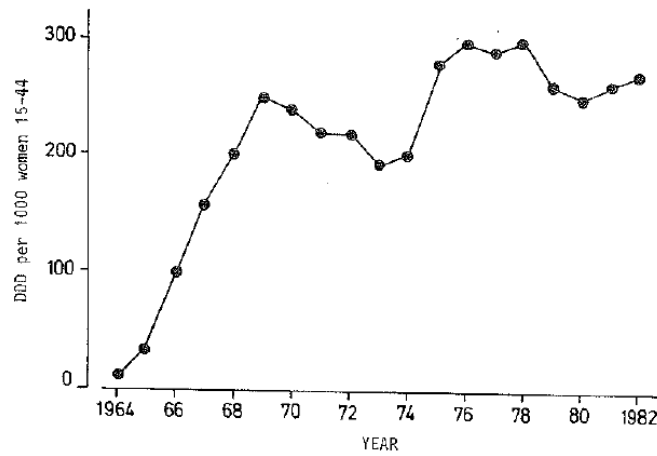
Figure 1: Sale of OCs per 1 000 women 15–44 years in Sweden from 1964 to 1982. The sale is expressed as the defined daily dose (DDD) per one women and year.

Source: Swedish National Board of Health Workshop on Oral Contraceptives,

1984.

This institutional setting offers a unique environment to analyze the impact of pill on women's career and employment decisions. Not only were the legal and medical institutions that played a role in the supply of the pill subject to uniform rules during this time period, so too was the educational system, a key supplier contraceptive information and sex education. The introduction of the pill in Sweden provides a rare setting where many of the salient institutional features are arguably constant. The supply curve for the pill in Sweden was flat and fixed in each locality due to the policy environment described above. What shifted the supply curve women faced were the significant nonpecuniary costs associated with using the pill regularly. Since the pill prescription must be frequently refilled at a pharmacy, women living in areas with less access to pharmacies faced higher non-pecuniary costs. Oral contraceptives represented

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a small fraction of pharmacy sales, and the location of pharmacies was determined not by markets but by the government that heavily regulated the retail pharmaceutical sector. The location of pharmacies is plausibly independent of local economic circumstances, in the sense that profitability played little role in these location decisions and negative economic shocks that may adversely affect women's employment opportunities had little effect on the pharmacy network in their community.

4   Data Description

We aim to explain how exogenous differences in the supply of oral contraceptives across Swedish localities affected women's employment and career decisions. We also account for differences in local demographic and economic characteristics and current conditions in the local marriage market in addition to a variety of individual level controls. We use differences in the non pecuniary costs of obtaining the pill, related to local health care provision, to instrument for that part of pill use that is unrelated to individual demand. Table 1 presents summary statistics for the variables used in this analysis. The variables are described in the following subsections.

4.1   Pill Use

The Swedish drug market is special, as is the institutional context in which the birth control pill was introduced in Sweden. Since prices are fixed at the same

Table 1: Summary Statistics

Variable	Mean	Variance	Minimum	Maximum
Employment	0.70	.46	0	1
Labor Income	10860	11236	0	299921
Married	0.54	.49	0	1
Age	31.1	8.9	15	49
Pill Per Woman	10.3	1.8	3.6	14.9
Pharmacy per Hectar	.0006	.001	0	.00373

level across all localities and supply of the pill is not rationed or limited except through required prescription I argue that the supply curve women face in each locality varies only due to the non-pecuniary costs of obtaining the pill and I use differnces in pharmacy density to instrument for that part of pill demand that is related to this exogenous shift in the supply curve across communities.

The measure of pill use used throughout this analysis will be sales of oral contraceptives in SEK by locality per the fecund female population, chosen to be women between the ages of 15 and 40. We have data on all oral contraceptive sales in Sweden by locality from 1970 onward compiled from the quarterly *Swedish Drug Market* publication from Läkemedelstatistik, AB. This publication presents complete information regarding pill sales in 70 disaggregated local markets. Prices are set by a central authority and do not vary across localities. Similarly, prescription drugs can only be distributed by a publicly administrated network of pharmacies whose assortment of drugs, staffing, and hours of operation are subject to central public supervision. Figure 2 plots pill use per fecund woman aged 15-40 in 1970, and Figure 3 plots changes in pill use over the five year period studied here.
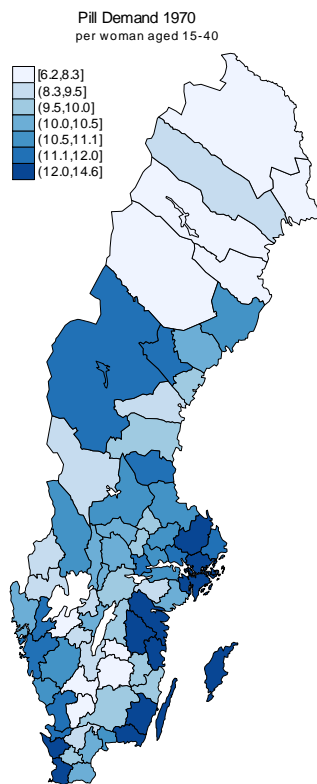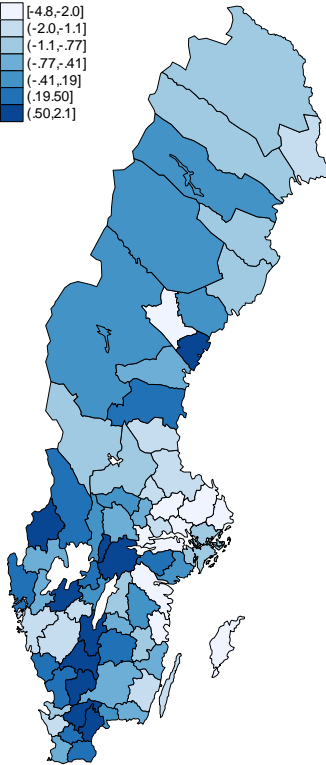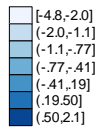
Figure 1: Pill Use Per Woman Aged 15-40 in 1970.

Figure 2: Change in Pill Use per Woman 1970-74

Previous studies have relied on retrospective surveys to determine whether and which types of contraception women had used at different points in time. These individual level surveys are useful in eliciting information on which types of birth control methods women have had experience with, but this information on the extensive margin is an incomplete picture of women's exposure to the pill. We take a different approach to measuring demand for the pill by using actual sales data to construct a measure of demand for the pill that we argue is more complete. Our measure of pill demand captures both the extensive margin of pill demand, more and more women opt to try the pill, as well as the intensive margin that women continue to take the pill. Direct quantification of pill use has not been analyzed in earlier studies.

4.2   Pharmacy Density

Data on the location of pharmacies was compiled from the Svensk Farmacevtisk Matrikel, published annually by the Swedish Academy of Pharmaceutical Sciences. Data on pharmacy location is then aggregated at the kommune level to quantify pharmacy services for the over 290 Swedish kommuns. During the period we analyze there was an aggregate increase in pharmacies from 603 to 625, though this modest increase belies the changes in the locations of existing pharmacies brought about by the extensive reorganization undertaken by Apoteket. The reallocation of pharmacies was not just the result of increased access in urban areas. Stockholm had a net loss of three pharmacies during this period, while Gothenberg gained 3 pharmacies, and Malmö was relatively

unchanged after the five years we study.

Pharmacy density is defined as the number of pharmacies per hectare, and it proxies for the distance the average woman must travel to get her pill perscription filled. In kommuns where pharmacies are common the non-pecuniary costs of getting the pill are small. Pharmacy density is measured relative to the total area of the kommun, but alternative measures that quantify pharmacy density per the area of more populated areas in the kommun yield similar results.

4.3 Earnings, Participation and Marital Status

Earnings and marital status data come from the Longitudinal Individual Database (LINDA) from SCB. LINDA is a registry based data set that samples roughly 3 percent of the Swedish population, and follows individuals continuously from the time they enter the sample frame. The data includes all labor income sources as well as household level income, wealth, and demographic characteristics.

5 Empirical Framework and Results

The results reported here are estimated by panel regressions and share a common linear specification where $Pill_{kt}$ represents demand for the pill per fecund female in community k at time t. Covariates X_{it} represent the contemporaneous factors specific to the each woman or her community that may affect her earnings, employment, or marital status as measured by Y_{it}. Time fixed effects, γ_t, and individual specific effects η_i will also be included in some specifications

$$Y_{it} = \ln(Pill_{kt})\alpha + X_{it}\beta + \gamma_t + \eta_i + \varepsilon_{it}.$$

We instrument for Pill use using Kommun level pharmacy density, though standard errors are clustered at the market level, since this is the level at which we observe pill use.

5.1 Earnings and the Pill

By substituting log earnings for Y_{it} in the empirical model we can estimate an elasticity of earnings to the pill. Results for such an exercise are reported in Table 2 for alternative specifications and assumptions regarding the distribution of the individual specific effect η_i. The first column of Table 2 is estimated using an IV estimator on the pooled data. The maintained assumption with this approach is that the individual fixed effects, η_i, are randomly distributed. Column 1 only accounts for market level pill use. The instrument is strong with a first stage F statistic of 29. The coefficient estimate on pill use is positive and significant at the one percent level. The coefficient can be interpreted as an elasticity, and suggests the quantitative impact of the pill on women's earnings was sizable. The second column includes quadratic terms in age, year and region fixed effects, as well as the share of women aged 45-50 that are employed in the Lan to capture common shocks for women's labor. The first stage is strong and the coefficient point estimate on pill supply is positive, significant, and twice as the estimate in the first column. The results suggest that fecund women's earnings were highly responsive to the supply of the pill supply.

Table 2: Women's Log Labor Earnings and Pill Use

	Pooled		Within		First Difference	
	(1)	(2)	(3)	(4)	(5)	(6)
Log Pill Use	1.63**	3.48***	1.28***	3.01***	0.62***	1.64**
	(0.50)	(1.05)	(0.20)	(0.83)	(0.17)	(0.51)
Women's Employment 45+		-0.38		-0.27		-0.68*
		(0.36)		(0.25)		(0.33)
Age Quadratic	No	Yes	No	Yes	No	Yes
Year Fixed Effect	No	Yes	No	Yes	No	Yes
Region Controls	No	Yes	No	Yes	No	Yes
N	152031	152031	145517	145517	104364	104364

Note: Pill use per woman is instrumented for using pharmacies per hectar. The sample population is women aged 15-45, and the dependent variable includes all sources of labor income. Women's Employment 45-50 is the share of women with positive labor earnings. Standard errors clustered by market are reported in brackets.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Columns 3 and 4 present results for the same specifications presented in columns 1 and 2 using the within estimator. These specifications assume that the residuals in the empirical model are strictly exognous. The first stage results are strong; F statistics are greater than 10 in both specifications. The coefficient estimates are similar in sign, significance, and magnitude to the results obtained from the pooled estimator. The final two columns of Table 2 present results for the same specifications estimated using a first difference estimator. This specification relaxes the assumptions on the residuals and assume only that they are weakly exogenous. First stages in both specifications are strong, and the coefficient estimates are both positive and highly significant, though half the magnitude of the pooled and within estimates of both specifications.

In Table 3 we present cohort specific estimates of the impact of the pill on earnings. All specifications are estimated using the within estimator and standard errors are clustered by market. The impact of the pill on earnings is positive and statistically significant for all cohorts of women between the ages of 20 and 34, with the coefficient estimates increasing through the 30-34 year old cohort, and then dropping off sharply both in magnitude and significancy for women 35 and older. The earnings responses to the pill are large for many cohorts of women, and the estimates suggest that the impact of the pill was not limited to young women, but also had a significant effect on the earnings of women whom had chosen careers well before the introduction of the pill. The power of the pill was not limited to the young, and appeared to have a broad impact on women's earnings decisions. Indeed, the largest point estimate for the effect of the pill on earnings is for women between the ages of 30-34. For these women the pill is less likely to be working through fertility delay than through more effective "stopping."

5.2   Employment and the Pill

Table 4 presents estimates of the empircal model described earlier where employment status is the dependent variable. Employment for woman i during year t is equal to 1 if the woman has earned some labor income during the year and 0 otherwise. Kommun level pharmacy density is used to instrument for log pill use, just as in earlier results. Results regarding employment are more

Table 3: Women's Log Labor Earnings and Pill Use by Cohort - Within

	15-19	20-24	25-29	30-34	35-39
Log Pill Use	2.68	2.94**	3.03**	3.72*	2.33
	(1.51)	(1.04)	(1.10)	(1.75)	(1.27)
Women's Employment 45+	-0.47	-0.24	-0.00	-0.31	-0.23
	(0.51)	(0.23)	(0.29)	(0.41)	(0.26)
Age Quad	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes

Note: Pill use per woman is instrumented with pharmacies
per hectar. Standard errors are clustered by market and
reported in brackets.
* $p<0.05$, ** $p<0.01$, *** $p<0.001$

mixed. Estimates based on pooled data are positive, though only sinificant at the five percent level in the specification that includes age, economic, region, and year controls. Results from estimates of a similar models using the within estimator are similar in magnitude, though much more highly significant. Year to year variation in employment status is small. With little variation it is not surprising that first difference estimates of the effect of the pill on earnings elasticities are small and insignificant.

Table 5 presents cohort specific estimates of the impact of the pill on employment using the within estimator. The employment effects of the pill are the largest and most significant for those women aged 20-24. The size and significance of the coefficient estimates suggests that the impact of the pill on employment was concentrated among young women, and that the pill appeared to have no effect on the employment of women above 30 years of age.

Table 4: Women's Employment and Pill Use

	Pooled		Within		First Difference	
	(1)	(2)	(3)	(4)	(5)	(6)
Log Pill Use	0.36	0.74*	0.44***	0.85**	0.09	0.18
	(0.20)	(0.33)	(0.07)	(0.31)	(0.06)	(0.20)
Women's Employment 45+		0.07		-0.03		-0.16
		(0.21)		(0.12)		(0.27)
Age Quad	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes
Region FE	No	Yes	No	Yes	No	Yes
N	152031	152031	145517	145517	104364	104364

Note: Pill use per woman is instrumented for using pharmacies per hectar. The sample population is women aged 15-45. Employment is an indicator that takes on a 1 if labor income>0, 0 otherwise. Women's Employment 45+ is the share of women with positive labor earnings. Standard errors clustered by market are reported in brackets.
* p<0.05, ** p<0.01, *** p<0.001

Table 5: Women's Employment and Pill Use by Age - Within

	15-19	20-24	25-29	30-34	35-39
Log Pill Use	0.82	1.03***	0.54	-0.09	-0.15
	(0.58)	(0.25)	(0.36)	(0.51)	(0.54)
Women's Employment 45+	-0.29	0.10	-0.04	0.05	0.04
	(0.23)	(0.14)	(0.11)	(0.09)	(0.08)
Age Quad	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes

Note: Pill use per woman is instrumented for using pharmacies per hectar. Standard errors are clustered by market and reported in brackets.
* p<0.05, ** p<0.01, *** p<0.001

5.3 Marriage and the Pill

The final dimension along which we analyze the impact of the pill is time spent in marriage. Table 6 presents results for version of the empirical model where the dependent variable takes on a value of 1 if the woman is married and 0 otherwise. The sample is now restricted to those women that are unmarried for at least one year from 1970-74. We estimate empirical specifications similar to those considered before. The models are estimated on pooled data and using a radom effects estimator. The random effects estimator is a weighted average of the between and within estimator. Marriage is not a state that people move in and out of frequently, so the within estimator may not be appropriate for quantifying the effects of the pill on time spent in marriage. The results reported in Table 6 suggest that the pill significantly reduced the time spent in marriage for women that were single for at least one year.

6   Conclusion

The introduction of the pill in Sweden was unique in several respects. First, it coincided with a large reorganization of retail pharmacies undertaken by the government after the nationalization of all pharmacies in Sweden. The reform of the retail pharmaceutical sector in Sweden provides a unique source of exogenous variation in the supply of the pill across communities that can be used to identify the causal impact of the pill on women's earnings, employment, and marriage decisions. This variation in the supply of the pill is specific to this

Table 6: Marriage and Pill Use

| | Pooled | | Random Effects | |
	(1)	(2)	(3)	(4)
Log Pill Use	-0.62*	-1.80*	-0.49***	-1.54***
	(0.27)	(0.76)	(0.02)	(0.07)
Women's Employment 45+		0.01		0.03
		(0.34)		(0.03)
Age Quad	No	Yes	No	Yes
Year FE	No	Yes	No	Yes
Region FE	No	Yes	No	Yes

Note: Pill use per woman is instrumented for using
pharmacies per hectar. The sample population is
women aged 15-45. Marriage is an indicator that is 1 if
if a women is married, 0 otherwise. Women's Employment
45+ is the share of women with labor earnings between 45-50.
Standard errors, clustered by market for the pooled regression,
are reported in brackets. * $p<0.05$, ** $p<0.01$, *** $p<0.001$

mode of contraception, and does not vary access to other contraceptive methods such as the IUD or diaphragm. The reorganization of pharmacies in Sweden shifted the supply curve for the pill for all women, not only those in a particular age group. As a result we are able to exploit this variation in pill supply to estimate responses to the pill for women of all ages. While previous studies have focused exclusively on the impact that liberalized access to contraception had on unmarried women under the age of 21, we can estimate the specific impact of the pill for women of all ages, regardless of marital status.

Another unique feature of our study is the detailed market level data on pill sales that encompass the entire universe of oral contraceptive sales in Sweden. These measures allow for direct quantification of the use of the pill without reliance on subjective or retrospective survey data on women's contraceptive

choices. The use of this unique data for evaluating the impact of the pill on women's life choices is unique.

Our estimates suggest that the pill had a positive and significant effect on women's labor supply, and that these elasticities were particularly large for women through age 34. Participation responses are also positive and significant in many specifications, and estimating models for different cohorts of women suggests that the participation responses are concentrated among women age 20-24. Consistent with previous studies we also find that the pill had a negative effect on the amount of time women spent in marriage, conditional on being unmarried for at least one year.