The Impact of Health Insurance Coverage on Cancer Screening among Women in Thailand

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Abstract

Using data from the 2007 Thai Health and Welfare Survey, this paper analyzes the impact of health insurance coverage and other socioeconomic factors on the likelihood of receiving clinical breast examinations, mammograms, and cervical screening tests among adult women. The paper focuses on breast and cervical screening because breast and cervical cancer are the leading cancer among women in Thailand and early detection increases the likelihood of survival. The author uses logistic regression to produce a cross-sectional estimate of the impact of income and insurance coverage on utilization among Thai women within the past 5 years. The results indicate among low income women the access afforded by the Universal Coverage plan, significantly increases the probability of utilizing cervical screening tests. While among women in the high monthly household income group having the Civil Servant Medical Benefit Scheme and private health insurance increases the propensity to have clinical breast examinations and cervical screening tests. Private health insurance is the only health insurance that has significant and positive probability of having mammograms among women from a high monthly household income group. These results imply that the Universal Coverage plan implemented in 2001 for people without health insurance can assist women in the low monthly household income group to get cervical screening tests with small co-payments.

Keywords

Cancer screening, Health insurance, Thailand

Introduction

The two most common cancers among women are cervical cancer and breast cancer in both developed and developing countries (Boffetta & Parkin, 1 9 9 4 ; Bray, McCarron, & Parkin, 2004; Parkin, Pisani, & Ferlay, 1993; Parkin&Fernandez, 2006; Tangcharoensathien, Tantivess, Teerawattananon, Auamkul, & Jongudoumsuk, 2 0 0 2 ; Vatanasapt, Sriamporn, & Vatanasapt, 2002).

Cervical cancer kills more than 270,000 women each year worldwide disproportionately affecting the poorest and most vulnerable women. At least 80% of cervical cancer deaths occur in developing countries with most occurring in the poorest regions (Parkin, Bray, & Devesa, 2001). There are also a rising number of women with breast cancer in the recent years and it remains the second most common cancer in some regions of developing Asian countries (Chopra, 2001). Studies suggest that approximately 40% reduction in mortality from breast cancer can be achieved through screening every one to three years among large portions of women over age 50 (Day, 1991; Miller, Chamberlain, Day, Hakama, Prorok, 1990). The delay of treatment commonly causes death. Cancer patients in the latest stage also face physical and mental challenges especially inability to work due to lost energy and also high medical treatment expenses, which lead to catastrophe in the household finance. Early cancer detection from mammogram and cervical cancer screening tests increases the likelihood of survival through an early treatment (Jatoi & Miller, 2003; Kelsey & Bernstein, 1996; Parkin & Fernandez, 2006; Shapiro, Coleman, Broeders, Codd, Koning, Fracheboud, et al., 1998). However, the majority of breast cancer in most Asian societies continues to be diagnosed at a relatively late stage (Agarwal, Pradeep, Aggarwal, Yip, Cheung, 2007).

A number of studies in developed and developing countries provide some significant evidence on the correlation between socioeconomic factors and health insurance on the usage of preventive care that can be applied to improve the existing health related policy. Age is one of the socioeconomic factors that determine the demand for preventive care. Based on Grossman's (1972) model of the demand for health capital and health inputs, the health capital stock is assumed to depreciate over time and health investment can be produced according to the household production function. From the Grossman model, there is a higher risk for older women to have breast cancer or cervical cancer compared to younger women. Beside the health risk, Cropper (1977) points out that individuals have different incentives to make investment in preventive care at different points in their lifecycles. The older individuals will have shorter pay-off periods for their investment compared to the young individuals. The shorter pay-off period may be one of the reasons that preventive care declines with age. Several studies show that usage of mammograms (Kenkel, 1994; Lairson, Chan, & Newmark, 2005; Mandelblatt, Gold, O'Malley, Taylor, Cagney, Hopkins, & Kerner,

1999; Williams, Lindquist, Sudore, Covinsky, & Walter, 2008) and cervical screening tests (Kenkel, 1994; Mandelblatt et al., 1999) decrease with age.

Education level of women is another socioeconomic factor affecting the demand for breast and cervical screening tests. Based on Grossman (1972) and Kenkel (1991), the more educated would demand more on health investment. Numerous empirical studies support these theoretical models that more educated people are more likely to use mammograms (Anderson & May, 1995; Calle, Flanders, Thuns, & Martin, 1993; Kenkel 1994; Hsia et al., 2000; Lairson et al., 2005; Katz, Zemencuk, & Hofer, 2000; Rohlfs, Borrell, Pasarin, & Plasencia, 1999; Zhang, Tao, & Irwin, 2000) and cervical screening tests (Anderson & May, 1995; Calle et al., 1993; Hsia et al., 2000; Kenkel, 1994; Rohlfs et al., 1999; Warren, Londono, Wessel, & Warren, 2006).

Another socioeconomic significant factor affecting demand for breast and cervical screening is incomes. Several studies show that the poor or low income group remains less likely to have mammograms (Anderson & May, 1995; Calle et al., 1993; Halliday, Taira, Davis, & Chan, 2007; Hsia et al., 2000; Katz, Zemencuk, & Hofer, 2000; Makuc, Freid, & Kleinman, 1989; Williams, Lindquist, Sudore, Covinsky, & Walter, 2008; White, Urban, & Taylor, 1993) and cervical screening tests (Anderson & May, 1995; Hsia et al., 2000; Makuc et al., 1989). Shootman, Jeffe, Baker, and Walker (2006) suggest that increasing poverty rate levels was associated with never having been screened for cervical cancer using a 2002 Behavioral Risk Factor Surveillance System survey. The lower propensity for breast and cervical screening tests usage maybe due to limited financial resources to spend on health investment.

Health insurance is an important factor for demand for breast and cervical screening tests, which lowers the expected price of preventive care and allows the preventive care to be affordable for individuals. Putthasri et al. (2004) found that the uninsured group took the highest burden of mammography service fees compared to other public health insurance in Thailand. Many studies show that having health insurance is estimated to increase the probability of mammograms [Kenkel, 1994; Hsia et al., 2000; Zhang et al., 2000; Breen, Wagener, Brown, Davis, Ballard-Barbash, 2001; Sudano & Baker, 2003; Pagan, Puig, & Soldo, 2007; Lairson et al., 2005; Adams, Florence, Thorpe, Becker, & Joski, 2003; Pagan, Asch, Brown, Guerra, & Armstrong, 2008; Putthasri, Tangcharoensathien, Mugem, & Jindawatana, 2004] and cervical screening tests (Adams et al., 2003;Carney et al., 2012; Hsia et al., 2000; Kenkel, 1994; Pagan et al., 2007; Sudano & Baker, 2003).

Health policy makers have been concerned and have tried to encourage breast and cervical screening through promotional and preventive care programs at a minimal cost through public health insurance. The objective of this paper is to investigate the impact of socioeconomic factors and health insurance on the likelihood of getting breast and cervical

screenings including clinical breast examination, mammograms, and cervical screening tests within the previous 5 years using the 2007 Thai Health and Welfare Survey. Logistic regressions analyze by monthly household income quartiles suggest that among women in the low monthly household income groups having the Universal Coverage plan increases the propensity to get cervical screening tests in the past 5 years. While among women in the higher monthly household income having the Civil Servant Medical Benefit Scheme and private health insurance increases the propensity to get clinical breast examination and cervical screening tests. The private health insurance is the only health insurance that has significant and positive probability of having mammograms among women from a high monthly household income group. This implies that the Universal Coverage plan implemented in 2001 for people without health insurance can assist women in the low monthly household income group to gain access to cervical screening tests with small co-payments. This finding will be useful for public health policy makers to evaluate the existing healthcare policy such as the Universal Coverage plan as well as other public health insurance on the effectiveness of breast and cervical screening tests through promotional and preventive care program.

Public health programs in Thailand

Following the public health policy reform in 2001, the Thai public health insurance program now consists of three schemes as shown in Table 1. First, the Civil Servant Medical Benefit Scheme (CSMBS) insures government employees, retirees, and their dependents. CSMBS beneficiaries receive free access to admission and ambulatory services with free choice of providers that are paid by Fee-for-Service (Limwattananon, Tangcharoensathien, & Prakongsai, 2005). The CSMBS funding comes from general tax. Second, the Social Security Scheme (SSS) insures private sector employees. SSS beneficiaries receive free access to admission and ambulatory services only at registered hospitals that are paid by capitation (Limwattananon et al., 2005). The SSS funding comes from mandatory social security taxes on employees and employers, and government contributions. Third, The Universal Coverage (UC) plan is for the rest of the population. The Universal Coverage plan funding is derived from government tax revenue.

The introduction of the UC plan is expected to reduce the barrier to healthcare access and make healthcare more affordable. The UC plan tries to promote accessibility to primary healthcare treatment at local health centers or hospitals. The referral system is required from the registered health center or hospital if UC insured individuals need further treatment at a tertiary healthcare institution such as a provincial public hospital. The government budget is used as a limited health coverage capitation for the UC plan's funding, which is distributed to healthcare facilities according to the number of UC registered (A. Na Ranong, V. Na Ranong, Triamworakul, & Wongmontha., 2005; Suraratdecha, Saithanu, &

Tangcharoensathien, 2005). The coverage includes the cost of curative, preventatives, promotional care and administration. The preventive and promotional services aim to minimize morbidity and mortality. The preventative package is financed by 14% of total capitation (Teerawattananon & Tangcharoensathein, 2004). The preventive and promotion services covered by UC packages are listed in Table 2. The preventive and promotion services covered by UC package are listed in Table 3.

Table 1 Health insurance schemes

Scheme	Target population	Coverage	Source of funding	Payment method
1. The Civil Servant Medical Benefit Scheme (CSMBS)	Government employee, retiree, and dependents	6 million, 10%	General tax, non-contributory	Fee-For-Service reimbursement model
2. The Social Security Insurance (SSS)	Private sector employee	8 million, 13%	Payroll tax tripartite contribution	Capitation inclusive outpatient and inpatient
3. The Universal Coverage (UC)	Rest of population	47 million, 74%	General tax, non-contributory	Capitation outpatient, prevention and health promotion; Global budget and Diagnostic-Related-Groups (DRG) for inpatient

Source: Tangcharoensathien, Prakongsai, Limwattananon, Patcharanarumoi, & Jongudomsuk (2007).

Table 2 Summary of reproductive health services packages after introduction of Universal Coverage

Components of reproductive health service	After Reform		
	CSMBS	SSS	UC
Sex education and adolescent reproductive health	Poorly defined	Poorly defined	Yes
Family planning	Yes	No	Yes
Essential obstetric care	Yes	Yes	Yes
Abortion and abortion complications	Yes	Yes	Yes
Menopause services	Yes	No	No
Reproductive tract infections including HIV/AIDS	Yes	No	Yes
Reproductive tract cancers	Yes	Yes	Yes
Infertility	Partial	No	No

Source: Tangcharoensathein, Tantivess, Teerawattananon, Aumkul, & Jongudoumsuk (2002).

Table 3 Summary of the nine International Conference on Population and Development *(*ICPD*)* and Sexual and Reproductive Health *(*SRH*)* services and the UC package coverage

The ICPD and SRH services	Services covered by UC package			Not covered by UC package
	Preventive and promotion services	Curative services	High cost care	
Unplanned pregnancy and unsafe abortion	Sex education; family planning	Abortion in cases of rape and risk to maternal health; treatment of abortion complication	NA	Safe abortion services for all
Maternal mortality and morbidity	Reduce unwanted pregnancy; antenatal care	Essential obstetric care for the first two children; treatment for complications	NA	
Reproductive tract infections, including STDs	Sex education and promotion of use of condoms; screening for syphilis in high risk groups and in antenatal care	Treatment based on syndromic and laboratory approaches	NA	
HIV/AIDS	Sex education and condoms; premarital and antenatal counseling and HIV testing; opportunistic infection prophylaxis in some provinces; prevention of mother to child transmission among pregnant women	Definitive treatment and care for opportunistic infections, and other palliative care		Highly Active Antiretroviral Therapy, but recently adopted as a national program in 2004 and administered outside UC
Reproductive tract cancers	Pap smear, clinical breast examination, Mammogram	Diagnostic, medical and surgical treatment as well as radiation therapy and other palliative care	Chemotherapy	

The ICPD and SRH services	Services covered by UC package			Not covered by UC package
	Preventive and promotion services	Curative services	High cost care	
Female genital mutilation	NA	NA	NA	NA
Sexual and gender based violence	General counseling services	Medical treatments and other palliative care for victims of violence	NA	
Infertility	Not covered	Not covered	Not covered	All interventions excluded and paid for by beneficiaries
Menopausal services	Not covered	Not covered	Not covered	All interventions excluded and paid for by beneficiaries

Source*:* Teerawattananon & Tangcharoensathein (2004) & Tangcharoensathein, Tantivess, Teerawattananon, Aumkul, & Jongudoumsuk (2002)

Methodology

The logistic regression model is applied to describe factors associated with each of the three screening tests including mammograms, clinical breast examinations, and cervical screening tests. Based on Maddala (1983) and Wooldridge (2002) the logistic analysis model is assume that there is an underlying response variable y^* defined by the regression relationship in equation (1).

$$y^* = x\beta + u \tag{1}$$

where x represents the individual and household characteristics and the disturbance term u. A dummy variable y defined by equation (2).

$$y = 1 \text{ if } y^* > 0$$
$$y = 0 \text{ otherwise} \tag{2}$$

From (1) and (2) we get

$$P(y = 1|x) = P(y^* > 0|x) = P(u > -x\beta) = 1 - F(-x\beta) = F(x\beta) \tag{3}$$

where F is the cumulative distribution function for u. u has a standard logistic distribution. The logit model is shown by equation (4).

$$F(x\beta) = \frac{\exp(x\beta)}{1+\exp(x\beta)} \tag{4}$$

For the nonlinear model interpretation, the marginal effects of the individual and household characteristics are calculated to interpret the β_j on both continuous and discrete explanatory variables. The marginal effects derivations are referred from Wooldridge (2002) and Cameron and Trevedi (2009). When x_j is continuous, the marginal effect is computed by equation (5).

$$\frac{\partial p(x)}{\partial x_j} = f(x\beta)\beta_j, \text{ where } f(x\beta) \equiv \frac{dF}{d(x\beta)}(x\beta) \tag{5}$$

There two important properties when explanatory variables are continuous. First, if $F(.)$ is strictly increasing cdf function, then the sign of the marginal effect is determined by the sign of β_j. Second, the relative effects for continuous variables x_j and x_h, the ratio of the partial effects is constant and given by the ratio of the corresponding coefficients by equation (6).

$$\frac{\frac{\partial p(x)}{\partial x_j}}{\frac{\partial p(x)}{\partial x_h}} = \frac{\beta_j}{\beta_h} \tag{6}$$

When x_K is a binary explanatory variable, the marginal effect from changing x_K from zero to one while holding all other variables fixed is computed by equation (7).

$$F(\beta_1 + \beta_2 x_2 + \cdots + \beta_{K-1} x_{K-1} + \beta_K x_K) - F(\beta_1 + \beta_2 x_2 + \cdots + \beta_{K-1} x_{K-1}) \qquad (7)$$

For other discrete variables such as number of family member in the household, then the effect on the probability of x_K going from c_K to $c_K + 1$ is computed by equation (8).

$$F(\beta_1 + \beta_2 x_2 + \cdots + \beta_{K-1} x_{K-1} + \beta_K(c_K + 1)) - F(\beta_1 + \beta_2 x_2 + \cdots + \beta_{K-1} x_{K-1} + + \beta_K c_K) \quad (8)$$

Another important result is the elasticity of income for mammograms, clinical breast examinations, and cervical screening tests. The calculation is shown by equation (9).

$$\varepsilon = \frac{\partial y}{\partial x} \times \frac{x}{y} \qquad (9)$$

Data

The data in the empirical analysis is based on the 2007 Health and Welfare Survey (HWS). This survey was conducted by the National Statistical Office in Thailand from January to June 2007. The sample was geographically stratified to ensure it was representative at provincial levels. The full sample consists of 69,679 individuals from 21,539 households. The survey contains information on demographic characteristics, economic status, health insurance status, and health information.

Variables name, mean, and standard deviations are listed in Table 4 to Table 6. The dependent variables are binary variables indicating whether or not the respondent had mammograms, clinical breast examinations, and cervical screening tests in the past 5 years. Only women aged 40 years and older were asked mammogram questions. Mammograms refer to the 12,447 respondents. Only women aged 20 years and older were asked clinical breast examination questions. Clinical breast examination refers to the 18,448 respondents. Only women aged 35 years and older were asked cervical screening test questions. Cervical screening tests refer to the 14,597 respondents. The independent variables include age, monthly household income, types of health insurance, education, marital status, family size, and region of household.

Head of household schooling is generated as a dummy variable and classified into four groups: i) head of household with primary schooling, ii) head of household with lower secondary schooling, iii) head of household with upper secondary schooling, and iv) head of household with college level schooling. Marital status is generated as a dummy variable and classified into two groups: i) divorced and ii) married. Types of main health insurance are also generated as dummy variables and classified into four groups: (1) CSMBS beneficiary includes government employees, retirees, and their dependents, (2) SSS beneficiary includes private sector employees, (3) UC beneficiary including the rest of the Thai population, and (4)

Private health insurance beneficiary. There are approximately two percent of women who did not realize their eligibility for UC plan. The distribution of the beneficiaries of public health schemes according to household income level using HWS 2007 data is illustrated in Figure 1.

Table 4 Descriptive statistics of dependent and independent variables (Dependent variables*:* Mammogram)

Variables	Description	Mean (Standard Deviation)
Dependent variables		
Mammogram[ψ]	Had mammogram within the past 5 years(for women age above 40 years old)	0.0623 (0.2418)
Independent variables		
North[ψ]	Living in the northern region	0.2796 (0.4488)
Northeast[ψ]	Living in the northeast region	0.2693 (0.4436)
South[ψ]	Living in the southern region	0.1299 (0.3362)
Urban[ψ]	Living in the municipal area	0.6001 (0.4899)
Divorced[ψ]	Marital status (divorced =1, otherwise =0)	0.0281 (0.1653)
Married[ψ]	Marital status (married =1 , otherwise=0)	0.6491 (0.4773)
Large family[ψ]	Household with family member included servant more than 5 people	0.1055 (0.3072)
Age between 40 to 55 years[ψ]	Women aged between 40 to 55 years	0.54519 (0.4980)
Age between 56 to 70 years[ψ]	Women aged between 56 to 70 years	0.3102 (0.4626)
Primary education level[ψ]	Head of household with primary schooling	0.6716 (0.4696)
Lower secondary education level[ψ]	Head of household with lower secondary schooling	0.0688 (0.2531)
Upper secondary education level[ψ]	Head of household with upper secondary schooling	0.0591 (0.2359)
College level[ψ]	Head of household with college level	0.0919 (0.2889)
Income	Monthly household income (Baht)	20,531.5700 (30,922.3100)
CSMBS[ψ]	Civil Servant Medical Benefit Scheme status	0.2148 (0.4107)
UC[ψ]	Universal Coverage health insurance status	0.7213 (0.4484)
SSS[ψ]	Social Security Scheme insurance plan status	0.0381 (0.1914)
Private[ψ]	Private health insurance status	0.0269 (0.1618)

Note*:* Number of observation is 12,447. [ψ] is dummy variable*.*

Table 5 Descriptive statistics of dependent and independent variables (Dependent variables*:* Clinical breast examination)

Variables	Description	Mean (Standard Deviation)
Dependent variables		
Clinical breast examination$^{\psi}$	Had clinical breast examinations within the past 5 years (for women age above 20 years old)	0.3066 (0.4611*)*
Independent variables		
North$^{\psi}$	Living in the northern region	0.2629 (0.4402)
Northeast$^{\psi}$	Living in the northeast region	0.2634 (0.4405)
South$^{\psi}$	Living in the southern region	0.1413 (0.3484)
Urban$^{\psi}$	Living in the municipal area	0.6083 (0.4882)
Divorced$^{\psi}$	Marital status (divorced =1, otherwise =0)	0.0259 (0.1589)
Married$^{\psi}$	Marital status (married =1 , otherwise=0)	0.6845 (0.4647)
Large family$^{\psi}$	Household with family member included servant more than 5 people	0.1188 (0.3236)
Age between 20 to 35 years$^{\psi}$	Women aged between 20 to 35 years	0.2309 (0.4214)
Age between 36 to 50 years$^{\psi}$	Women aged between 36 to 50 years	0.3771 (0.4847)
Age between 51 to 65 years$^{\psi}$	Women aged between 51 to 65 years	0.2528 (0.4346)
Primary education level$^{\psi}$	Head of household with primary schooling	0.6228 (0.4847)
Lower secondary education level$^{\psi}$	Head of household with lower secondary schooling	0.0879 (0.2833)
Upper secondary education level$^{\psi}$	Head of household with upper secondary schooling	0.0835 (0.2766)
College level$^{\psi}$	Head of household with college level	0.1004 (0.3006)
Income	Monthly household income (Baht)	20,890.4200 (32,517.7700)
CSMBS$^{\psi}$	Civil Servant Medical Benefit Scheme status	0.1776 (0.3822)
UC$^{\psi}$	Universal Coverage health insurance status	0.6950 (0.4604)
SSS$^{\psi}$	Social Security Scheme insurance plan status	0.0941 (0.2919)
Private$^{\psi}$	Private health insurance status	0.0280 (0.1650)

Note*:* Number of observation is 18,448. $^{\psi}$ is dummy variable.

Table 6 Descriptive statistics of dependent and independent variables (Dependent variables*:* Cervical screening test)

Variables	Description	Mean (Standard Deviation)
Dependent variables		
Cervical screening test[ψ]	Had cervical screening test within the past 5 years (for women age above 35 years old)	0.4588 (0.4983)
Independent variables		
North[ψ]	Living in the northern region	0.2751 (0.4466)
Northeast[ψ]	Living in the northeast region	0.2716 (0.4448)
South[ψ]	Living in the southern region	0.1321 (0.3386)
Urban[ψ]	Living in the municipal area	0.5995 (0.4900)
Divorced[ψ]	Marital status (divorced =1, otherwise =0)	0.0283 (0.1658)
Married[ψ]	Marital status (married =1 , otherwise=0)	0.6762 (0.4679)
Large family[ψ]	household with family member included servant more than 5 people	0.1092 (0.3119)
Age between 35 to 50 years[ψ]	Women aged between 35 to 50 years	0.5046 (0.4999)
Age between 51 to 65 years[ψ]	Women aged between 51 to 65 years	0.3195 (0.4663)
Primary education level[ψ]	Head of household with primary schooling	0.6564 (0.4749)
Lower secondary education level[ψ]	Head of household with lower secondary schooling	0.0754 (0.2641)
Upper secondary education level[ψ]	Head of household with upper secondary schooling	0.0698 (0.2548)
College level[ψ]	Head of household with college level	0.0934 (0.2909)
Income	Monthly household income (Baht)	20,867.5500 (34,000.6400)
CSMBS[ψ]	Civil Servant Medical Benefit Scheme status	0.2025 (0.4019)
UC[ψ]	Universal Coverage health insurance status	0.7169 (0.4505)
SSS[ψ]	Social Security Scheme insurance plan status	0.0529 (0.2238)
Private[ψ]	Private health insurance status	0.0278 (0.1644)

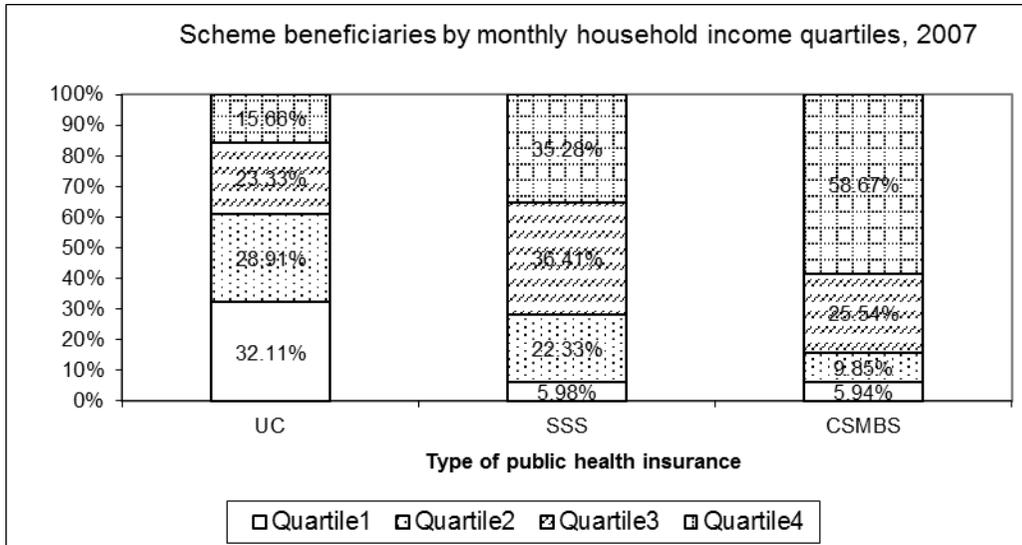Note*:* Number of observation is 14,597. [ψ] is dummy variable.

Figure 1 Public health insurance scheme beneficiaries by monthly household income quartiles, 2007

Source: NSO Health and Welfare Survey 2007

Empirical Results

Elasticity of income for mammograms, clinical breast examinations, and cervical screening tests

The estimated results of the elasticity of income for mammograms, clinical breast examinations, and cervical screening tests by monthly household income quartiles are shown in Table 7. The estimation results suggest that the elasticity of the income for mammograms, clinical breast examinations and cervical screening tests are positive and less than one at the mean monthly household income. This suggests that mammograms, clinical breast examinations, and cervical screening tests are normally good. The elasticity of income for mammograms is 0.0756. The elasticity of income for clinical breast examinations is 0.0290. The elasticity of income for cervical screening tests is 0.0553. As monthly household income increases, there are higher percentages of propensity to get mammograms, clinical breast examinations, and cervical screening tests. The elasticity of income for mammograms is also significant and positive among women from the monthly household income quartile I and IV groups. This implies that having a mammogram is normally good for women from the low and high monthly household income groups. The elasticity of income for clinical breast examinations is significant and negative among women from the monthly household income quartile III. This suggests that getting a clinical breast examination is inferior for women from

the mid-high monthly household income groups. As their monthly household income increases, they may choose more sophisticated breast screening such as mammography. Lastly, the elasticity of income for cervical screening tests is positive and significant among women from the monthly household income quartile I. As the monthly household income increases among women in the low monthly household income group, there are higher percentages of propensity to get cervical screening tests.

Logistic analysis on mammograms

The full results on the logit estimation of demand for mammogram (reported by marginal effect) are illustrated in Table 8. For each monthly household income quartiles, having mammograms was estimated as a function of the following explanatory variables including health insurance, education, age, marital status, family size, and living region. The dependent variable takes on 1 if women had a mammogram within the past 5 years and 0 otherwise. There are several interesting points that we conclude from Table 8. First, private health insurance is the only health insurance that has significant and positive probability of having mammograms among women from high monthly household income groups. All three types of public health insurance including CSMBS, UC, and SSS are insignificant indicators on the likelihood of having mammograms among women across monthly.

household income groups. Mammogram procedures involving high costs are usually only available in private hospitals and public hospitals at the tertiary level. Even public health insurances have some coverage on mammograms, it may be harder among the insured to gain access. Second, across all monthly household income quartiles except household income quartile II, the head of household's education has an insignificant effect on the likelihood of having mammograms. Third, as expected, the probability of having a mammogram is higher at the recommend age and then declined as the payoff period shortened. Fourth, in the household income quartile III and IV, living in an urban area was related to a higher probability of having a mammogram. Living in an urban area involves less travel time and cost of commuting to the healthcare providers. Fifth, across all household income quartiles, marital status and family size has insignificant effect on the likelihood of having a mammogram.

Logistic analysis on clinical breast examinations

The full results on the logit estimation of demand for clinical breast examinations (reported by marginal effect) are shown in Table 9. For each income quartiles, having clinical breast examinations was estimated as a function of the following explanatory variables including health insurance, education, age, marital status, family size, and living region. The dependent variable takes on 1 if women had clinical breast examinations within the past 5 years and 0 otherwise. Several points can be discussed from Table 9. First, the probability of

having a clinical breast examination increased with having health insurance for women from monthly household income quartile II and IV. Women with the UC plan from monthly household income quartile II and IV have a higher propensity to get a clinical breast examination (approximately 11.07 % and 8.60%) compared with women who didn't realize their eligibility for the UC plan. Women with the CSMBS from monthly household income quartile II and IV have a higher propensity to get a clinical breast examination (approximately 25.28% and 18.55%) compared with women who didn't realize their eligibility for the UC plan. In addition, women with private health insurance from monthly household income quartile IV have a higher propensity to get a clinical breast examination (approximately 9.64%) compared with women who didn't realize their eligibility for the UC plan. Second, across all monthly household income quartiles, the head of households education has insignificant effect on the likelihood of having a clinical breast examination. Third, across all monthly household incomes, the probability of having a clinical breast physical examination increases compared with women age above 65 years. Fourth, in the monthly household income quartile II and III, living in an urban area was related to a lower probability of having a clinical breast examination among middle monthly household income women. Living in the northern or the northeastern region was related to a higher probability of having a clinical breast examination across all monthly household income women. Fifth, across all monthly household income quartiles, married women have higher propensity to have a clinical breast examinations compared with single women. Sixth, in the monthly household income quartile III, women who live with more than 5 household members were less likely to have clinical breast examination comparing with the smaller family size household.

Logistic analysis on cervical screening test

The full results on the logit estimation of demand for cervical screening tests (reported by marginal effect) are shown in Table 10. For each income quartiles having cervical screening test was estimated as a function of the following explanatory variables including health insurance, education, age, marital status, family size, and living geographic. The dependent variable takes on 1 if women had cervical screening test within the past 5 years and 0 otherwise. Several appealing points can be discussed from Table 10. First, the probability of having cervical screening tests increased with having CSMBS for women across monthly household income groups. In addition, women with UC plan from the lowest monthly household income group have a higher propensity to get the cervical screening tests (approximately 20.23%) compared with women who didn't realize their eligibility for the UC plan. Women with private health insurance from the highest monthly household income group are more likely to have a cervical screening test. Second, head of household education has a positive significance on the likelihood of having a cervical screening test for women from monthly household income quintile I and II. However, among monthly household incomes

above the median, head of household education has insignificant influence on the likelihood of having a cervical screening test. Third, across all monthly household income, the probability of having a cervical screening test increases compared with women over 65 years of age. Fourth, in the monthly household income quartile II and III, living in a urban area was related to a lower probability of having a cervical screening test among middle monthly household income women. Living in the northern or northeastern region was related to a higher probability of having a cervical screening test across all monthly household income women. Fifth, across all monthly household income quartiles, married women have a higher propensity to have a cervical screening test compared to single women. Sixth, in the monthly household income quartile II and III, women who live with more than 5 household members were less likely to have a cervical screening test then those with the smaller family size household.

Table 7 Demand for mammogram, clinical breast examinations and cervical screening tests by household income quartiles (Reported by elasticity of income)

	Mammograms					Clinical breast examinations					Cervical screening tests				
Dependent variables	Mean income 20,532 THB	Quartile I 7,024 THB	Quartile II 12,589 THB	Quartile III 24,349 THB	Quartile IV	Mean income 20,890 THB	Quartile I 7,611 THB	Quartile II 13,333 THB	Quartile III 24,396 THB	Quartile IV	Mean income 20,868 THB	Quartile I 7,231 THB	Quartile II 12,875 THB	Quartile III 24,410 THB	Quartile IV
Income	0.0756*** (0.0212)	0.9819** (0.4414)	0.1770 (0.8564)	0.0355 (0.5162)	0.1351*** (0.0517)	0.0290** (0.0114)	-0.0015 (0.1306)	-0.2108 (0.2437)	-0.4268* (0.2270)	0.0222 (0.0279)	0.0553*** (0.0189)	0.2287** (0.1096)	-0.1596 (0.1806)	0.1143 (0.1621)	0.0446 (0.0278)
Number of observation	12,447	3,081	3,112	3,112	3,111	18,448	4,612	4,613	4,612	4,611	14,597	3,652	3,647	3,649	3,649

Notes: the number in the parenthesis is a standard error.

*** Significant at 1% level ** Significant at 5% level * Significant at 10% level.

Table 8 Demand for mammogram (Reported by marginal effect)

	Marginal effect of variables for getting mammogram				
	Mean income 20,532 THB	Quartile I 7,024 THB	Quartile II 12,589 THB	Quartile III 24,349 THB	Quartile IV
Income	1.87e-07***	5.43e-06**	1.01e-06	-3.92e-09	2.12e-07***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
CSMBS	0.0167	-0.0172	-0.0225	0.0032	0.0467
	(0.0153)	(0.0123)	(0.0100)	(0.0243)	(0.0381)
UC	-0.0078	0.0206	-0.0248	-0.0036	-0.0256
	(0.0134)	(0.0099)	(0.0204)	(0.0232)	(0.0350)
SSS	0.0123	0.1053	0.0417	-0.0287	0.0271
	(0.0176)	(0.1304)	(0.0446)	(0.0161)	(0.0419)
Private	0.0301*	-0.0067	0.0531	-0.0073	0.0559*
	(0.0180)	(0.0260)	(0.0504)	(0.0202)	(0.0354)
Primary education level	-0.0017	0.0165	0.0084	-0.0116	-0.0199
	(0.0088)	(0.0086)	(0.0128)	(0.0203)	(0.0235)
Lower secondary education level	-0.0138	0.0278	0.0111	-0.0282	-0.0414
	(0.0095)	(0.0369)	(0.0282)	(0.0136)	(0.0200)
Upper secondary education level	0.0016	-0.0075	0.0206	-0.0024	-0.0281
	(0.0128)	(0.0240)	(0.0340)	(0.0240)	(0.0215)
College level	0.0316*		0.2082*	0.0038	-0.0018
	(0.0168)		(0.1331)	(0.0294)	(0.0233)
Age between 40 to 54 years	0.0442***	0.0245	0.0030	0.0460**	0.0773**
	(0.0111)	(0.0173)	(0.0143)	(0.0210)	(0.0314)
Age between 55 to 69 years	0.0478	0.0269	0.02112	0.0672*	0.0608
	(0.0169)	(0.0192)	(0.0197)	(0.0410)	(0.0518)
Divorced	0.0104	-0.0102	-0.0036	0.0625	0.0035
	(0.0191)	(0.0158)	(0.0170)	(0.0596)	(0.0474)
Married	0.0076	-0.0007	0.0050	0.0049	0.0160
	(0.0065)	(0.0095)	(0.0114)	(0.0135)	(0.0179)
Urban	0.0290***	0.0082	0.0063	0.0282***	0.0500***
	(0.0055)	(0.0083)	(0.0097)	(0.0104)	(0.0140)
North	-0.0061	0.0173	0.0060	-0.0066	-0.0235
	(0.0066)	(0.0139)	(0.0152)	(0.0133)	(0.0154)

Northeast	0.0045	0.0126	0.0250	0.0020	-0.0007
	(0.0071)	(0.0120)	(0.0163)	(0.0140)	(0.0190)
South	0.0198**	0.0084	0.0475*	0.0700***	-0.0285*
	(0.0100)	(0.0215)	(0.0268)	(0.0251)	(0.0154)
Family size greater	-0.0058	-0.0127	-0.0151	0.0015	-0.0210
than 5	(0.0082)	(0.0119)	(0.0114)	(0.0181)	(0.0179)
Pseudo R-squared	0.0600	0.0388	0.0427	0.0485	0.0875
Log likelihood	-2614.3006	-453.0925	-516.7541	-661.0874	-975.0134
Sample size	12,447	3,081	3,112	3,112	3,111

Note the number in the parenthesis is a standard error.

*** Significant at 1% level ** Significant at 5% level * Significant at 10% level

Income quartile I includes individual from household income below 7,024 THB. Income quartile II includes individual from household income between 7,024 THB and 12,589 THB. Income quartile III includes individual from household income between 12,589 THB and 24,349 THB. Income quartile IV includes individual from household income above 24,349 THB.

Table 9 Demand for clinical breast examinations (Reported by marginal effect)

	Marginal effect of variables for getting clinical breast examinations				
	Mean income 20,890 THB	Quartile I 7,611 THB	Quartile II 13,333 THB	Quartile III 24,396 THB	Quartile IV
Income	4.26e-07***	-1.34e-06	-5.31e-06	-5.02e-06	1.04e-07
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
CSMBS	0.1719***	0.1501	0.2528***	0.0627	0.1855***
	(0.0342)	(0.1005)	(0.0821)	(0.0570)	(0.0529)
UC	0.0604**	0.0724	0.1107**	0.0100	0.0860*
	(0.0251)	(0.0546)	(0.0448)	(0.0476)	(0.0474)
SSS	0.0203	0.1520	0.0803	-0.0287	0.0130
	(0.0313)	(0.1114)	(0.0742)	(0.0504)	(0.0518)
Private	0.0650**	0.1365	-0.1069	0.0331	0.0964**
	(0.0311)	(0.1600)	(0.0879)	(0.0587)	(0.0405)
Primary education level	-0.0065	0.0344	-0.0049	0.0035	-0.0920**
	(0.0179)	(0.0279)	(0.0400)	(0.0382)	(0.0375)
Lower secondary education level	-0.0219	0.0321	0.0193	-0.0707*	-0.0594
	(0.0230)	(0.0539)	(0.0524)	(0.0385)	(0.0463)
Upper secondary education level	-0.0045	0.0777	-0.0381	0.0040	-0.0620
	(0.0261)	(0.0858)	(0.0499)	(0.0484)	(0.0450)
College level	0.0162	-0.0654	0.0378	-0.0028	-0.0545
	(0.0256)	(0.1007)	(0.0932)	(0.0501)	(0.0379)
Age between 20 to 35 years	0.1542***	0.1906***	0.1344***	0.1031**	0.0994**
	(0.0247)	(0.0478)	(0.0515)	(0.0483)	(0.0512)
Age between 36 to 50 years	0.2637***	0.3276***	0.2496***	0.1703***	0.2223***
	(0.0218)	(0.0386)	(0.0462)	(0.0470)	(0.0449)
Age between 51 to 65 years	0.2317***	0.2625***	0.1850***	0.1926***	0.2129***
	(0.0244)	(0.0399)	(0.0519)	(0.0552)	(0.0504)
Divorced	0.0691*	0.1270*	-0.1029	0.1492*	0.0603
	(0.0399)	(0.0759)	(0.0577)	(0.0920)	(0.0837)
Married	0.1061***	0.0952***	0.1209***	0.1029***	0.1027***
	(0.0113)	(0.0207)	(0.0242)	(0.0225)	(0.0238)
Urban	-0.0300***	-0.0105	-0.0486***	-0.0481***	-0.0267
	(0.0098)	(0.0183)	(0.0187)	(0.0184)	(0.0221)
North	0.0916***	0.1509***	0.0561**	0.0800***	0.1107***
	(0.0139)	(0.0302)	(0.0261)	(0.0289)	(0.0323)

	Marginal effect of variables for getting clinical breast examinations				
	Mean income 20,890 THB	Quartile I 7,611 THB	Quartile II 13,333 THB	Quartile III 24,396 THB	Quartile IV
Northeast	0.0887***	0.0836***	0.1012***	0.1167***	0.0948***
	(0.0145)	(0.0273)	(0.0297)	(0.0306)	(0.0357)
Family size greater than 5	-0.0267*	-0.0022	0.0255	-0.0989***	-0.0414
	(0.0152)	(0.0434)	(0.0340)	(0.0243)	(0.0266)
Pseudo R-squared	0.0557	0.0719	0.0629	0.0505	0.0686
Log likelihood	-10492.114	-2529.7916	-2623.5373	-2547.8325	-2704.1114
Sample size	18,448	4,612	4,613	4,612	4,611

Note the number in the parenthesis is a standard error.

*** Significant at 1% level ** Significant at 5% level * Significant at 10% level

Income quartile I includes individual from household income below 7,611 THB. Income quartile II includes individual from household income between 7,611 THB and 13,333 THB. Income quartile III includes individual from household income between 13,333 THB and 24,396 THB. Income quartile IV includes individual from household income above 24,396 THB.

Table 10 Demand for cervical screening tests (Reported by marginal effect)

	Marginal effect of variables for getting cervical screening test				
	Mean income 20,868 THB	Quartile I 7,231 THB	Quartile II 12,875 THB	Quartile III 24,410 THB	Quartile IV
Income	1.12e-06***	0.00001*	-9.86e-06	3.47e-06	3.90e-07
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	.00000
CSMBS	0.1876***	0.2643**	0.2534***	0.1589**	0.1001*
	(0.0358)	(0.1227)	(0.0801)	(0.0665)	(0.0587)
UC	0.0688**	0.2023**	0.1009	0.0920	-0.0364
	(0.0332)	(0.0683)	(0.0714)	(0.0604)	(0.0573)
SSS	0.0567	0.2007	0.1009	0.0075	0.0417
	(0.0411)	(0.1361)	(0.0901)	(0.0699)	(0.0692)
Private	0.1360***	-0.0919	0.1651	0.0444	0.1503***
	(0.0431)	(0.1681)	(0.1863)	(0.1049)	(0.0428)
Primary education level	0.0758***	0.1132***	0.1448***	-0.0066	0.0040
	(0.0218)	(0.0348)	(0.0406)	(0.0515)	(0.0469)
Lower secondary education level	0.1010***	0.0515	0.2280***	0.0293	0.0051
	(0.0319)	(0.0785)	(0.0603)	(0.0643)	(0.0580)
Upper secondary education level	0.1015***	0.2611**	0.1482*	0.0821	-0.0343
	(0.0355)	(0.1043)	(0.0774)	(0.0697)	(0.0599)
College level	0.1383***	-0.1747	0.1621	-0.0341	0.0661
	(0.0364)	(0.1350)	(0.1503)	(0.0803)	(0.0515)
Age between 35 to 50 years	0.3583***	0.4191***	0.3948***	0.2665***	0.2586***
	(0.0193)	(0.0339)	(0.0414)	(0.0421)	(0.0433)
Age between 51 to 65 years	0.2697***	0.3226***	0.2620***	0.1995***	0.2055***
	(0.0214)	(0.0370)	(0.0489)	(0.0469)	(0.0421)
Divorced	0.0859**	0.0207	0.0153	0.2704***	0.0460
	(0.0432)	(0.0867)	(0.0811)	(0.0626)	(0.0855)
Married	0.1709***	0.1456***	0.1746***	0.1416***	0.2082***
	(0.0148)	(0.0269)	(0.0307)	(0.0309)	(0.0309)
Urban	-0.0350***	-0.0234	-0.0528**	-0.0678***	-0.0205
	(0.0132)	(0.0245)	(0.0242)	(0.0249)	(0.0277)

	Marginal effect of variables for getting cervical screening test				
	Mean income 20,868 THB	Quartile I 7,231 THB	Quartile II 12,875 THB	Quartile III 24,410 THB	Quartile IV
North	0.1096***	0.1344***	0.1261***	0.1231***	0.0748**
	(0.0166)	(0.0363)	(0.0319)	(0.0328)	(0.0342)
Northeast	0.0864***	0.0771**	0.1057***	0.1059***	0.0960**
	(0.0173)	(0.0347)	(0.0334)	(0.0361)	(0.0415)
South	-0.0508**	-0.0369	-0.0886**	0.0133	-0.0783**
	(0.0201)	(0.0515)	(0.0398)	(0.0379)	(0.0366)
Family size greater than 5	-0.0616***	-0.0217	-0.0959**	-0.1080***	-0.0517
	(0.0196)	(0.0552)	(0.0402)	(0.0364)	(0.0327)
Pseudo R-squared	0.0924	0.1282	0.1067	0.0624	0.0836
Log likelihood	-9146.5161	-2143.6546	-2246.9789	-2363.75	-2306.2482
Sample size	14,597	3,652	3,647	3,649	3,649

Note the number in the parenthesis is a standard error.

*** Significant at 1% level ** Significant at 5% level * Significant at 10% level

Income quartile I includes individual from household income below 7,231 THB. Income quartile II includes individual from household income between 7,231 THB and 12,875THB. Income quartile III includes individual from household income between 12,875 THB and 24,410 THB. Income quartile IV includes individual from household income above 24,410 THB.

Conclusion

Breast and cervical cancers are the leading reproductive organ cancers among Thai women. The early cancer detection from breast and cervical screening tests increases the likelihood of survival through early treatment. It is important for health policy makers to design policies such as public health insurance to improve the usage of promotional and preventive care such as breast and cervical screening. Thailand introduced the Universal Coverage plan in 2001 to the Thai population who did not have health insurance. Logistic regressions result by the monthly household income quartiles suggest that the Universal Coverage insured in the low monthly household income group increased the likelihood of getting cervical screening tests. These results imply that the Universal Coverage plan implemented in 2001 for people without health insurance can assist women in the low monthly income group to access cervical screening tests with small co-payment. While among women in the high monthly household income group having the Civil Servant Medical Benefit Scheme and private health insurance increased the propensity to have clinical breast examinations and

cervical screening tests. Private health insurance is the only health insurance that has significant and positive probability of having mammograms among women from high monthly household income group.

The results of monthly household income, head of household education, age, marital status, and household geographics are significant determinants of the demand for preventive care including having mammograms, clinical breast examinations, and cervical screening tests. The elasticity of income for mammograms and cervical screening tests are normal goods for women from the low monthly income group. As monthly household income increases, there is a higher propensity for women to get mammograms and cervical screening tests. The empirical results of head of household education and age support the essential variable in the theoretical model of health investment. To improve the access among households with limited cancer knowledge, health policy makers should raise awareness and encourage women to have frequent breast and cervical screening tests by providing extensive information about cancer and other preventive methods at health centers, hospitals, or through different types of media.

Acknowledgements

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