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ACCESS, UTILIZATION, AND EQUITY IN CANADA AND THE U.S.:

AN EMPIRICAL MODEL OF PHYSICIAN VISITS

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ABSTRACT

We use a simple theoretical model and generalized Lorenz curves to provide an economic interpretation of the distribution of physician visits in Canada and the U.S. The methodology enables us to compare differences in access, level of utilization, and equity in the distribution of services across populations, while controlling for differences in the distribution of covariates. We find that Canadians have greater access to physician services, greater utilization, and a more equitable distribution of services relative to Americans. Insurance mitigates inequities in the distribution of services for females ages 20 to 64 in the U.S., but not for males. The observed differences across countries are consistent with a model in which the ratio of marginal benefits to marginal costs for a physician visit is higher in Canada than the U.S.

1. INTRODUCTION

Numerous interest groups and policy makers are in favor of significant health-care reform in the U.S. In recent debates on the shape these reforms should take, some have suggested that the U.S. adopt the Canadian model of universal health insurance coverage. An expected benefit is the equalization of access to health care across the U.S. population; national health insurance would facilitate the ability of Americans to seek medical care on the basis of need, rather than ability to pay. To assess the validity of this reasoning, we develop a simple economic model of visits to the physician. We use this theoretical framework in conjunction with generalized Lorenz curves to compare and interpret the observed distribution of physician visits in Canada and the U.S.

A number of recent studies compare the Canadian and U.S. health care systems. The Canadian system has been found to be more effective in restraining health care expenditures per capita (Evans, Lomas, Barer, et al. 1989). Results indicate that reasons for differential spending in the two countries include higher administrative costs, higher input prices, and in some cases higher intensity of services provided per patient in the U.S.(Newhouse, Anderson, & Roos. 1988; Fuchs & Hahn. 1990; Redelmeier & Fuchs. 1993; Rouleau, Moye, Pfeffer, Arnold, & et.al. 1993). Although these studies shed light on the intensity of resource utilization in these two countries, a concomitant comparison of the intensity and distribution of resources within these two populations has not yet been conducted.

Why do we expect to find differences in the distribution of medical resource utilization between Canada and the U.S.? An estimated 25 million adults under age 65 in the U.S. are uninsured (Swartz. 1988). These individuals are 20 percent less likely than publicly or privately insured individuals to utilize any health care services in a given year. Even for those in the U.S.

who are insured, evidence from the Rand Health Insurance Experiment indicates that the presence of coinsurance and deductibles reduces their demand for health care relative to what it would be otherwise (Manning, Newhouse, Duan, Keeler, Leibowitz, & Marquis. 1987). Thus, we hypothesize a wider disparity in access to services in the U.S.than in Canada.

Our data sources are the 1985 Statistics Canada General Social Survey (GSS) and the 1984 U.S. Census Bureau Survey of Income and Program Participation (SIPP). Each dataset is a nation-wide, population-based sample survey containing detailed information on health-services utilization, health status, and socio-demographic status. A particular advantage of these population-based datasets is that we can examine differences in access to care (the probability of seeing a physician), as well as differences in the level of utilization conditional upon access to the health-care system. Although provider-based datasets contain more detailed information on the level of health-care services actually provided, they cannot be used to address questions concerning differential access to care.

Our empirical investigation of cross-country differences in access to and utilization of health-care services yields the following results: After controlling for differences in observables, we find that Canadians have greater access to physician services and a more equitable distribution of services relative to Americans. This finding holds true even for the elderly, in spite of the insurance coverage provided by the U.S. Medicare program for those over age 65. A closer examination of the data indicates that these differences cannot be explained by race composition; both whites and nonwhites in the U.S. fair poorly relative to Canadians with similar socio-demographic characteristics. And, although insured Americans have greater access and utilization than uninsured Americans, insured males in the U.S. still use less physician services and face a less equitable distribution of visits than Canadian males. We do not find a less equitable distribution of physician services for insured women in the U.S., although insured U.S. females face lower access to health care.

The observed differences across countries are consistent with a model in which the ratio of marginal benefits to marginal costs for a physician visit is higher in Canada than in the U.S. For individuals under age 65, the differential across countries is widest for the first one or two visits, and the differential is larger when one compares Canadians to uninsured Americans. These results are consistent with the hypothesis that lack of coverage and co-payments in the U.S. have their largest impact on the relative marginal cost of access to physician services across countries.

In section 2, we introduce the generalized Lorenz curve as a tool for comparing the distribution of physician visits between Canada and the U.S., while in section 3 we outline a simple economic model of physician visits. In section 4, we use fitted generalized Lorenz curves to make comparisons of access, level of utilization, and equity of distribution between Canada and the U.S., controlling for covariates. The economic model of physician visits is then used to provide a structural interpretation of the results. We conclude our paper in section 5.

2. *CROSS-COUNTRY DIFFERENCES IN THE UTILIZATION OF PHYSICIAN SERVICES*

In this section, we summarize the overall differences between Canada and the U.S. in the use of physician services, as measured by the number of doctor visits in a given year. Comparisons will be made in three dimensions: first, access to service as given by the fraction of the population with one or more visits in the past year; second, the amount of utilization as given by the mean number of visits in the population of interest; and third, equity in the distribution of visits.

2.1 GENERALIZED LORENZ CURVES

A convenient descriptive tool for making cross-country comparisons in each of the three dimensions described above is the generalized Lorenz curve (GLC) proposed by Shorrocks (1983). Shorrocks proposed the GLC as an extension of the standard Lorenz curve method of making welfare comparisons across countries regarding the distribution of incomes. Although the GLC is generally used to rank income distributions, it can be constructed for any distribution of interest. We utilize GLC analysis to compare the distribution of annual physician visits per capita in Canada and the U.S.

A Lorenz curve can be derived by indexing individuals in a finite population by their number of physician visits h_i so that $h_1 \leq h_2 \leq \ldots \leq h_n$, and then calculating

$$L\left(\frac{k}{n}\right) = \sum_{i=1}^{k} \frac{h_i}{n\mu} \qquad k = 1,\ldots,n$$

where μ is the mean number of visits in the population. Thus, a Lorenz curve graphs the cumulative proportion of the population with at least a given number of visits (k/n) along the x-axis, and that group's percentage of the population's total number of physician visits L(k/n) along the y-axis.[1] A Lorenz curve that maps the 45 degree line exactly would represent an equal distribution of physician visits across the population, while Lorenz curves drawn further from this line represent rising health care inequality.[2] The drawback of the Lorenz curve is that, while one country may have a more equal distribution of physician visits than another, it may also have a

[1]We compute k/n and its corresponding Lorenz curve and GLC for each discrete number of visits in the sample. For example, the first value of k/n on each axis is determined by the total number of persons in the sample with at least one visit to the doctor; the second value of k/n is determined by the total number of persons with at least two visits, and so forth.

[2]That is, a relatively small share of the population is utilizing a disproportionately large share of physician services.

lower average number of visits. Thus, it is unclear which physician services distribution is preferred on welfare grounds. The GLC incorporates both the equity and absolute differences in number of physician services between countries by scaling up the Lorenz curve by the population's mean number of visits. That is,

$$GLC(\frac{k}{n}) = \mu L(h,\frac{k}{n}) = \sum_{i=1}^{k} \frac{h_i}{n}$$

The x-axis of the GLC is again the cumulative proportion of the population with at least a given number of visits (k/n), but the y-axis of the GLC graphs the total number of physician visits for the k/nth proportion of the population, divided by the total population size n. If country A's GLC lies above that of country B's at all points, then *ceteris paribus* country A's distribution of physician visits is preferred to country B's for a wide class of social welfare functions, since the GLC takes into account both the distribution and the mean of utilization in each country. If countries A and B have the same mean number of visits but A's GLC is above that of B, then A will have a more equitable distribution of visits than B.[3] As with Lorenz curves, if the GLCs cross, such statements cannot be made a priori.

2.2 DATA

Examining health-service utilization across countries requires large samples which are representative of the Canadian and American populations. The Canadian data we use are derived from the 1985 Statistics Canada General Social Survey (GSS), which provides information on

[3]If the mean number of physician visits differs, then one must look at the Lorenz curves to determine if the distribution of physician visits is more concentrated in country A than in country B. However, in each of the susequent figures in the paper, we have found that if one GLC lies above another, then the same is true for the corresponding Lorenz curves. Consequently, to conserve space, we only include the GLCs in the text. Lorenz curves for selected groups are, however, presented in an appendix.

11,200 individuals aged 15 and over with an oversampling of those aged 65 and older. The survey excludes full-time residents of institutions. For data from the U.S., we use the U.S. Census Bureau's 1984 Survey of Income and Program Participation (SIPP), Wave 3. This survey provides information on approximately 40,000 U.S. residents aged 15 and over in 1984. A more detailed description of these databases is provided in Appendix I. These surveys were chosen because they ask almost identical questions regarding the utilization of health services during roughly the same time period. In particular, both ask the respondent to list the number of physician visits in the previous 12 months, in addition to providing information on demographics, presence of chronic or limiting health conditions, and health insurance status (in the U.S.).[4,5]

2.3 UTILIZATION OF PHYSICIAN SERVICES IN CANADA AND THE U.S.

GLCs describing the distribution of physician visits in Canada and the U.S. for four major age-sex groups are presented in Figure 1.[6] The left endpoints of the GLCs pictured in Figure 1(a) indicate that approximately 50 percent more males aged 20 - 64 in the U.S. have zero physician visits than in Canada. The right endpoints imply that the mean number of physician visits is slightly higher in Canada. Because the Canadian GLC lies above that for the U.S. (i.e., it is less

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[4]In the SIPP, interviewees were asked, "During the past 12 months, how many times did ... see or talk to a medical doctor or assistant?" In the GSS, interviewees were asked, "During the past 12 months, how many times did you see or talk to a family doctor or general practitioner about your own health? What about a medical specialist?"

[5]Data limitations in Canada prohibit us from performing a comparison using more recent data. All health databases in Canada collected after 1985 report income in only broad categories, rather than continuously. Categorical income data would limit our ability to control for differences in income in the subsequent work. In addition, the SIPP is the only U.S. database with information on health care utilization variables which also has a broad set of potential instruments for insurance status, which are required for the analysis to be performed in the following sections.

[6]The left endpoints of the GLCs indicate the percentage of persons with zero visits in each country. The right endpoints represent the mean number of visits in each subgroup.

bowed downward), the distribution of physician visits is more unequal in the U.S.[7] These findings are consistent with the view that universal health insurance coverage in Canada both increases and equalizes access to health care in Canada. If the lack of insurance coverage prevents Americans from seeing a physician, then a small fraction of the population will have a larger number of visits, as shown in Figure 1(a). Figure 1(b) shows that qualitatively similar patterns are found for females under 65, although they have a higher average number of visits and a much smaller fraction with zero visits in both countries than males.

The existence of universal insurance coverage for individuals 65 and over in the U.S. suggests that the distribution of physician services should be equalized across the two countries for the elderly population. Figures 1(c) and 1(d) do show that the cross-country differences in the fraction of individuals with zero visits over the past year declines for this age group. However, visits are still more equally distributed in Canada than in the U.S. The disparities for those over 65 may reflect the presence of co-payments and deductibles in the U.S. Medicare system, which raise the cost of seeking physician advice relative to Canada.

Given the results for broad age-sex groups, we attempt to determine whether the differences reflect the lack of access to care for particular subgroups in the U.S. First, blacks have been found to utilize less physician services than whites in the U.S. (Cunningham & Cornelius. 1993). In addition, blacks generally have lower family income and are less likely to have health insurance. Consequently, we compare nonwhite and white Americans separately with Canadians under 65.[8] Figures 2(a) and 2(b) indicate that although nonwhite males and females

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[7]In this and other figures to follow, the differences between the Canadian and U.S. GLCs are also found in the Lorenz curves for each county.

[8]The U.S. sample contained too few blacks over 65 to conduct a similar analysis for this age group.

appear to have slightly less access to care, the distribution of visits is approximately the same across racial groups. In particular, the GLCs for nonwhite and white females are virtually identical. The cross-country differences do not result from racial differences in the U.S.

The second sub-group likely to have less access to care are the uninsured in the U.S. Figures 2(c) and 2(d) plot the GLC by insurance status for males and females, respectively.[9] The figures confirm that at least some of the Canadian/American differences found in the previous figures can be attributed to variations in insurance status in the U.S. The uninsured are substantially worse off both in terms of access and number of physician visits. For example, over 50 percent of uninsured males had zero visits over the past 12 months, as opposed to 38 percent of insured American males. As was true for those 65 and over, however, it is still the case that insured Americans are more likely to make zero visits and have a more unequal distribution of visits than their Canadian counterparts, as is shown by the Lorenz curves in Figures [A1] and [A2] in the Appendix. Again, this may reflect deductibles and copayments of American insurance schemes which are not present in Canada. In the SIPP data, only 13 percent of individuals with private insurance report that it covers the complete cost of a doctor visit.

Overall, the figures have shown substantial differences across countries in the utilization of physician services in each of the three dimensions described at the beginning of this section. We conjecture that this reflects differences in the costs to the individual of the health care system in the two countries. However, they may also reflect underlying variations in the demographic and health characteristics of the two populations. To investigate these issues further, we develop a formal empirical model of an individual's utilization of physician services in the next section.

[9] Uninsured individuals are those reporting they were not covered by any form of health insurance (private, Medicare, Medicaid, or any other form) in 1984.

3. *AN ECONOMIC MODEL OF THE UTILIZATION OF PHYSICIAN SERVICES*

The previous section described cross-country differences in the utilization of physician services. Placing a more direct economic interpretation on these differences requires a more structured econometric approach. In this section, we introduce a simple, economic model (developed by Cameron and Heckman (1993) to investigate schooling attainment) that we have adapted to analyze health-care utilization. Assume that the total costs of health care to an individual $c(h|x,\nu)$ are increasing and weakly convex in the number of visits h. Costs also depend upon a vector of background characteristics x and a person-specific effect ν. The total benefits from outpatient care are given by the benefit function $b(h|x,\epsilon)$, which is increasing in the number of visits h but at a weakly decreasing rate. Benefits also depend upon a vector of background characteristics x and a person-specific effect ϵ. The optimal choice of health care is the solution to

$$(3.1)\ \max_{h}\ b(h|x,\epsilon)-c(h|x,\nu).$$

Suppose the benefit and cost functions are multiplicatively separable in each of their respective components so that

$$(3.2)\ b(h|x,\epsilon)=b(h)\,\psi(x)\,\epsilon$$

$$(3.3)\ c(h|x,\nu)=c(h)\,\phi(x)\,\nu$$

where

$$\psi(x)\geq 0;\ \ \phi(x)\geq 0;$$

The solution to (3.1) is straightforward. When $\epsilon \geq 0$ and $\nu \geq 0$ (i.e., a person derives non-negative benefit from visiting a physician and incurs a non-negative cost), an individual makes h visits to the physician if

$$(3.4)\quad b(h)\psi(x)\epsilon - c(h)\phi(x)\nu \geq 0$$

$$(3.5)\quad b(h)\psi(x)\epsilon - c(h)\phi(x)\nu \geq b(h-1)\psi(x)\epsilon - c(h-1)\phi(x)\nu$$

and

$$(3.6)\quad b(h)\psi(x)\epsilon - c(h)\phi(x)\nu \geq b(h+1)\psi(x)\epsilon - c(h+1)\phi(x)\nu.$$

Thus, a person making h visits to the physician satisfies the following inequalities

$$\frac{(b(h)-b(h-1))\psi(x)}{(c(h)-c(h-1))\phi(x)} \geq \frac{\nu}{\epsilon}$$

$$(3.7)\quad \frac{(b(h+1)-b(h))\psi(x)}{(c(h+1)-c(h))\phi(x)} \leq \frac{\nu}{\epsilon}$$

$$\frac{b(h)\psi(x)}{c(h)\phi(x)} \geq \frac{\nu}{\epsilon}.$$

These inequalities partition ν/ϵ into intervals:

$$(3.8)\quad \frac{(b(h+1)-b(h))\,\psi(x)}{(c(h+1)-c(h))\,\phi(x)} \leq \frac{\nu}{\epsilon} \leq \min\{\frac{b(h)\,\psi(x)}{c(h)\,\phi(x)}, \frac{(b(h)-b(h-1))\,\psi(x)}{(c(h)-c(h-1))\,\phi(x)}\},\ h=0,1,2,...$$

Let

$$(3.9)\quad \exp(l(h)) = \frac{b(h+1)-b(h)}{c(h+1)-c(h)}.$$

The probability that an individual with characteristics x makes h visits to the physician is:

$$(3.10)\quad Pr[H=h|x] = Pr[l(h-1)+\log(\frac{\psi(x)}{\phi(x)}) \leq \epsilon^* \leq l(h)+\log(\frac{\psi(x)}{\phi(x)})],$$

where $\epsilon^* = \log(\nu) - \log(\epsilon)$. If ϵ^* is distributed normally with mean zero and variance σ^2, and $\psi(x)/\phi(x)$ = $\exp(x\beta)$, then

$$(3.11)\quad Pr[H=h|x] = F[\frac{l(h-1)+x\beta}{\sigma}] - F[\frac{l(h)+x\beta}{\sigma}],$$

which is an ordered probit model where $F[.]$ is the standard normal distribution function. Estimates of the parameters of the model, including the $l(h)$ functions, may then be obtained using the method of maximum likelihood.

Note that $\exp(l(h))$ represents the ratio of the incremental benefit of an additional physician visit to the incremental cost. Moreover, the economic structure of the model implies that

$$l(h+1)<l(h),\quad h=0,1,2,...$$

If the distribution of person-specific heterogeneity is common across the Canadian and American populations, then the $l(h)$ functions will differ across the two countries because they represent differences in the marginal benefit/marginal cost ratio between the two health care systems. For example, suppose $l(h)$ is found to be larger in Canada than in the U.S. This may reflect the greater marginal benefit, conditional upon covariates x, of a physician visit in Canada, or the higher cost of a visit in the U.S., or both. To the extent that the benefits of physician visits are similar in the two countries, differences in $l(h)$ will reflect cost differences across the two health care systems.

4. *RESULTS*

In this section, we present the estimates of the ordered probit model given by equation (3.11) derived from the model of visits to the physician. The dependent variable is physician visits h, while the characteristic vector x includes the demographic variables age, household size, marital status, education, and race (immigrant status in Canada). Linear, quadratic, and cubic transformations of household income are also included, as well as an indicator variable for observations missing income data in the Canadian dataset. To control for the impact of variations in health status across countries on h, measures of chronic health limitations are also included in x,[10] as is a measure of the supply of physician services in the individual's state or province.

Using the parameter estimates, we construct GLCs for a variety of individual types in order to determine the extent to which the aggregate differences shown in Figure 1 may be attributed to variation in individual characteristics across the two countries, or to differences across countries in the effects of these characteristics on physician visits. After constructing the fitted GLCs, we compare the $l(h)$ functions estimated from the ordered probit model to determine whether Americans face relatively lower marginal benefits and/or higher marginal costs of physician visits

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[10]Dummy variables for activities of daily living (ADLs) and chronic limitations are included. The ADL dummy equals 1 if an individual has a problem with one or more of the following activities: walking, climbing stairs, carrying, seeing, or hearing. For Canada chronic disability is present if the individual ever had high blood pressure or heart trouble or has diabetes, arthritis/rheumatism/bursitis, and is limited in activity due to a long-term physical condition of health problem. Chronic disability is present for an American if the individual has arthritis/rheumatism, diabetes, heart trouble, high blood pressure, or lung/respiratory trouble such that the person needs help getting around/in or out of bed, or with light housework/meal preparation, or the problem limits work.

than their Canadian counterparts.

4.1 ORDERED PROBIT ESTIMATES

The estimates from the ordered probit models for males and females aged 20-64 and 65 and over are presented in Tables 1A and 1B, respectively. Initial estimation of the model suggested that different coefficients should be allowed for the probability of zero visits versus h equal to one or more. In each case, a positive coefficient implies that an increase in the variable is associated with an increase in the probability of a higher number of visits (i.e., a decrease in the probability of zero visits, increase in h). The tables yield a number of notable results. First, family income generally has a significant effect only on the probability of having a physician visit in the past year, and not on the number of visits. Second, columns (1), (2), (5), and (6) of Table 1A show that education has a significantly positive impact on the probability of more physician visits in the U.S. In contrast, the education status coefficients are smaller in magnitude and are less precisely estimated in Canada. One interpretation of this result is that education is a measure of an individual's permanent income. Support for this interpretation is provided in Table 1B, which shows that for those over age 64 who are covered by some form of insurance in both countries, education has a significant impact only on the probability of zero visits for U.S. males.

With regard to the remaining estimates, note that the effect of chronic health status on physician visits is fairly similar across countries in each age-sex group. A striking difference is found for the doctors per capita measure. The even numbered columns show that the variable is significant and positive for all groups in the U.S. and only one (females 65+) in Canada, implying that a greater supply of physicians is associated with an increased probability of more visits among Americans. This may reflect physician induced demand in the U.S. (Fuchs. 1978).[11]

4.2 FITTED GENERALIZED LORENZ CURVES

The GLCs from section 2 indicated that the distribution of physician services is more unequal for each age and sex group in the U.S. than in Canada. In addition, U.S. individuals have less physician visits on average, and a higher proportion of Americans report zero visits. These cross-country differences may be due to systematic differences in demographic characteristics or health status in these two populations. For instance, a wider income distribution in the U.S. could explain the more unequal distribution of services. In addition, Americans may be healthier, so that less of them need to visit the doctor.

Using the ordered probit estimates we can construct GLCs for each of the two countries utilizing a standardized set of characteristics. We can then compare the probability distribution of physician visits we would expect for a given individual living in Canada versus the U.S. To derive these fitted GLCs, recall that the ordered probit estimates yield the probability of each number of visits for a given set of x's. These probabilities can be summed to yield the predicted cumulative proportion of the population with each number of visits on the x-axis of the GLC. These probabilities can also be used to calculate the expected number of physician visits along the y-axis. As a base comparison group, we choose the mean values of the U.S. characteristic vector x for the appropriate age-sex sample.

Fitted GLCs describing the distribution of physician visits in Canada and the U.S. for the four major age-sex groups are presented in Figure 3. The left endpoints indicate the probability of zero visits in each country. For each age and sex group, the probability of zero visits is higher

[11] Physician induced demand may be limited in Canada, due to the caps on total physician salaries set by each province.

in the U.S. than in Canada. Thus, in spite of the U.S. Medicare program, Americans over 65 have less access to physician care than their Canadian counterparts. However, Figure 3 also reveals that disparities in access between Canada and the U.S. are wider for those under 65 than for the elderly. Thus, U.S. Medicare does appear to improve access for those over 65 relative to the mixed system of public and private insurance faced by those under 65.

The right endpoints in Figure 3 indicate the mean number of physician visits expected in each country. The mean number of visits is approximately equal for females under age 65 in Canada and the U.S. However, for all other age groups, Canadians have more visits to the doctor than their U.S. counterparts. These results are consistent with analyses performed using aggregate data by Fuchs and Hahn (1990), which demonstrated that Canadians receive more physician services per capita than Americans. Our analysis goes beyond their work by demonstrating that the cross-country disparity is not attributable to differences in health status or socio-demographic characteristics in Canada and the U.S.

The more inequitable distribution of services in the U.S. implies that a lower average number of physician services are concentrated among a smaller share of the population in the U.S. versus Canada. Taken in conjunction with our finding that Americans have lower access to physician care, these results are consistent with a scenario in which individuals in the U.S. do not obtain as much preventive or early acute care as comparable Canadians, which then leads U.S. patients to require relatively higher utilization of services when their illness becomes more severe. On the other hand, the results may simply imply that Americans on the lower end of the distribution *always* receive disproportionately less physician care than their Canadian counterparts throughout the course of illness. Our data are insufficient to distinguish between these two scenarios.

Figure 3, as well as Figures A3 to A6 reveal that in each case the Canadian GLC (and corresponding Lorenz curve) lies above the U.S. GLC, indicating that the distribution of physician visits is more unequal in the U.S. Thus, the lower access and utilization of services in the U.S. is also distributed more inequitably relative to Canada. This is also true for females over 65.

Finally, neither the GLCs in Canada nor those for the U.S. have a constant slope, indicating that inequity in the distribution of physician visits exists for both countries. But keep in mind that these GLCs have been drawn holding the x's constant, so that the observed inequity in both countries is not attributable to observed differences in health status. Some of the remaining inequity in both countries may be due to unobserved differences in health status across patients, such as differences in the occurrence of acute illness events, or the relative severity of chronic illnesses. However, our assertion is that the disparity observed *between* Canada and the U.S. is attributable to the differing health-care systems.

4.3 CAN RACE OR INSURANCE STATUS EXPLAIN THE CROSS-COUNTRY DIFFERENCES FOR THOSE UNDER 65?

To determine whether the disparities in the distribution of physician visits between the two countries reflects racial differences in care in the U.S., we estimated the ordered probit model separately for whites and blacks under age 65, and used the estimates to graph fitted GLCs for these two groups. The results appear in Figure 4.[12] As with the unconditional GLCs, the fitted GLCs in Figures 4(a) and 4(b) indicate that nonwhite males and females are somewhat more likely to have zero visits, but the distribution of visits is relatively similar across racial groups. Thus, nonwhite males and females with characteristics similar to their white counterparts are predicted to have relatively similar use of physician services in the U.S. Yet both racial groups have lower

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[12] The ordered probit estimates are available from the authors upon request.

utilization and a more unequal distribution of physician services than Canadians. Differences across countries are not due to race composition in the U.S.

To examine the influence of health insurance coverage in the U.S. on the disparities in the GLCs for those under 65, we estimated the ordered probit model separately for individuals reporting some form of insurance coverage, and for the uninsured. A variety of studies have suggested that unobservables influencing the demand for health care may be correlated with those affecting insurance status (Manning, Newhouse, Duan, Keeler, Leibowitz, & Marquis. 1987; Cameron, Trivedi, Milne, & Piggott. 1988; Goldman. 1995). Consequently, we jointly estimate the probability that an individual is covered by insurance and the number of insured and uninsured physician visits, assuming that the unobservables are jointly normally distributed.[13] Details of the likelihood function for this model are provided in Appendix 2. The results, which are available from the authors upon request, provide evidence of adverse selection into insurance coverage for females. Unobservables which increase the probability of insurance coverage are significantly positively related to those which increase the probability of more physician visits among insured women. However, no significant relationship is found for men.

Using these estimates, Figures 4(c) and 4(d) graph fitted GLCs for insured and uninsured persons in the U.S. and Canada under age 65.[14] For males the fitted GLCs confirm the results of the raw data. Insured American men have greater access, greater utilization, and a more equal distribution of physician visits than uninsured American men, but their utilization is still below

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[13]The ordered probits for the number of physician visits for the insured and uninsured contain the same variables as before. In addition to these variables, the insurance status equation includes indicators for the household head's industry and occupation (Cameron, Trivedi, Milne, & Piggott. 1988). In addition, Gruber and Poterba (1994) show that the self-employed are much less likely to be covered by health insurance. Consequently, we also include an indicator for whether the head is self-employed, as well as dummies for the size of firm employing the head.

[14]Again, the mean characteristics of U.S. males and females ages 20 to 64 are used to construct the fitted GLCs.

that of similar Canadians, and more inequitable.[15] For females aged 20 to 64, we also find that Canadians have the highest access to care, followed by insured Americans, with uninsured American women having the lowest probability of a physician visit. But, contrary to the findings for males, insured U.S. women have a higher predicted mean number of visits than Canadian women, so that the GLCs for these two groups cross. Thus, for one socio-demographic subgroup, the U.S. system of health-care insurance does not lead to unambiguously lower social welfare than in Canada.

The higher utilization observed for most Canadians is consistent with the hypothesis that first-dollar insurance coverage for physician services lowers the relative marginal costs of utilization and increases demand for services. Lower relative marginal costs of physician visits may also contribute to more equitable distribution of physician services in Canada. Even insured American males ages 20 to 64 and the elderly covered by Medicare have less access, lower utilization, and a more unequal distribution of services than their Canadian counterparts. Thus, differences in insurance policies may also significantly affect the relative marginal costs of physician visits. In the next section, we use our ordered probit estimates to compare the relative marginal benefits and costs of physician visits in Canada and the U.S.

4.4 CROSS-COUNTRY DIFFERENCES IN MARGINAL BENEFIT-MARGINAL COST RATIOS

Using equation (3.9), we know that $\exp(l(h)) * \exp(\bar{x}\hat{\beta})$ is the the ratio of the marginal benefit to the marginal cost of the h^{th} physician visit for individuals in a given country with characteristics $\bar{x}$. Comparing the benefit-cost ratios for Canada and the U.S. provides an estimate of the cost and/or benefit differences of the two health care systems. In the subsequent figures, the ratio of $\exp(l(h)) * \exp(\bar{x}\hat{\beta})$ for Canada to the same quantity for the U.S. is plotted against the

[15] This is also shown by the fitted Lorenz curves plotted in Figures A[7] and A[8].

number of physician visits. If the Canada-U.S. ratio is greater than one, then the h^{th} visit in Canada carries a higher incremental benefit and/or lower cost.

Note that we cannot use these marginal benefit-marginal cost estimates to determine whether there is "efficient" utilization of physician services in either country. Our framework begins with the assumption that each patient chooses the optimal level of services, where marginal benefit equals marginal costs, which varies according to individual characteristics. We use these revealed optimal choices of individuals to draw a profile for a representative individual, of the relative marginal benefits and marginal costs of each subsequent visit to the doctor. Thus, we cannot say whether each additional visit is justified on social efficiency grounds; but we can say whether the marginal benefit to marginal cost ratio for the additional visit is higher in Canada or the U.S.

Figure 5(a) plots the Canada-U.S. ratio for 20-64 year old males and females. The plot shows that the marginal benefit-marginal cost ratio of going from zero to one physician visit is more than 50 percent higher for Canadian females and over 25 percent higher for Canadian males versus their U.S. counterparts. After 2 visits, the difference in the ratio of marginal benefits to marginal costs in Canada versus the U.S. narrows, so that the relative marginal benefit to marginal cost ratios are almost equal for the third and subsequent visits.

The observed differences across countries can be attributed to relatively higher marginal benefits of physician visits, and/or lower relative marginal costs for these visits in Canada versus the U.S.; we cannot separately identify these two terms. Yet despite the relatively large number of studies comparing health care in Canada and the U.S., we are unaware of any studies which demonstrate that the marginal benefit of a physician visit differs between these two countries. Fuchs and Hahn also found no definite evidence of significant differences in quality or intensity of outpatient physician care in Canada and the U.S. (1990). In addition, Canadian and most American physicians are reimbursed on a fee-for-service basis, so that they face the same economic incentives to maximize the number of patients seen.

On the other hand, more compelling evidence exists that the marginal cost of a physician visit is higher in the U.S. than in Canada. Uninsured Americans must bear the full cost of a physician visit, while outpatient vists are free to Canadian patients.[16] Even for U.S. patients who are insured, not all physician visits have zero marginal costs due to the presence of deductibles and coinsurance in most plans. The results above are consistent with the hypothesis that deductibles play a significant role in explaining observed differences in access between Canada and the U.S. The most significant difference in the ratio of marginal benefits to marginal costs between Canada and the U.S. is for the initial visit, where deductibles are likely to be effective for most insured visits. But as the number of visits increases, and the probability that insured patients have surpassed their deductible rises, the marginal benefit-marginal cost differential narrows and eventually disappears.

Given that the marginal benefit-marginal cost ratio becomes virtually equal for three or more visits, the results suggest that coinsurance rates play less of a role in limiting the number of physician visits in the U.S. versus Canada. If U.S. coinsurance rates indeed supressed the demand for physician services relative to Canada, we would expect the Canada-U.S. marginal benefit-marignal cost ratio in Figure 5(a) to remain above 1 *for all* physician visits.

At first glance this finding appears to contradict the results of the Rand Health Insurance Experiment (Manning, Newhouse, Duan, Keeler, Leibowitz, & Marquis. 1987), which found a

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[16]Canadian physicians are reimbursed directly by the government and must accept this reimbursement as payment in full.

significant price effect of coinsurance rates on the demand for physician services. But note that our framework incorporates *all* benefits and costs of a physician visit. For example, Fuchs and Hahn find fragmentary evidence that, relative to Canadian doctors, U.S. physicians may offer more attractive amenities to patients such as more desirable locations, more space per patient, newer furnishings, or more elaborate decor. Such amenities may increase the "psychic" benefit of a physician visit in the U.S. relative to Canada. Queues for a number of health care services have also been noted in Canada, which may increase the time costs of a physician visit (Coyte, Wright, Hawker, et al. 1994; Katz, Mizgala, & Welch. 1991; Naylor, Morgan, Levinton, et al. 1993). These non-monetary benefits and costs may service to balance out the cross-country ratio of marginal benefits to marginal costs of additional physician visits as the number of visits rises.

Figure 5(b) plots the ratio of Canada-U.S. marginal benefit-marginal cost ratio for individuals 65 years and over. In all cases, the ratio of marginal benefits to marginal costs is higher in Canada than in the U.S. These results are consistent with the hypothesis that the marginal cost of a physician visit is higher in the U.S., even in the presence of Medicare. Coverage under Medicare Part B for physician visits still requires payment of a deductible, and a 20 percent coinsurance rate. In addition, U.S. physicians are allowed to balance bill Medicare patients, a practice which is forbidden in Canada. Finally, the U.S. Medicare program does not cover a variety of preventive services, such as a complete physical examination for history and evaluation, laboratory tests for cholestorol or occult blood in stool, or counseling for health risks (Burton, Steinwachs, German, et al. 1995). The combined additional costs that the U.S. elderly face relative to their Canadian counterparts can be significant, as revealed by data from the 1987 U.S. National Medical Expenditure Survey, which indicates that persons 65 and older covered by Medicare and private insurance still paid 24 percent out of pocket for ambulatory physician services (Hahn & Lefkowitz. 1992). Thus relative to the U.S., universal health insurance in Canada implies differing relative marginal costs of a physician visit for both the young and elderly populations.

Figure 5(c) plots the white-nonwhite marginal benefit-marginal cost ratio for U.S. males and females. For both sexes, the marginal benefit-marginal cost ratio is remarkably equal. Differences in treatment of whites and nonwhites who are otherwise similar in the U.S. health care system appear negligible when compared to Canada-U.S. disparities. Figures 5(d) and 5(e) plot the Canada-U.S. marginal benefit-marginal cost ratio separately for U.S. insured and uninsured males and females respectively. The graphs indicate substantially higher Canada-U.S. marginal benefit-marginal costs ratios for uninsured versus insured Americans. This result is consistent with the hypothesis that the marginal costs of a visit to the doctor are higher for uninsured versus insured Americans.

5. *CONCLUSION*

Policy makers, academics, and journalists have actively engaged in comparisons of the Canadian and U.S. health-care systems. These cross-country comparisons seem logical, given that both countries have a similar standard of living and share many of the same cultural and ethical values. Medical training is also similar in Canada and the U.S., with each country recognizing the equivalence of training received in the other. However, Canada and the U.S. differ greatly in their method of payment for health care services. Canada has opted for universal health insurance coverage, while the U.S. has a mixture of public and private insurance, which leads to lack of insurance coverage for a significant share of the population.

In light of these significant differences in health care coverage, we have used population-based survey data to compare the distribution of physician visits in Canada and the U.S. We find that Canadians have greater access to physician services and more utilization. Moreover, the lower number of visits in the U.S. is distributed more inequitably. While insured Americans have greater access than uninsured Americans, they still have less access to services than comparable Canadians. In addition, insured males in the U.S. have fewer physician visits and a more inequitable distribution of these visits than Canadian men. The observed differences across countries are consistent with a model in which the ratio of marginal benefits to marginal costs for an initial physician visit is higher in Canada than the U.S. Even for insured Americans the presence of deductibles may limit access relative to that observed in Canada.

Despite well-publicized findings that Canadians must queue for surgical procedures such as coronary artery bypass graft surgery and that U.S. patients who have suffered a myocardial infarction receive more aggressive care than their Canadian counterparts, we find that overall Canadians receive more outpatient services than individuals in the U.S. Our economic framework indicates that one of the most striking differences between the two countries is in the ratio of marginal benefits to marginal costs of the initial physician visit each year. A discrepancy of just one visit per year for a mostly healthy population may seem inconsequential. However, rapid improvements in medical care have increased the potential for preventive treatment to improve the overall health of the population. For example, Coronary Heart Disease is the primary cause of mortality in North America (National Center for Health Statistics. 1989); physicians can utilize one visit to perform hypertension or cholesterol screening which may reveal the need for further treatment, or counsel the patient regarding smoking habits. Annual visits can also be used for Papanicalaou, mammography, fecal occult blood tests, or prostate screening to prevent cancer. Whether the patient visits the doctor once a year for a regular checkup or for a minor ailment, the doctor would have the opportunity to perform or recommend screening tests which were deemed necessary.

Our data prevents us from analyzing more specific types of physician care; for instance the distinction between visits to a general practitioner versus a specialist, or more expensive versus less expensive interventions. Such questions must be analyzed using provider-based databases, which provide more detailed medical data, but yield less information on socio-demographic status and the characteristics of those who do not gain access to the health care system. Concurrent efforts to analyze population-based and provider-based datasets will yield the most informative picture regarding access and the distribution of health care services in the future.

TABLE 1A ORDERED PROBIT ESTIMATES FOR U.S. AND CANADIAN MALES AND FEMALES AGED 20-64 DEPENDENT VARIABLE IS NUMBER OF PHYSICIAN VISITS								
Variables	MALES				FEMALES			
	U.S.		CANADA		U.S.		CANADA	
	0 Visits (1)	1+Visits (2)	0 Visits (3)	1+Visits (4)	0 Visits (5)	1+Visits (6)	0 Visits (7)	1+Visits (8)
Age 30	0.058 (1.798)	0.113 (3.564)	-0.059 (-0.963)	-0.019 (-0.389)	-0.077 (-2.394)	-0.118 (-4.486)	-0.212 (-3.085)	-0.173 (-3.929)
Age 40	0.082 (2.216)	0.121 (3.335)	-0.090 (-1.231)	0.031 (0.494)	-0.258 (-7.435)	-0.292 (-9.972)	-0.434 (-5.575)	-0.309 (-5.603)
Age 50	0.140 (3.607)	0.244 (6.540)	0.052 (0.634)	0.124 (1.792)	-0.222 (-5.697)	-0.247 (-7.579)	-0.379 (-4.592)	-0.286 (-4.975)
Age 60	0.209 (3.934)	0.292 (5.977)	0.220 (1.915)	0.314 (3.307)	-0.281 (-5.624)	-0.305 (-7.228)	-0.251 (-2.480)	-0.108 (-1.590)
HH Size=2	-0.129 (-2.716)	-0.110 (-2.430)	0.003 (0.033)	-0.053 (-0.765)	-0.138 (-2.753)	-0.143 (-3.472)	0.095 (1.052)	-0.153 (-2.549)
HH Size=3	-0.178 (-3.677)	-0.113 (-2.469)	-0.035 (-0.396)	-0.161 (-2.149)	-0.150 (-2.879)	-0.120 (-2.787)	0.164 (1.701)	-0.029 (-0.449)
HH Size=4	-0.260 (-5.512)	-0.185 (-4.097)	-0.058 (-0.697)	-0.148 (-2.064)	-0.367 (-7.156)	-0.301 (-7.094)	-0.050 (-0.536)	-0.118 (-1.796)
Income	0.237 (3.300)	0.096 (1.397)	0.232 (1.448)	0.140 (1.009)	0.197 (2.785)	-0.017 (-0.263)	-0.255 (-1.411)	-0.103 (-0.905)
$Income^2$	-0.071 (-1.886)	-0.047 (-1.321)	-0.058 (-1.273)	-0.049 (-1.225)	-0.089 (-2.452)	-0.019 (-0.542)	0.073 (1.327)	0.019 (0.534)
$Income^3$	0.0062 (1.169)	0.0068 (1.358)	0.004 (1.219)	0.0044 (1.326)	0.0097 (1.957)	0.0037 (0.723)	-0.0054 (-1.139)	-0.0006 (-0.184)
Miss Inc			0.192 (1.142)	0.103 (0.701)			-0.360 (-2.093)	-0.145 (-1.330)
Married	0.167 (5.532)	0.078 (2.611)	0.046 (0.732)	-0.023 (-0.416)	0.233 (8.441)	0.224 (9.615)	-0.045 (-0.661)	0.060 (1.333)
Docs per 1000	0.0015 (0.591)	0.0064 (2.649)	0.012 (1.101)	0.011 (1.263)	0.001 (0.425)	0.006 (3.046)	-0.0036 (-0.320)	-0.011 (-1.383)
HS Grad	0.123 (3.803)	0.052 (1.668)	0.020 (0.317)	0.010 (0.182)	0.096 (3.075)	0.036 (1.346)	0.102 (1.572)	0.012 (0.272)
Some Coll	0.216 (5.836)	0.133 (3.756)	0.165 (2.382)	0.160 (2.681)	0.188 (4.925)	0.103 (3.168)	0.109 (1.480)	0.026 (0.497)
Coll Grad	0.230 (5.897)	0.090 (2.405)	0.175 (2.214)	0.064 (0.936)	0.333 (7.748)	0.233 (6.557)	0.069 (0.720)	0.011 (0.159)
ADL Limitation	0.515 (14.034)	0.658 (20.488)	0.302 (3.961)	0.405 (6.877)	0.480 (13.753)	0.642 (23.165)	0.319 (4.500)	0.431 (9.497)
Chronic Limitation	0.646 (9.477)	0:677 (12.792)	0.840 (6.633)	0.902 (11.325)	0.554 (8.209)	0.615 (13.243)	0.503 (3.940)	0.867 (12.341)
Nonwhite/ foreign	-0.079 (-2.281)	-0.010 (-0.297)	0.089 (1.306)	0.143 (2.562)	-0.050 (-1.510)	0.011 (0.396)	0.046 (0.664)	0.074 (1.543)
Log-L	-21129.4		-6471.76		-27976.1		-9144.11	
N	11911		3308		13013		4092	

TABLE 1B
ORDERED PROBIT ESTIMATES FOR U.S. AND CANADIAN MALES AND FEMALES AGED 65+
DEPENDENT VARIABLE IS NUMBER OF PHYSICIAN VISITS

Variables	MALES				FEMALES			
	U.S.		CANADA		U.S.		CANADA	
	0 Visits (1)	1+Visits (2)	0 Visits (3)	1+Visits (4)	0 Visits (5)	1+Visits (6)	0 Visits (7)	1+Visits (8)
Age 70	0.087 (1.346)	0.043 (0.795)	0.197 (2.250)	0.070 (1.128)	0.131 (2.202)	0.079 (1.730)	0.007 (0.076)	0.128 (2.056)
Age 80	0.076 (0.926)	0.004 (0.063)	-0.014 (-0.113)	-0.054 (-0.603)	0.011 (0.154)	-0.041 (-0.741)	-0.155 (-1.352)	0.043 (0.520)
HH Size=2	-0.085 (-0.763)	-0.075 (-0.766)	0.159 (1.109)	0.141 (1.246)	-0.129 (-1.545)	-0.046 (-0.711)	-0.078 (-0.675)	0.021 (0.265)
HH Size=3	-0.152 (-1.160)	-0.168 (-1.472)	0.072 (0.431)	0.119 (0.915)	-0.200 (-1.868)	-0.071 (-0.840)	0.126 (0.755)	-0.026 (-0.233)
HH Size=4	-0.335 (-2.475)	-0.242 (-1.978)	0.063 (0.354)	0.093 (0.684)	-0.255 (-2.122)	-0.150 (-1.643)	-0.018 (-0.120)	-0.056 (-0.539)
Income	0.715 (2.817)	0.163 (1.015)	-0.496 (-1.617)	0.008 (0.036)	0.781 (3.244)	0.234 (1.651)	0.023 (0.086)	-0.156 (-0.777)
$Income^2$	-0.356 (-2.111)	-0.062 (-0.764)	0.187 (1.891)	-0.015 (-0.218)	-0.414 (-2.520)	-0.125 (-1.658)	0.023 (0.233)	0.041 (0.576)
$Income^3$	0.045 (1.522)	0.006 (0.626)	-0.017 (-1.913)	0.0014 (0.227)	0.057 (1.882)	0.015 (1.496)	-0.005 (-0.478)	-0.003 (-0.530)
Miss Inc			-0.378 (-1.445)	-0.026 (-0.142)			0.052 (0.261)	-0.233 (-1.580)
Married	0.065 (0.710)	0.077 (0.975)	0.128 (1.009)	0.002 (0.019)	0.108 (1.471)	0.098 (1.701)	0.118 (1.008)	0.021 (0.271)
Docs per 1000	-0.0014 (-0.199)	0.014 (2.487)	-0.0014 (-0.083)	0.015 (1.247)	0.017 (3.338)	0.014 (3.376)	0.014 (0.849)	0.022 (1.907)
HS Grad	0.105 (1.526)	-0.021 (-0.366)	-0.048 (-0.428)	-0.016 (-0.184)	0.024 (0.392)	-0.029 (-0.627)	-0.036 (-0.395)	-0.052 (-0.779)
Some Coll	0.216 (1.889)	0.041 (0.460)	0.059 (0.342)	-0.186 (-1.626)	0.012 (0.130)	0.003 (0.035)	0.067 (0.491)	-0.037 (-0.386)
Coll Grad	0.244 (2.270)	0.059 (0.688)	-0.121 (-0.683)	-0.034 (-0.236)	0.146 (1.448)	0.116 (1.561)	0.007 (0.033)	-0.218 (-1.525)
ADL Limitation	0.345 (5.388)	0.490 (9.489)	0.243 (2.880)	0.219 (3.466)	0.568 (9.732)	0.679 (15.184)	0.360 (4.005)	0.377 (5.889)
Chronic Limitation	0.391 (4.736)	0.511 (7.888)	0.401 (3.916)	0.641 (9.385)	0.427 (5.795)	0.445 (8.617)	0.471 (4.809)	0.630 (9.875)
Nonwhite/ foreign	0.015 (0.164)	0.057 (0.727)	0.171 (1.660)	0.135 (1.887)	0.158 (1.935)	0.210 (3.359)	0.071 (0.732)	-0.052 (-0.784)
Log-L	-4935.23		-3427.27		-7219.80		-3962.50	
N	2155		1446		3105		1631	

APPENDIX 1 - DESCRIPTION OF THE SIPP AND GSS DATA SETS

The primary data sources for the analysis are the 1984 panel of the Survey of Income and Program Participation (SIPP) in the United States, and the 1986 General Social Survey (GSS) of Canada. The 1984 SIPP is a 3-year panel survey consisting of 9 four-month waves covering the period from 1984 to 1986. The survey is designed to be a random sample of non-institutionalized individuals in the U.S. We were concerned that there may have been non-random sample attrition in the SIPP. Consequently, we also estimated our models using the sample weights provided for each wave of the survey. The parameter estimates using the weighted data were identical to the third decimal place to the unweighted estimates. Consequently, we report the unweighted estimates. Each wave of the SIPP consisted of a core questionaire (asked each wave) and a topical module which changed from wave to wave. The demographic and income data are derived from the core questionaire. The information on health care utilization and insurance status is derived from the wave 3 Health and Disability topical module. The topical module asked detailed questions regarding the individual's functional status, including activity of daily living (ADL) limitations such as whether the individual can climb a flight of stairs. These responses were used to construct the ADL limitation variable as described in footnote 10. In addition, respondents were queried as to the main health condition which prevented them from undertaking certain tasks. These responses were used to construct the Chronic limitation variable as described in footnote 10. Finally, the Health and Disability module asked respondents to list the number of times they had seen a doctor in the past year, as well as a detailed set of questions concerning whether the individual had private insurance coverage, the extent of such coverage, whether the individual had public coverage such as Medicare or Medicaid, and when the individual was last covered by insurance if they were not currently. Responses to these questions were used to construct our insurance indicator.

The data for Canada are taken from the 1985 GSS. The data set is a random sample of Canadians, with an oversampling of individuals aged 65 and older. This survey is applied to a different set of individuals each year and consists of a core set of questions on demographic characteristics and income, and a topical module which varies by year. The 1985 topical module was Health. The primary advantage of the health module of the 1985 GSS is that the questionaire is very similar to that in the Health and Disability module of the 1984 SIPP. In particular, individuals were asked to list the number of physician visits in the previous year, and were queried as to ADL and chronic limitations. Responses to these questions were used to construct the corresponding variables used in the analysis.

We supplemented the SIPP and GSS data with information on the number of doctors per capita in the individual's state or province of residence. Information on the number of physicians per capita in Canadian provinces was obtained from unpublished data produced by the Health Information Dividsion, Department of National Health and Welfare, in Ottawa Ontario. Figures on physicians per capita in U.S. states was obtained from the annual publication Health, United States produced by the National Center for Health Statistics.

APPENDIX 2 - LIKELIHOOD FUNCTION

This appendix describes the construction of the likelihood function for the ordered probit model with sample selection based on insurance status described in section IV.2. Suppose the determinants of whether the individual is covered by insurance is given by the reduced form equation

$$(A1)\quad I_i^* = Z_i\gamma + u_i$$

where the vector of observed characteristics influencing insurance coverage, Z_i, include the x_i variables from the utilization equations. In addition, Z_i includes indicators for the household head's occupation, industry, self-employment status, and size of the firm at which the head is employed. The individual is observed to be covered by insurance if the latent variable I_i^* is greater than zero. The dummy indicator $I_i = 1$ if the individual is covered, and zero otherwise.

To construct the likelihood function, let ε_I^* denote the unobservables influencing utilization among the insured, and ε_N^* denote the unobservables influencing utilization among the uninsured. The I and N subscripts will be used to denote parameters from the insured and uninsured utilization equations. The likelihood function is based on the joint probability of observing a certain number of physician visits, h, and insurance coverage. As in other sample selection models utilizing cross-sectional data, cov(ε_I^*, ε_N^*) cannot be identified and is set equal to zero (Maddala. 1983). Given this restriction, if the unobservables are jointly normally distributed, the probability of observing h physician visits by an individual with health insurance is given by:

$$(A2)\quad G_I(H_i = h, I_i = 1) = \int_{-Z_i\gamma}^{\infty} \int_{l_I(h-1)-x_i\beta_I}^{l_I(h)-x_i\beta_I} f_I(\varepsilon_I^*, u)\, d\varepsilon_I^*\, du,$$

where $f_I(.,.)$ is a bivariate normal density function. The probability of observing *h* visits by an uninsured individual is similarly given by:

$$(A3)\quad G_N(H_i=h,I_i=0)=\int_{-\infty}^{-Z_i\gamma}\int_{l_N(h-1)-x_i\beta_N}^{l_N(h)-x_i\beta_N} f_N(\varepsilon_N^*,u)\,d\varepsilon_N^*\,du,$$

where $f_N(.,.)$ is a bivariate normal density function. Equations (A2) and (A3) may be used to construct the likelihood function for the model:

$$(A4)\quad L=\prod_{i=1}^{N}\prod_{h=1}^{H}[G_I(H_i=h,I_i=1)^{d_{ih}}]^{I_i}[G_N(H_i=h,I_i=0)^{d_{ih}}]^{1-I_i}$$

where d_{ih} is an indicator which equals one if the individual has h physician visits.

REFERENCES

Burton, L.C., Steinwachs, D.M., German, P.S., Shapiro, S., Brant, L.J., Richards, T.M., & Clark, R.D. (1995). Preventive services for the elderly: Would coverage affect utilization and costs under Medicare? *American Journal of Public Health, 85,* 387-391.

Cameron, A.C., Trivedi, P.K., Milne, F., & Piggott, J. (1988). A microeconometric model of the demand for health care and health insurance in Australia. *Review of Economic Studies, 55,* 85-106.

Cameron, S., & Heckman, J. Life cycle schooling and educational selectivity: Models and evidence. Dept. of Economics, Univ. of Chicago. (1993).

Coyte, P.C., Wright, J., Hawker, G.A., Bombardier, C., Dittus, R.S., Paul, J.E., Freund, D.A., & Ho, E. (1994). Waiting times for knee-replacement surgery in the United States and Ontario. *The New England Journal of Medicine, 331,* 1068-1071.

Cunningham, P., & Cornelius, L. Agency for Health Care Policy and Research. Use of health care: Findings from the SAIAN and the Household Survey (AHCPR Pub. No. 93-0041). Public Health Service. (1993). 16, 1 p. National Medical Expenditure Survey Research Findings 16.

Evans, R., Lomas, J., Barer, M., Labelle, R., Fooks, C., Stoddart, G., Anderson, G., Feeny, D., Gafni, A., Torrance, G., & Tholl, W. (1989). Controlling health expenditures -the Canadian reality. *The New England Journal of Medicine, 320,* 571-577.

Fuchs, V., & Hahn, J. (1990). How does Canada do it? A comparison of expenditures for physicians' services in the United States and Canada. *The New England Journal of Medicine,* 323 *(13),* 884-890.

Fuchs, V.R. (1978). The supply of surgeons and the demand for operations. *Journal of Human Resources, 13,* 35-56.

Goldman, D. (1995). Managed care as a public cost-containment mechanism. *RAND Journal of Economics, 26,* 277-295.

Gruber, J., & Poterba, J. (1994). Tax incentives and the decision to purchase health insurance: evidence from the self-employed. *Quarterly Journal of Economics, 109,* 701-734.

Hahn, B., & Lefkowitz, D. Agency for Health Care Policy and Research. Annual expenses and sources of payment for health care services (AHCPR Pub. No. 93-0007). Public Health Service. (1992). 1 p. National Medical Expenditure Survey Research Findings 14.

Katz, S.J., Mizgala, H.F., & Welch, H.G. (1991). British Columbia sends patients to Seattle for coronary artery surgery. *The Journal of the American Medical Association, 266,* 1108-1111.

Maddala, G.S. (1983). *Limited-dependent and qualitative variables in econometrics.* New York: Cambridge University Press.

Manning, W.G., Newhouse, J.P., Duan, N., Keeler, E.B., Leibowitz, A., & Marquis, M.S. (1987). Health insurance and the demand for medical care: evidence from a randomized experiment. *The American Economic Review, 77,* 251-277.

National Center for Health Statistics. Births, marriages, and deaths for August 1989; Monthly vital statistics report. US Dept of Health and Human Services. (1989). (PHS) 89-1120,

Naylor, C.D., Morgan, C.D., Levinton, C.M., Wheeler, S., Hunter, L., Klymciw, K., Baigrie, R.S., & Goldman, B.S. (1993). Waiting for coronary revascularization in Toronto: 2 years' experience with a regional referral office. *Canadian Medical Association Journal, 149,* 955-962.

Newhouse, J.P., Anderson, G., & Roos, L.L. (1988). Hospital spending in the United States and Canada: A comparison. *Health Affairs, 7,* 6-16.

Redelmeier, D., & Fuchs, V. (1993). Hospital Expenditure in the United States and Canada. *The New England Journal of Medicine, 328,* 772-778.

Rouleau, J.L., Moye, L.A., Pfeffer, M.A., Arnold, J.M.O., & et.al. (1993). A comparison of management patterns after acute myocardial infarction in Canada and the United States. *The New England Journal of Medicine, 328,* 779-784.

Shorrocks, A.F. (1983). Ranking income distributions. *Economica, 50,* 3-17.

Swartz, K. (1988). *The Uninsured and Workers Without Employer-Group Health Insurance.* monograph, Washington D.C. The Urban Institute, 3789-02, August 1988.

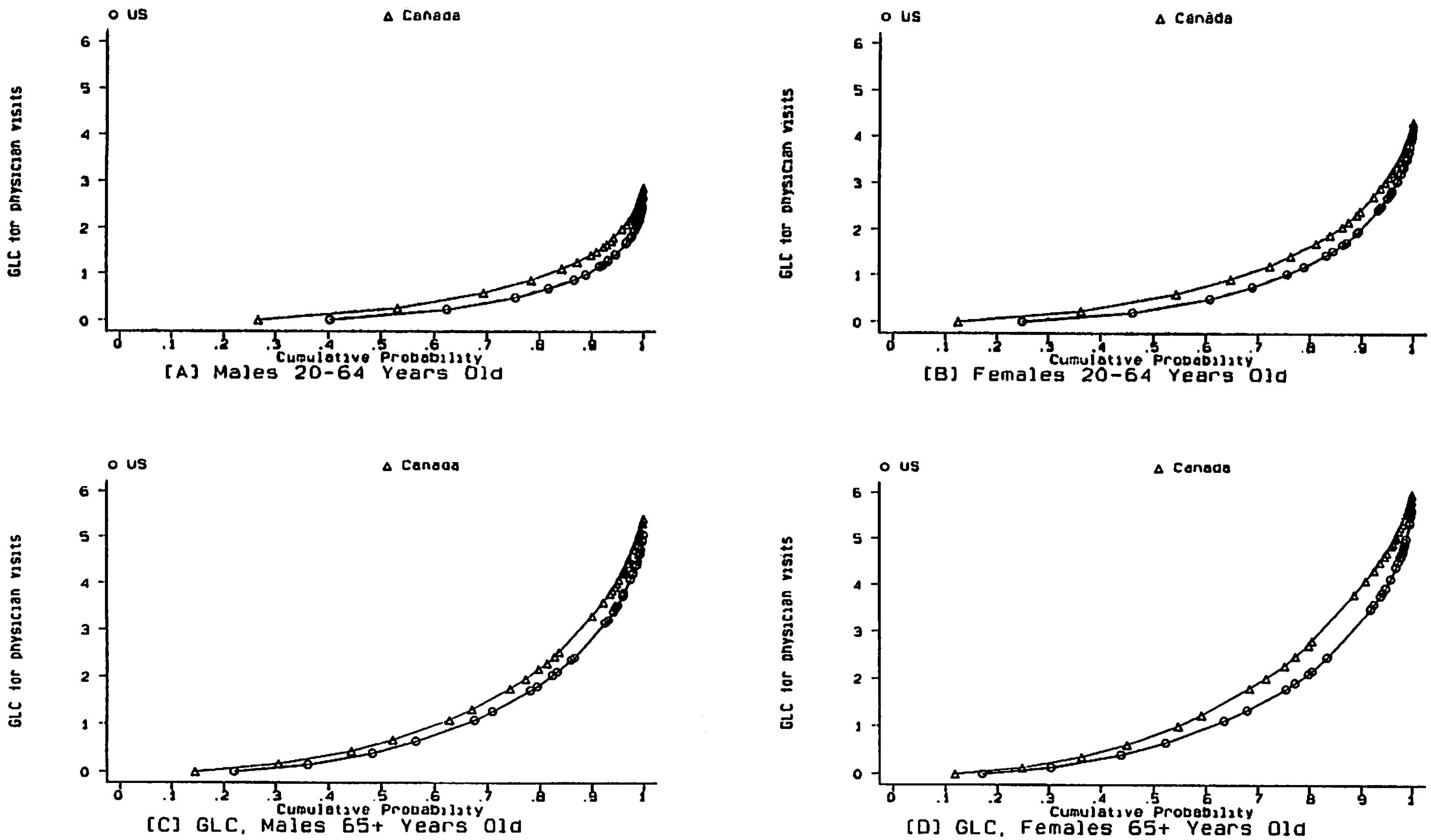


Figure 1
GENERALIZED LORENZ CURVES, BASE GROUPS

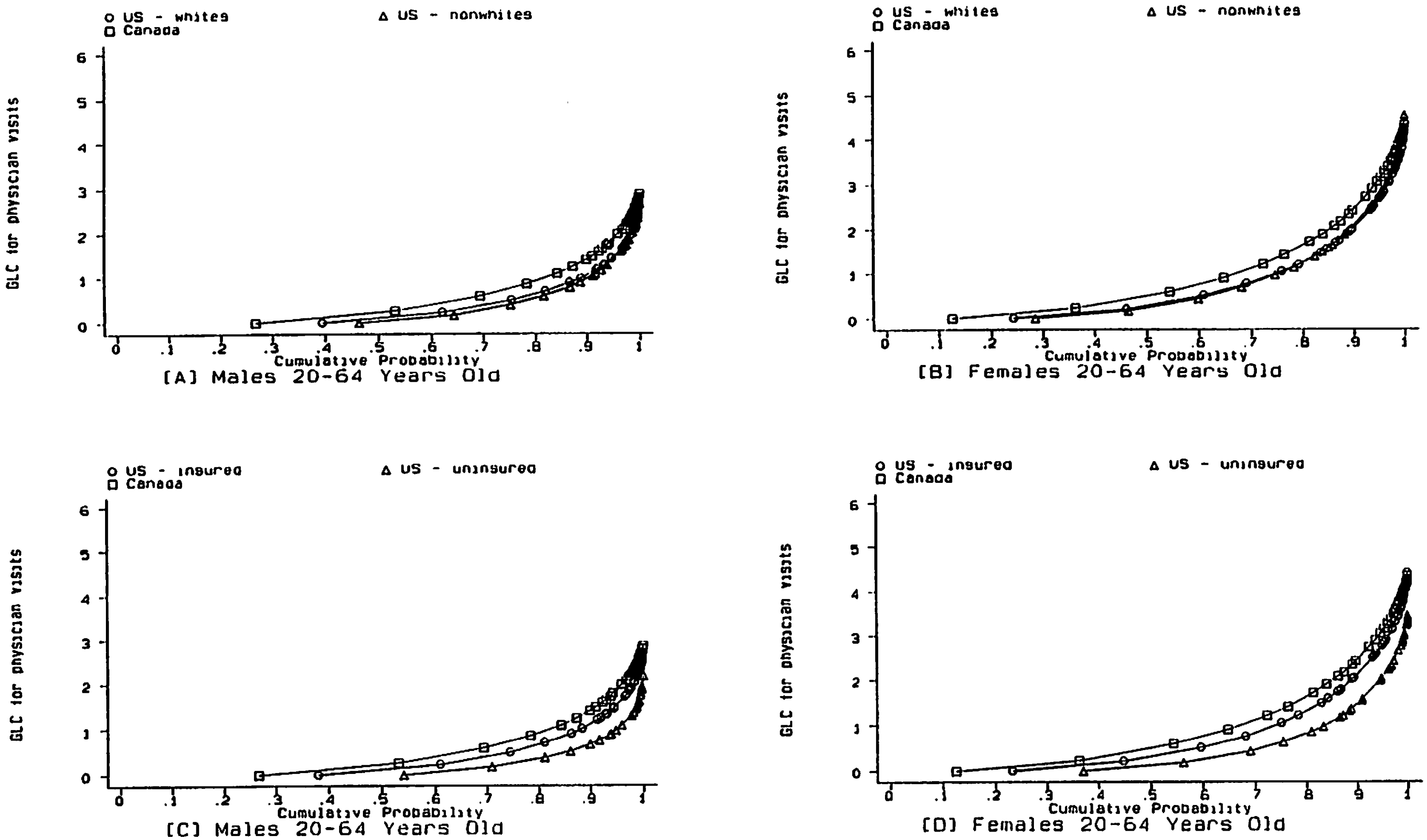


Figure 2
GENERALIZED LORENZ CURVES, SELECTED GROUPS

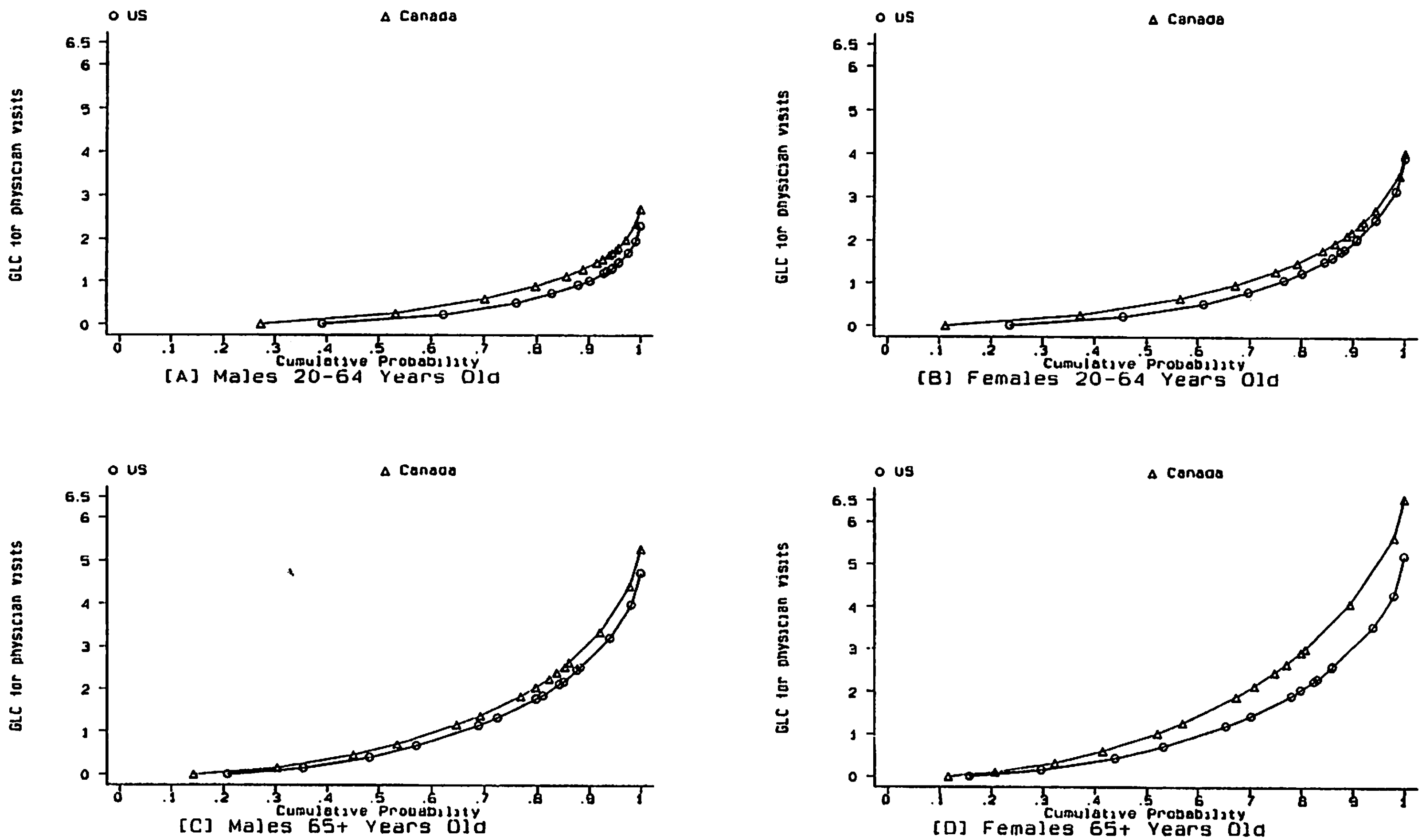


Figure 3
FITTED GENERALIZED LORENZ CURVES

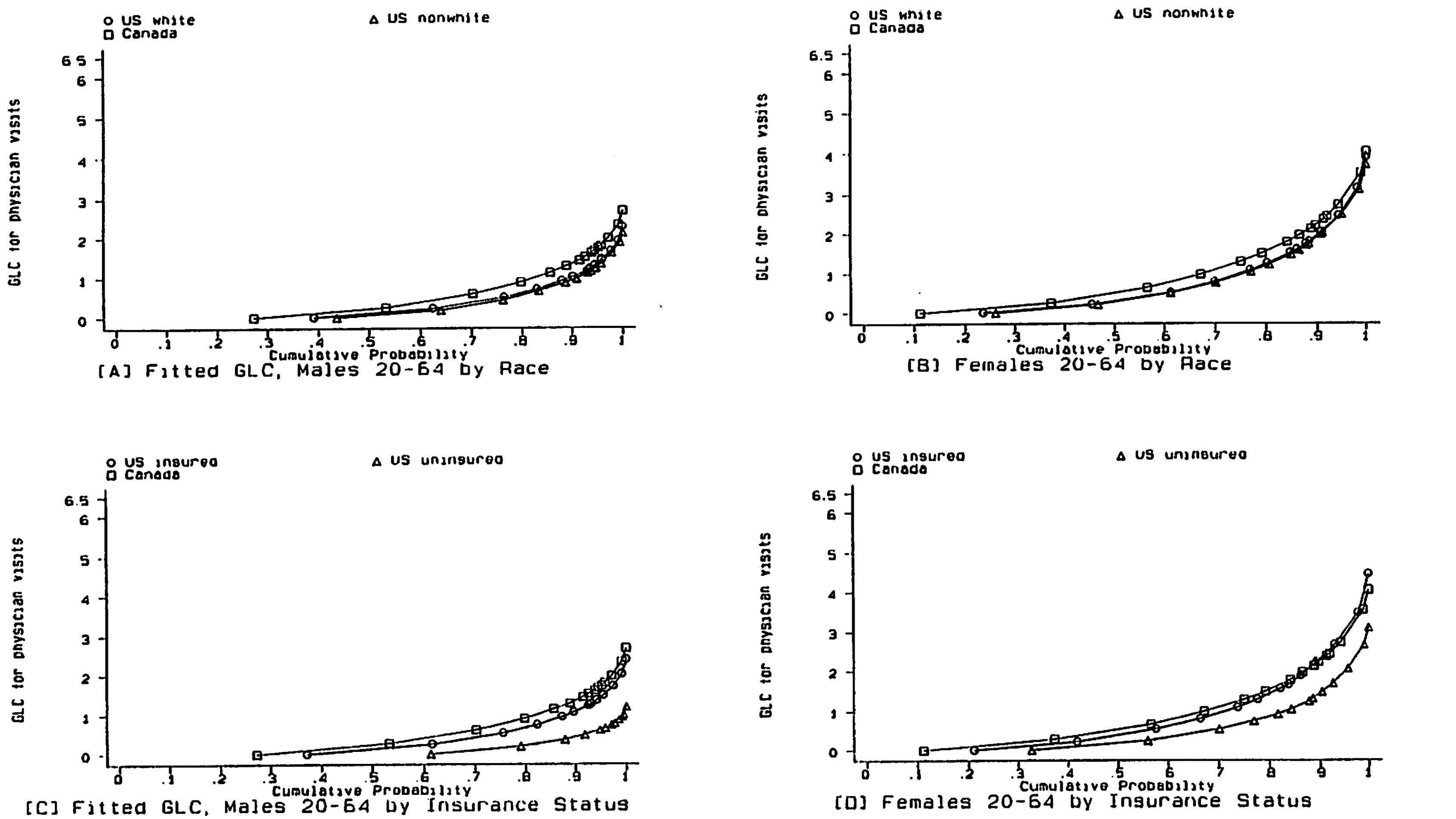
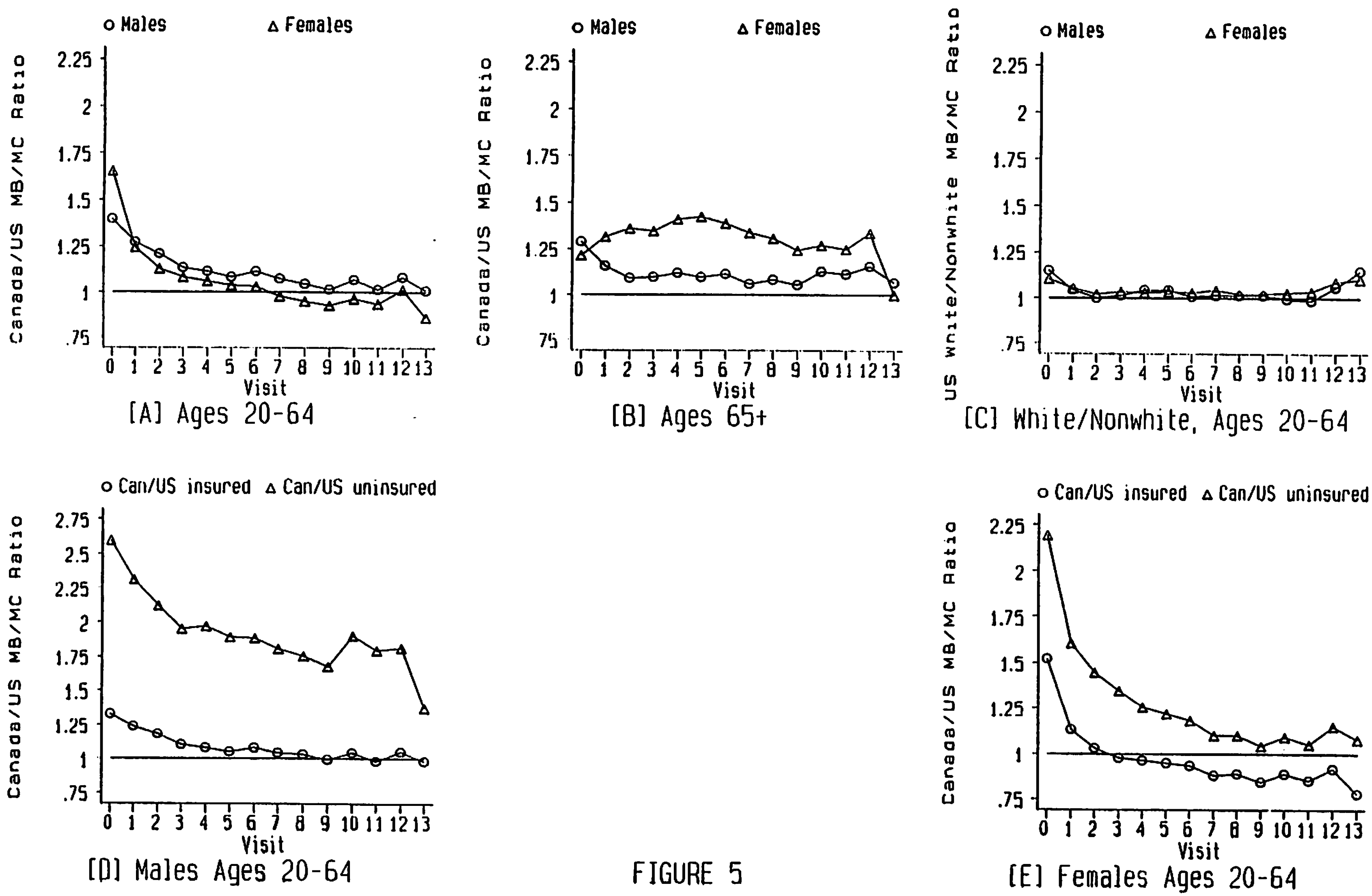
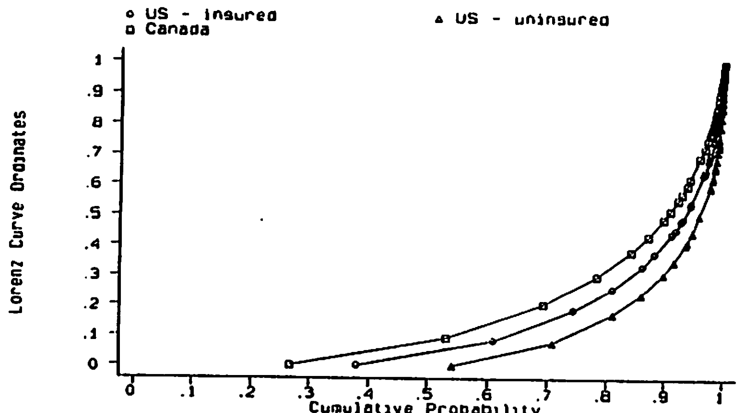


Figure 4
FITTED GENERALIZED LORENZ CURVES,SELECTED GROUPS

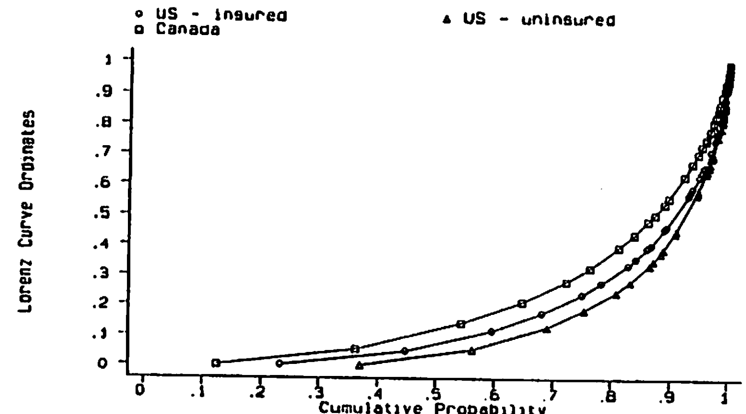


o Males
Δ Females
Canada/US MB/MC Ratio
Visit
[A] Ages 20-64
o Males
Δ Females
Canada/US MB/MC Ratio
Visit
[B] Ages 65+
o Males
Δ Females
US White/Nonwhite MB/MC Ratio
Visit
[C] White/Nonwhite, Ages 20-64
o Can/US insured
Δ Can/US uninsured
Canada/US MB/MC Ratio
Visit
[D] Males Ages 20-64
o Can/US insured
Δ Can/US uninsured
Canada/US MB/MC Ratio
Visit
[E] Females Ages 20-64

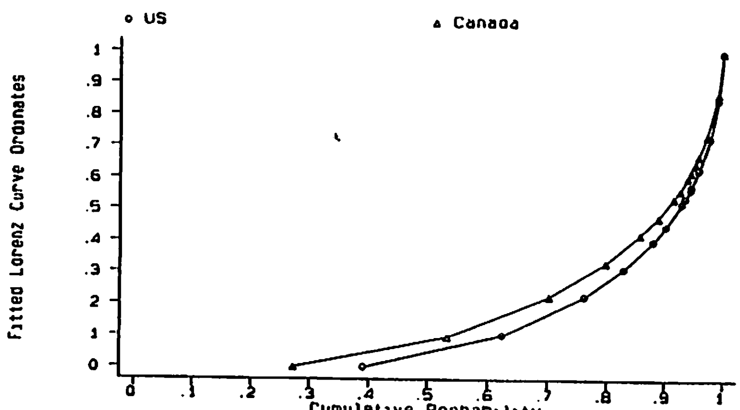
FIGURE 5



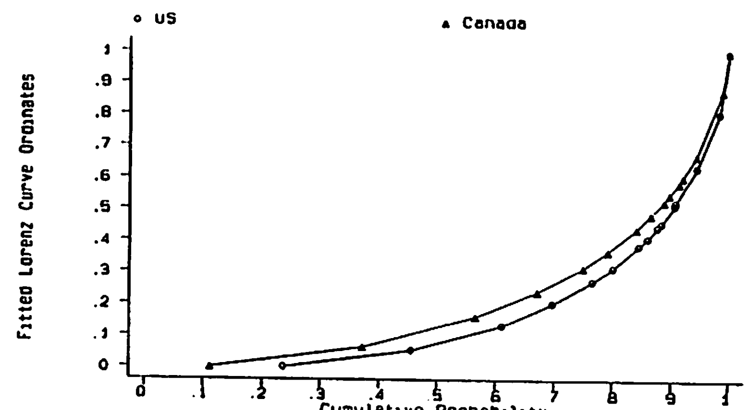
[A1] Males 20-64 Years Old



[A2] Females 20-64 Years Old

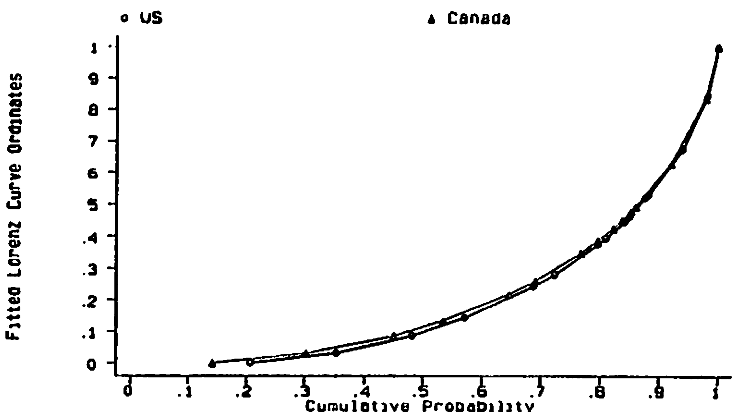


[A3] Males 20-64 Years Old

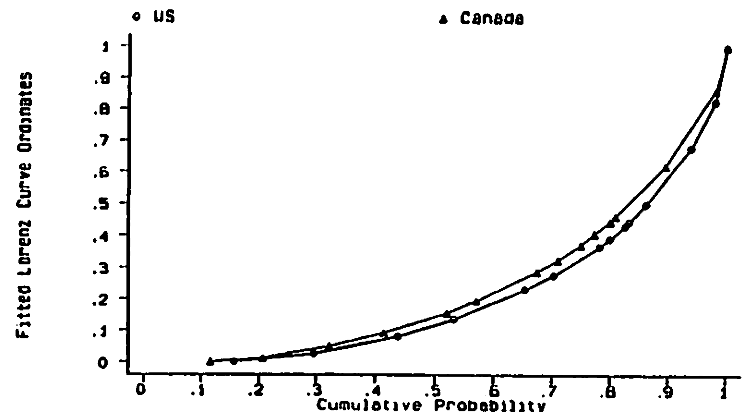


[A4] Females 20-64 Years Old

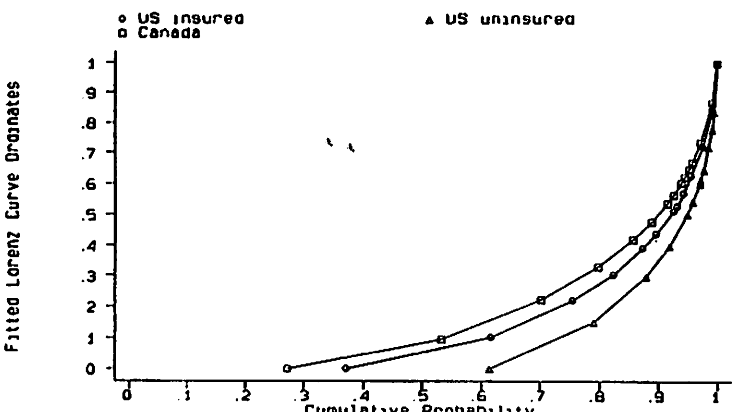
Appendix
LORENZ CURVES AND FITTED LORENZ CURVES



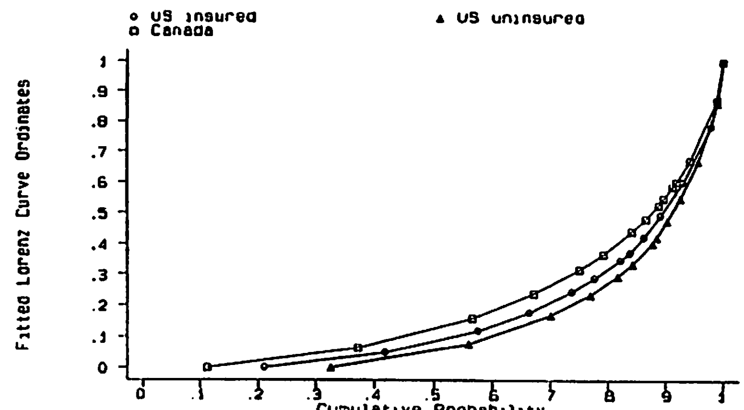
[A5] Males 65+ Years Old



[A6] Females 65+ Years Old



[A7] Males 20-64 by Insurance Status



[A8] Females 20-64 by Insurance Status

Appendix

FITTED LORENZ CURVES