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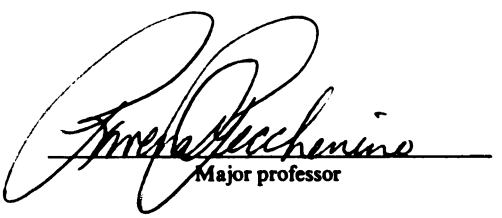

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ESSAYS ON MEDICAID AND ITS POPULATIONS

By

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ABSTRACT

ESSAYS ON MEDICAID AND ITS POPULATIONS

By

Heather L. Bednarek

This dissertation examines the long-run effects of the public and private funding regimes that currently exist to deal with various health shocks. The public sources of funding are Medicaid, which directly finances long-term care of the elderly and medical care for low-income workers, and Medicare, whereas the sources of private funding may be insurance or out-of-pocket. These funding mechanisms are examined at the macroeconomic level of health care policy in a general equilibrium, overlapping generations framework. The effect of these programs on social welfare of the economy, rather than only the effect on the social welfare of the target group, is evaluated.

Long-term care for the elderly is paid for by Medicaid, private long-term care insurance or out-of-pocket with the majority being funded by Medicaid. The first chapter, *Should Medicaid, Private Insurance or Self-Payment be the Funding Regime for Long-Term Care?*, reexamines the work of Kotlikoff (1989) and his ranking of these three sources of financing for long-term care. The key results overturn his ranking of the three regimes: actuarially fair private insurance, self-payment and lastly Medicaid. In this analysis the self-payment regime is ruled out as an alternative which leaves only the Medicaid and private long-term care insurance regimes. These two regimes are compared in terms of their effects on steady-state equilibrium social welfare. Social welfare, in economies under the private long-term care insurance regime, with actuarially

fair insurance (zero transactions costs), is greater than in economies under the Medicaid regime. However, for some range of positive transactions costs on long-term care insurance policies, economies under the Medicaid regime yield greater social welfare than economies under the private insurance regime.

Health care for workers is paid for by a variety of public and private sources whether through an employer, Medicaid or out-of-pocket while all those over 65 have access to subsidized medical care via Medicare. The effects of the various health care programs and the financing thereof on the lifetime well-being of individuals across income groups is examined in the second chapter, *Health and Medical Benefits*. The tax-benefit system is examined in terms of its effect on different socio-economic groups both within and across generations. The key results show that in steady-state increases in the Medicare subsidy rate may improve health in old age but reduce lifetime well-being. It is much more beneficial to subsidize medical care of the young, whether via Medicaid or an employer, as it works to improve lifetime well-being. Second, the schemes of medical subsidies that most benefit high productivity workers may not be the ones that most benefit low productivity workers which is a direct outcome of who pays for the programs and who receives the benefits. Thirdly, variations of a Benthamite social welfare function are examined and the economy-wide, welfare maximizing Medicare subsidy rate is less than what it is in practice, even if more weight is placed on the well-being of the old than the young. Lastly, various policy changes were examined including means-testing Medicare and progressive tax rates. Generally these results are in line with earlier findings. Medical subsidies to the old reduce lifetime well-being while subsidies to the young tend to increase lifetime well-being.

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TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

I. Introduction

National health expenditures have grown from 5.5% of GDP in 1963 to 13.5% of GDP in 1997. Private sources paid for 53.6% while public sources paid 46.4% in 1997. Over the past 30 years there has been considerable growth in both private and public health care expenditures. Of public sector health care financing, Medicaid spending in 1966 was .17% of GDP while in 1997 it was 1.97% of GDP, 10.6 times its initial size. Medicare spending consisted of .23% of GDP in 1966 while in 1997 it was 2.6% of GDP, a 10.5 fold increase. Private sector health expenditures nearly doubled in 30 years, rising from 4% of GDP in 1963 to peak at 7.8% of GDP in 1993. However, since 1993 private sector health expenditures have decreased slightly to 7.2% of GDP in 1997. Over the past 30 years the portion of private sector health expenditures that has been out-of-pocket payments by individuals has dropped dramatically from 61% in 1963 to 32% in 1997. Concurrently, the share of private sector health expenditures via private insurance has moved in the opposite direction. In 1963 private insurance expenditures covered only 31.6% and in 1997 59.5%. See Tables 1, 2 and 3.

This dissertation examines the effects of these public and private programs on welfare of the entire economy, rather than only the effect on the target group. The sources of funding are evaluated at the macroeconomic level of health care policy in two theoretical essays in a general equilibrium, overlapping generations framework. Each of the essays deals with various sources of health care funding including Medicare which provides health care for those over 65, Medicaid, which directly finances long-term care of the elderly and medical care for low-income workers, as well as employer provided medical benefits and private long-term care insurance.

II. Public Health Care Programs

a. Medicaid

Medicaid aids various low-income groups in different capacities. Because the program is administered at the state level there is some variation across states. However, the federal government mandates particular programs that states must have in place in order to receive federal grants. The differences come most starkly from those programs that states have the option to fund after the required groups are covered. This outline broadly defines the different groups of recipients and what types of benefits they receive.

First, Medicaid is required to provide acute care insurance to individuals receiving Aid to Families with Dependent Children (AFDC) or similar temporary assistance type programs for families. Those covered principally include poor single-parent families and two-parent families with an unemployed principle wage earner. Since the 1980's, Medicaid has also provided support to pregnant women and low-income children whose income is greater than that of AFDC eligibility, who thus would not otherwise qualify. Recently, the link between government financial assistance and Medicaid has been somewhat broken such that many low wage workers and their families may still qualify for Medicaid. Since the Welfare-to-Work legislation in 1996, the Medicaid rolls have increased somewhat while temporary financial assistance rolls have decreased. These individuals comprise the bulk of Medicaid enrollees (71% of entire Medicaid population) but only receive 29% of the total benefit of the program (HCFA, 1995).

Medicaid is also required to cover the acute care needs of those receiving Supplemental Security Income (SSI) which includes those who are blind and/or disabled. States also have the option (which 80% exercise) of providing long-term care to the

mentally retarded receiving care in a nursing home or intermediate care facility even if their income exceeds the means-tested program standard (in this case, the SSI limit) by as much as 300%. These two groups consist of about 16% of the Medicaid population and receive 39% of the total benefit (HCFA, 1995).

Medicaid also gives aid to the elderly, those individuals over 65, but in a different manner than for either of the two other groups. First, it is required to pay the Medicare premiums, deductibles and coinsurance for the low-income aged who are known as Qualified Medicare Beneficiaries (QMB). This aspect of Medicaid appeared in the late 1980's after Medicare no longer paid for these services for low-income elderly out of its own budget. The means-tested criterion for qualification is currently at 120% of the poverty line. States also have the option (which almost 80% exercise) of providing for the medically needy, which covers, for the most part, long-term care services (whether nursing home care or community based services). Although this option includes all qualified groups; elderly, blind, disabled, children and pregnant women, the elderly are by far the major users of this option. The elderly compose 12% of the Medicaid population and receive 32% of the total benefit (HCFA, 1995) with 90% (Coughlin et al., 1994) of that going toward the payment for long-term care services versus the QMB payments.

b. Medicare

Medicare is public health insurance for virtually all those over 65 and has 2 components, Part A (Hospital Insurance, HI) and Part B (Supplementary Medical Insurance, SMI) which primarily covers physician visits and out-patient procedures. Part

A is the much larger portion where participation is compulsory. Part B, the supplementary medical insurance portion is optional however most individuals choose to enroll and pay a monthly premium of about $45.

Medicare is funded in large part by a payroll tax of 1.45% each, on the worker and the employer, for a total of 2.9% collected per worker on the earnings of current workers and the tax is applied to all earnings with no ceiling. The tax proceeds are deposited into the HI Trust Fund from which disbursements to health care providers are made. Unlike HI, SMI is financed out of general revenues, not on a payroll tax. SMI is financed 75% by general revenues and 25% by premiums so it is quite heavily subsidized.

III. Long-Term Care Financing

At this time, particular attention is paid to long-term care financing mechanisms that will be discussed in Chapter 1. Medicaid has become increasingly important for the elderly as it is the only direct source of public funding for long-term care services (nursing home or community based) despite its original motive of providing acute care medical coverage to low income families. Those over 65 receive almost one-third of total Medicaid benefits totaling $40 billion or .5% of GDP (HCFA, 1996) with 90% (Moon, 1996) of that going toward the payment of long-term care services. Before Medicaid aids individuals in the financing of their long-term care, due to its nature as a poverty program, individuals must spend down virtually all of their assets and income. Often the case is that long-term care is financed first by individuals out-of-pocket. Lifetime income and assets can be thought of as the deductible before Medicaid becomes

the financer of last resort for public long-term care insurance. Medicare plays a much smaller role, as it does not explicitly cover long-term care services for individuals over 65 suffering a catastrophic illness. It only pays for long-term care that is associated with an acute illness an individual may be recovering from.

Private insurance pays for a small share of long-term care, between 4-5% (HCFA, 1996). Some suggest that many elderly are not aware that Medicare, in large part, does not cover long-term care costs. However if that were the only barrier then insurance companies would increase advertising in order to inform the elderly. Those that are more likely to need long-term care are often the ones that seek insurance which leads to the issue of adverse selection in the pool of elderly that purchase long-term care insurance. As such, premiums are thought not to be actuarially fair. Others suggest that individuals may be myopic in that they do not purchase a long-term care insurance policy early enough for such a low probability/high loss event. By the time the need becomes apparent the premiums are too costly for the individual to afford such a policy. Those in their middle years are not foresighted enough to purchase a policy and even with foresight, they may not buy a policy because the expected return in 30-40 years may be less than the cost. This is because of the intertemporal variability in the cost of care. Most policies pay out a fixed daily benefit for nursing home care and of those policies that do offer inflation adjustment (not necessarily tied to the medical care CPI) increase the daily benefit each year at a specified rate such as 5%. However, in the past decade, the cost of nursing home care has increased faster than the rate of inflation adjustment on most policies so that real coverage has decreased. Also, there is the possibility of a "crowding out" effect such that the presence of Medicaid discourages savings or the

purchase of long-term care insurance especially for those at the lower end of the income distribution. Familial crowding out may also occur whereby the adult children discourage parents from buying such insurance thereby committing themselves to the role of caregiver.

IV. Health Care Financing

The various subsidies for health care during one's working years are often correlated with the wage of the worker. It is usually higher wage earners that receive employer provided medical benefits as part of their total before-tax compensation. In 1996 less than 55% of those earning $7/hr or less received employer based medical benefits while almost 96% of those earning more than $15/hr received such benefits (Cooper and Schone, 1997). These individuals that have employer provided medical benefits are receiving an implicit tax break because benefits are taken out of before-tax earnings. Thus, the amount that they contribute to total government payroll tax revenue is decreased, holding the tax rate constant. This reduction in revenue can be sizable as 77% of full-time employees in medium and large private establishments have an employment based medical care plan (EBRI, 1997). The federal government estimates its lost tax revenue, due to preferential treatment of employer provided medical benefits, to be $71.5 billion in 1998 or approximately 1% of GDP (Executive Office of the President, 1998). At the same time, lower wage workers have much more limited access to medical coverage. Since the Welfare-to-Work legislation in 1996, Medicaid has increasingly become an alternative funder of medical care for many low wage workers who satisfy the income-test. The remaining workers, not receiving medical coverage

from either of the above programs, are left to pay for all of their medical care out-of-pocket.

While medical coverage when young comes from a variety of sources, all those over 65 receive Medicare, which subsidizes much of their medical care. Medicare subsidization is the same rate for all old, however the distribution of well-being across various income groups, both intra- and inter-generationally may be affected by the program. Within a generation, higher income retirees may reap more of the program's benefits and to the extent that higher income retirees spend more on all types of goods, they will spend more than low income retirees will. Thus implicitly those with higher income receive more Medicare benefits than those with lower income. Across generations, all young workers pay for Medicare via a payroll tax but the pay-as-you-go program may come at a very high cost in terms of their overall well-being. Also, any implicit tax break, due to employer provided medical coverage that high income workers receive and low income workers do not, further distorts the share of tax revenue contributed by each group as the tax burden on low income workers increases without generating any additional benefits for them. Thus, the various health care programs may implicitly transfer benefits from low income to high income individuals. These issues will be taken up in Chapter 2.

APPENDIX

APPENDIX

Table 1
National and private health expenditures as a fraction of GDP

	national health expenditures/GDP	private health expenditures/GDP	private health expenditures/ national health expenditures	out-of-pocket health expenditures/ private health expenditures	private insurance expenditures/ private health expenditures
1997	.135	.072	.536	.32	.595
1996	.136	.073	.538	.317	.601
1995	.137	.074	.542	.318	.602
1994	.136	.076	.554	.321	.600
1993	.137	.078	.571	.326	.598
1992	.134	.077	.578	.335	.590
1991	.130	.076	.585	.342	.583
1990	.122	.072	.595	.348	.576
1989	.115	.068	.596	.359	.561
1988	.111	.066	.596	.381	.533
1987	.107	.063	.586	.396	.511
1986	.104	.061	.588	.398	.518
1985	.103	.061	.594	.395	.522
1984	.100	.059	.589	.395	.518
1983	.101	.059	.585	.396	.511
1982	.100	.058	.583	.400	.506
1981	.092	.053	.578	.413	.496
1980	.089	.051	.576	.423	.490
1979	.084	.049	.581	.434	.487
1978	.083	.048	.583	.448	.473
1977	.084	.049	.588	.463	.458
1976	.082	.048	.583	.480	.433
1975	.080	.046	.580	.503	.413
1974	.076	.045	.592	.515	.396
1973	.073	.045	.61	.519	.389
1972	.074	.045	.614	.519	.382
1971	.072	.044	.615	.530	.372
1970	.071	.044	.622	.547	.358
1969	.066	.041	.621	.564	.344
1968	.063	.039	.622	.579	.339
1967	.061	.038	.627	.589	.333
1966	.058	.040	.699	.596	.327
1965	.057	.043	.75	.601	.325
1964	.057	.043	.751	.601	.316
1963	.055	.04	.744	.613	.316

(HCFA, 1998)

Table 2
Public health expenditures, Medicare, Medicaid as a fraction of GDP

	public health expenditures/GDP	public health expenditures/ national health expenditures	Medicare/GDP	Medicaid/GDP
1997	.063	.464	.0264	.0197
1996	.063	.462	.0261	.0201
1995	.063	.458	.0254	.0201
1994	.061	.446	.0240	.0194
1993	.059	.429	.0226	.0186
1992	.057	.422	.0218	.0170
1991	.054	.415	.0205	.0159
1990	.049	.405	.0194	.0131
1989	.046	.404	.0188	.0114
1988	.045	.404	.0178	.0109
1987	.044	.414	.0176	.0107
1986	.043	.412	.0174	.0103
1985	.042	.406	.0172	.0099
1984	.041	.411	.0170	.0099
1983	.042	.415	.0170	.0101
1982	.042	.417	.0162	.0100
1981	.039	.422	.0144	.0097
1980	.038	.424	.0135	.0094
1979	.035	.419	.0121	.0088
1978	.035	.417	.0117	.0085
1977	.035	.412	.0113	.0087
1976	.034	.417	.0109	.0084
1975	.034	.421	.0101	.0083
1974	.031	.408	.0090	.0074
1973	.028	.390	.0078	.0068
1972	.028	.386	.0076	.0068
1971	.028	.385	.0075	.0060
1970	.027	.378	.0074	.0051
1969	.025	.379	.0072	.0043
1968	.024	.378	.0069	.0039
1967	.023	.373	.0059	.0038
1966	.017	.302	.0023	.0017
1965	.014	.250	0	0
1964	.014	.249	0	0
1963	.014	.256	0	0

(HCFA, 1998)

Table 3
Medicare and Medicaid as a fraction of public health expenditures

	Medicare/ public health expenditures	Medicaid/ public health expenditures
1997	.423	.315
1996	.416	.320
1995	.407	.321
1994	.395	.318
1993	.386	.316
1992	.386	.301
1991	.381	.295
1990	.394	.266
1989	.406	.247
1988	.398	.244
1987	.399	.243
1986	.405	.240
1985	.414	.237
1984	.415	.239
1983	.405	.239
1982	.390	.239
1981	.370	.251
1980	.358	.249
1979	.344	.249
1978	.336	.246
1977	.327	.250
1976	.317	.244
1975	.298	.245
1974	.289	.239
1973	.274	.241
1972	.266	.238
1971	.272	.216
1970	.278	.192
1969	.288	.171
1968	.286	.163
1967	.260	.166
1966	.135	.010
1965	0	0
1964	0	0
1963	0	0

(HCFA, 1998)

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SHOULD MEDICAID, PRIVATE INSURANCE OR SELF-PAYMENT BE THE FUNDING REGIME FOR LONG-TERM CARE?

I. Introduction

Long-term care for the elderly is financed by Medicaid, private long-term care insurance or out-of-pocket. Currently, the means-tested government program, Medicaid, contributes about 50% of the total cost. The other sources of finance are Medicare, which covers 7% of costs, private insurance, covers 4-5%, and the remaining 35% comes directly out of the pockets of the elderly (HCFA, 1996), much of which is spent during the spenddown process before individuals qualify for Medicaid. Clearly Medicaid is the largest funder of long-term care, however is it the most effective? Effectiveness is measured in terms of the lifetime well-being of individuals. Rather than evaluate only the effect on the target group of old who need long-term care, this analysis looks at the lifetime effects of these programs. For example, in the Medicaid regime, some of the old reap the benefits of Medicaid while young workers pay for the program.

This paper, uses an overlapping generations framework, to examine the various funding regimes for long-term care: Medicaid, self-payment and private insurance. The analysis is at the macroeconomic level of health care policy. As such, the effects of the programs and their financing on the lifetime well-being of individuals in the economy is examined. For modeling purposes, Medicaid and the portion of Medicare that pays for long-term care will be consolidated and considered one government program known as Medicaid.

This analysis reexamines Kotlikoff's (1989) ranking of these three sources of financing for long-term care: actuarially fair private insurance, self-payment and lastly

Medicaid.[1] The key results in this paper overturn his ranking of the three regimes. The following analysis rules out the self-payment regime as an alternative because a truly catastrophic illness shock is catastrophic precisely because individuals' health is devastated such that they cannot finance the recovery from the shock on their own with only out-of-pocket medical expenditures.[2] Medicaid is known as a financer of last resort because it defines a catastrophic health shock as one in which an individual can no longer pay for with their own income. Thus with self-payment ruled out that leaves only the Medicaid and private long-term care insurance regimes remaining. These two regimes are compared in terms of their effect on steady-state equilibrium social welfare (lifetime well-being). Social welfare in economies under the private long-term care insurance regime, with actuarially fair insurance (zero transactions costs), is greater than in economies under the Medicaid regime. However, for some range of positive transactions costs on long-term care insurance policies, economies under the Medicaid regime yield greater social welfare than economies under the private insurance regime.

II. Literature Review

Aside from the work of Kotlikoff mentioned above there has been little theoretical examination of these funding regimes. Pauly (1990) examines possible reasons for failure to purchase long-term care insurance by well-informed, expected utility maximizing risk-averse individuals. He finds there may be no demand for such insurance coverage even if

[1] Kotlikoff refers to the financing of uncertain health expenditures. However, there are references specific to long-term care expenditures, such as Medicaid named as the government option. In the presence of Medicare, to a large extent, the greatest source of uncertain health expenditures when old are those for long-term care.

[2] The case of an illness that is not catastrophic, in health or financial terms, is examined in the appendix.

it is available at actuarially fair premiums because family members represent an alternative source of long-term care as well the fact that individuals tend to ignore high loss, low probability events.

Much of the other work that has been done to date is empirical or in the computational general equilibrium framework and mainly focuses on effects of the Medicaid regime and spenddown process. Examples of this are as follows. Hubbard et al. (1995) examine savings behavior in the presence of means-tested social insurance, such as Medicaid, across different income groups and allowing for various sources of uncertainty: medical, earnings, and length of life. Depending on where one is in the income distribution, the presence of Medicaid can have substantial negative effects on savings of the elderly. Norton (1995) suggests that the long-term care insurance part of Medicaid may increase the saving of elderly citizens due to welfare aversion i.e., the stigma they may feel is associated with receiving Medicaid. Contrary to expectations, it appears that the elderly receive intergenerational transfers to avoid Medicaid eligibility. Hoerger et al. (1996) examine the effects of public subsidies on three possible living arrangements of the disabled elderly: independent living, intergenerational household or nursing home. Public subsidies were found to have little effect on nursing home entry if they also subsidize community living. Although public subsidies that support living independently do increase the probability of individuals living on their own. Much of the literature thus far deals with Medicaid's effect on savings, intergenerational transfers and living arrangements. The effects of the Medicaid funding regime as well as other funding regimes on the well-being or welfare of individuals over the course of their lifetime is not examined; this paper makes a theoretical attempt to do so.

III. Model

Consider an infinitely lived economy consisting of finitely lived agents, firms and in the Medicaid regime, a government. Identical agents are born at the beginning of each period t (t=1,2,3...), live for 2 periods and die at the end of the second period. Individuals get utility from both consumption and health. There is no population growth and the size of the population is normalized to unity without loss of generality.

Agents work in the first period, supplying their labor inelastically. They divide their labor income between current consumption and saving for old age (and payroll Medicaid taxes in the Medicaid regime). Note that the health stock of young agents is constant and individuals' decisions do not affect it.

At the beginning of the second period agents suffer from a catastrophic illness[3] with probability p.[4] Agents divide their returns to saving between consumption and any medical care associated with a catastrophic illness.[5] The choice of medical care is affected by the sources of financing: income-tested Medicaid, private long-term care insurance, or self-payment.

Let the representative member of generation t's preferences be represented by

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[3] The illness is catastrophic in the sense that it is of high cost and cannot recover from it with only their own saving.

[4] Bequests are not an issue in this model because all agents live for two periods. However, the model could easily be extended to also include a probability of dying at the end of the first period.

[5] There has been much exposure in the public policy realm regarding the loopholes the old have employed in order to qualify for Medicaid. These include various ways of depleting their wealth through transference or bequests to their children while still alive. However, in the literature there is a notable study which finds that in practice this is not often the case (Sloan and Shayne, 1993). In any case, this issue will be abstracted from in this model.

(1) $$U = \ln\left[\Theta(t)\right] + \beta(1-p)\ln\left[\Theta^1(t+1)\right] + \beta p \ln\left[\Theta^2(t+1)\right]$$

where $\Theta(t)$ is the well-being of a member of generation t while young, $\Theta^1(t+1)$ [$\Theta^2(t+1)$] is the well-being of a member of generation t in state 1 (state 2) of old age and β is the discount rate.

Assume that the well-being of a young member of generation t is a constant-returns-to-scale function of her current consumption, c(t), and health stock, h. Specifically, $\Theta(t) = c(t)^{\delta} h^{1-\delta}$ where $\delta \in [0,1]$. Similarly, the well-being of an old type j member of generation t in the healthy state (state 1) is a constant-returns-to-scale function of current consumption, $c^1(t+1)$, and health stock, h. Specifically, $\Theta^1(t+1) = c^1(t+1)^{\gamma} h^{1-\gamma}$ where $\gamma \in [0,1]$.[6] The well-being of an old member of generation t in the catastrophic illness state (state 2) is a function of her consumption, $c^2(t+1)$, and health stock, h, as well as a catastrophic illness shock that destroys ε% of health stock and medical care for the recovery from the illness which varies according to regime. In the Medicaid regime medical care is in the form of a health transfer, $T^h(t+1)$. Specifically, well-being in the catastrophic illness state is $\Theta^2(t+1) = (c^2(t+1))^{\gamma}(h(1-\varepsilon) + T^h(t+1))^{1-\gamma}$ where $\gamma \in [0,1]$. In the private insurance regime medical care comes via a long-term care insurance policy, F(t+1), which replaces

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[6] The model can easily be extended to include a minor medical shock in state 1 of old age. This medical shock is of a "relatively minor" nature in which the retiree chooses the amount of out-of-pocket medical care. Due to its less severe nature, costs are not covered by Medicaid or the private insurance policy. This minor illness must be covered completely by self-payment.

the health transfer. In the self-payment regime all medical care is paid for out-of-pocket, m(t+1), which replaces the health transfer.

The firms in the economy are perfectly competitive profit maximizers that produce a single consumption good using a constant returns to scale production function $Y(t) = A\,K(t)^{\alpha}\,N(t)^{1-\alpha}$ where $A>0$ is a productivity constant, $K(t)$ is the physical capital stock at date t, $N(t)$ is the labor stock at date t. It can also be expressed in per capita terms, $y(t) = Ak(t)^{\alpha}$ where $y(t)$ is the output-labor ratio and $k(t)$ is the capital-labor ratio. Assume that capital fully depreciates in the production process. With regard to the production of medical care, old agents can convert consumption goods into medical care or private insurance at a rate of one-to-ϕ.

Under the Medicaid regime, the government covers the cost of catastrophic long-term care[7] by providing both health and consumption transfers (T^h and T^c) to those hit by the shock.[8] To pay for the program it levies a proportional Medicaid tax, τ^m, on the wages of all young workers. Also, to help finance the costs of the catastrophic long-term care the government confiscates the income of agents in the catastrophic illness state at rate τ^w which may be viewed as a state-contingent tax.[9]

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[7]The issue of nursing home quality of care differences between patients on Medicaid and those that are paying for services out-of-pocket or through private insurance will be abstracted from in this model.

[8]Although Medicaid is a single program, it provides long-term care aid in 2 distinct ways, both as a minimum level of consumption and health care. An example of this is nursing home care where some of the Medicaid is spent on custodial care such as meals each day for the individual as well as directly on the treatment of the long-term catastrophic illness e.g., prescriptions.

[9]Modeling the Medicaid program in this manner is no different than explicitly modeling the spenddown period of individuals who then receive Medicaid coverage. This is because in this model there is no uncertainty as to the time of death, i.e., individuals will spenddown their own assets before death. Thus, the government taxing an individual's income at nearly 100% and providing health care and consumption transfers is not different from the individual spending down and then becoming eligible for Medicaid.

Under the private insurance regime, the insurance market opens immediately as agents enter old age. An individual can buy a long-term care insurance policy, F, at a premium per dollar of υ, only before the state of the world is revealed. Due to agents' risk aversion as exhibited by their constant relative risk aversion utility function they will all buy actuarially fair insurance. However the insurance may not be fairly priced and for some positive transactions costs, σ, individuals may choose not to fully insure against the shock. If an agent is hit with a catastrophic illness shock, the policy immediately pays out and covers the catastrophic illness costs.

The representative agent at date t faces several constraints which may differ depending on the funding regime for long-term care. If Medicaid is the funding regime, well-being when young and in state 1 and 2 of old age are defined by (2a), (2c) and (2e) respectively. The budget constraints when young and in both states of old age are defined by equations (2b), (2d) and (2f). If private long-term care insurance is the funding regime, well-being when young (3a) and in the healthy state of old age (3c) are identical to (2a) and (2c) respectively. Well-being in the catastrophic illness state (3e) is analogous to (2e) as it is dependent on the insurance policy rather than the Medicaid transfer. The budget constraint when young (3b) is similar to (2b) but does not include the Medicaid payroll tax as the government had no role in this regime. The budget constraints in both states of old age, as defined by (3d) and (3f), are identical because retirees buy a long-term care insurance policy as soon as they enter old age, before they know if they will suffer from a catastrophic illness. If self-payment is the funding regime, well-being when young (4a) and in the healthy state of old age (4c) are identical to (2a) and (2c) respectively. Well-being in the catastrophic illness state of old age (4e) is analogous to

(2e) as it is dependent on the amount of medical care the individual chooses rather than the Medicaid transfer. The budget constraint when young (4b) is identical to that in the private insurance regime (3b) and the budget constraint in the healthy state of old age (4d) is identical to that in the Medicaid regime (2d). In this regime there is no consumption smoothing in old age so if an individual is hit with a catastrophic illness, only then does she allocate income to medical care as seen in the budget constraint (4f).

(2a)	$\Theta(t) = c(t)^{\delta} h^{1-\delta}$
(2b)	$c(t) = w(t)(1 - \tau^{m}(t)) - s(t)$
(2c)	$\Theta^{1}(t+1) = c^{1}(t+1)^{\gamma} h^{1-\gamma}$
(2d)	$c^{1}(t+1) = (1+\rho(t+1))s(t)$
(2e)	$\Theta^{2}(t+1) = c^{2}(t+1)^{\gamma}(h(1-\varepsilon) + T^{h}(t+1))^{1-\gamma}$
(2f)	$c^{2}(t+1) = ((1+\rho(t+1))s(t))(1-\tau^{w}) + T^{c}(t+1)$
(3a)	same as (2a)
(3b)	$c(t) = w(t) - s(t)$
(3c)	same as (2c)
(3d)	$c^{1}(t+1) + \phi\upsilon F(t+1) = (1+\rho(t+1))s(t)$
(3e)	$\Theta^{2}(t+1) = c^{2}(t+1)^{\gamma}(h(1-\varepsilon) + F(t+1))^{1-\gamma}$
(3f)	same as (3d)
(4a)	same as (2a)
(4b)	same as (3b)
(4c)	same as (2c)

(4d)	same as (2d)
(4e)	$\Theta^2(t+1) = c^2(t+1)^{\gamma}(h(1-\varepsilon)+m(t+1))^{1-\gamma}$
(4f)	$c^2(t+1)+\phi\, m(t+1) = (1+\rho(t+1))s(t)$

The representative agent at date t takes as given the return to saving when old, (1 + ρ(t+1)), wage rate, w(t), tax rate, τ^m(t), and the consumption and health transfers, T^c(t+1) and T^h(t+1). Under the Medicaid regime the agent chooses only s(t) to maximize (1) subject to (2a)-(2f). Under the private insurance regime [self-payment regime] the agent chooses both saving, s(t), and the size of the long-term care insurance policy, F(t+1) [the amount of medical care for recovery of the catastrophic illness, m(t+1)] to maximize (1) subject to (3a)-(3f) [(4a)-(4f)].

IV. Steady-state Equilibrium

A competitive steady-state equilibrium in this economy is a price vector {w, r, ρ}, an allocation {c, F(in the private insurance regime), m(in the self-payment regime)} and a capital stock {k} such that given these prices, allocations and capital stocks (a) agents' utility is maximized, (b) firms' profits are maximized (c) goods and factor markets clear (d) in the Medicaid regime, the government budget constraint is satisfied and (e) in the private insurance regime, the insurance market zero-profit condition holds.

Under the Medicaid funding regime for long-term care, substitution of (2a), (2c) and (2e) into the objective function (1) and maximizing subject to (2b), (2d) and (2f) yields the first-order condition (FOC) of the agent's problem with respect to savings, (5).

The second set of FOCs is derived under the assumption of the private long-term care insurance regime. The first order conditions are with respect to saving (6a) and the size of the long-term care insurance policy (6b).

The third set of FOCs is derived under the assumption of self-payment where agents pay for any and all long-term care. Analogous to those in the private insurance regime, the first-order conditions are with respect to saving (7a) and long-term care (7b).

(5)	$\frac{-\delta}{w(t)(1-\tau^{m}(t))-s(t)}+\frac{\beta\gamma(1-p)}{s(t)}+\frac{\beta\gamma p(1+\rho(t+1))(1-\tau^{w})}{(1+\rho(t+1))s(t)(1-\tau^{w})+T^{c}(t+1)}=0$
(6a)	$\frac{-\delta}{w(t)-s(t)}+\frac{\beta\gamma(1+\rho(t+1))}{(1+\rho(t+1))s(t)-\phi\upsilon F(t+1)}=0$
(6b)	$\frac{-\gamma\phi\upsilon}{(1+\rho(t+1))s(t)-\phi\upsilon F(t+1)}+\frac{(1-\gamma)p}{h(1-\varepsilon)+F(t+1)}=0$
(7a)	$\frac{-\delta}{w(t)-s(t)}+\frac{\beta\gamma(1-p)}{s(t)}+\frac{\beta\gamma p(1+\rho(t+1))}{(1+\rho(t+1))s(t)-\phi m(t+1)}=0$
(7b)	$\frac{-\gamma\phi}{(1+\rho(t+1))s(t)-\phi m(t+1)}+\frac{(1-\gamma)}{h(1-\varepsilon)+m(t+1)}=0$

Under the Medicaid funding regime, the first-order condition with respect to saving, s(t), (5), fully characterizes the agent's problem. If private long-term care insurance is the funding regime, equation (6b) can be solved for F(t+1) and substituted into (6a) to yield (8) which fully characterizes the agent's problem. Lastly, if self-payment is the funding regime, equation (7b) can be solved for m(t+1) and substituted into (7a) to yield (9) which fully characterizes the agent's solution to the problem.

(8)	$\frac{-\delta}{w(t)-s(t)}+\frac{\beta(\gamma+(1-\gamma)p)(1+\rho(t+1))}{(1+\rho(t+1))s(t)+\phi\upsilon h(1-\varepsilon)}=0$
(9)	$\frac{-\delta}{w(t)-s(t)}+\frac{\beta\gamma(1-p)}{s(t)}+\frac{\beta p(1+\rho(t+1))}{(1+\rho(t+1))s(t)+\phi h(1-\varepsilon)}=0$

In equilibrium, the representative firm maximizes profits and takes wages and rental rates as given. It hires labor and capital until their marginal products equal their factor prices.

(10) $w(t) = A(1-\alpha)K(t)^{\alpha} N(t)^{-\alpha} = A(1-\alpha)k(t)^{\alpha}$

(11) $r(t) = A\alpha K(t)^{\alpha-1} N(t)^{1-\alpha} = A\alpha k(t)^{\alpha-1}$

Due to the earlier assumptions of the agents' inelastic supply of labor and capital, as well as the constant returns to scale in production, these two equations also define factor market clearing.

The government must maintain a balanced budget. The proportional Medicaid tax on labor, τ^m, must adjust to cover the costs of long-term care. Medicaid benefits in the form of health and consumption transfers, T^h and T^c, are given to the p% of the population that is hit with a catastrophic illness shock. The transfers are each some fraction, ζ^h and ζ^c, of average income, y(t). Specifically, $T^h = \zeta^h y(t)$ and $T^c = \zeta^c y(t)$. The government finances this program through a proportional Medicaid tax, τ^m, on the wages of the young

as well as a proportional tax, τ^w, on the return to saving of the p% of the old that draw a catastrophic long-term shock.

$$(12) \qquad \tau^m(t)w(t) + p\tau^w((1+\rho(t))s(t-1)) = p(\zeta^c + \phi\zeta^h)y(t)$$

In the private long-term care insurance regime, a perfectly competitive insurance market opens for agents upon entry into old age before the state of the world for each agent is revealed.[10] Individuals have the opportunity to buy a long-term care insurance policy, only knowing the probability with which they may be hit with the catastrophic shock, εh. If the insurance is offered at an actuarially fair rate, the expected value of the insurance is just equal to its cost. If the policy is not actuarially fair, it also includes a proportional transactions cost (σ). With zero profits in this market, the premium per dollar of the insurance policy, υ, is equal to the probability of drawing a catastrophic illness shock, p, discounted by (1-σ) where σ is the proportional transactions cost per policy. Note that if the insurance is actuarially fair transactions costs are equal to zero.

$$(13) \qquad (1-p)\upsilon F(t+1) + p(\upsilon F(t+1) - F(t+1)) - \sigma\upsilon F(t+1) = 0 \quad \Rightarrow \quad \upsilon = \frac{p}{1-\sigma}$$

[10]Empirical observation suggests that those buying long-term care policies are, on average, at retirement age as most insurance companies do not sell policies to individuals under the age of 50 or over the age of 84 (HIAA 1997).

The goods market clearing requires that the demand for goods be equal to the supply of goods each period. Thus, saving of the young at time t determines the capital stock tomorrow,

(14) $s(t) = k(t+1)$

and by arbitrage

(15) $(1+\rho(t+1)) = r(t)$.

The factor market clearing conditions are given by equations (10) and (11).

Thus, steady-state equilibrium under the Medicaid regime, using equations (5), (10)-(12), and (14)-(15), is represented by (16).

(16) $$\frac{-\delta}{Ak^{\alpha}(1-\alpha-p(\zeta^{c}+\zeta^{h}-\tau^{w}\alpha))-k}+\frac{\beta(1-p)\gamma}{k}+\frac{\beta p\gamma\alpha(1-\tau^{w})}{(\alpha(1-\tau^{w})+\zeta^{c})k}=0$$

Steady-state equilibrium under the private insurance regime, using equations (8), (10)-(11) and (13)-(15) is represented by (17a). The steady-state value of a long-term care insurance policy using (6b) is given in (17b).

(17a) $$\frac{-\delta}{Ak^{\alpha}(1-\alpha)-k}+\frac{\beta(\gamma+(1-\gamma)p)(1-\sigma)\alpha Ak^{\alpha-1}}{\alpha(1-\sigma)Ak^{\alpha}+p\phi h(1-\varepsilon)}=0$$

$$(17b) \quad F = \frac{(1-\gamma)(1-\sigma)\alpha A k^{\alpha} - \gamma\phi\, h(1-\varepsilon)}{\phi(\gamma + (1-\gamma)p)}$$

Steady-state equilibrium under the self-payment regime, using equations (9)-(11) and (14)-(15), is represented by (18a). The steady-state value of medical care using (7b) is given in (18b).

$$(18a) \quad \frac{-\delta}{Ak^{\alpha}(1-\alpha) - k} + \frac{\beta(1-p)\gamma}{k} + \frac{\beta p \alpha A k^{\alpha-1}}{\alpha A k^{\alpha} + \phi\, h(1-\varepsilon)} = 0$$

$$(18b) \quad m = \frac{(1-\gamma)\alpha A k^{\alpha} - \gamma\phi\, h(1-\varepsilon)}{\phi}$$

The analytical results of the welfare analysis for the various regimes are ambiguous. For example in the Medicaid regime, an increase in Medicaid benefits for those old hit with a catastrophic illness has a positive effect on well-being when old however it is at the cost of lower well-being when young due to the increase in payroll taxes that is needed to pay for the increased benefits. It becomes a question of which effect is greater and so numerical solutions and simulations have been employed. The baseline set of parameters for the numerical solutions is as follows:

Medicaid subsidy rate for the health transfer	$\zeta^h = .40$
Medicaid subsidy rate for the consumption transfer	$\zeta^c = .19$
Tax rate on the income of old hit with catastrophic illness	$\tau^w = .99$
Proportional transactions costs when buying private L-T care insurance	$\sigma = 0$
Price of L-T care	$\phi = 1$
Probability of catastrophic illness in old age	$p=.1$
Elasticity of well-being when young with respect to consumption	$\delta = .5$
Elasticity of well-being when old with respect to consumption	$\gamma=.5$
Health Stock	$h=.05$
Magnitude of catastrophic health shock	$\varepsilon=4.10$
Capital's share of output	$\alpha=.3$
Intertemporal discount factor	$\beta=.5$
Total factor productivity	$A=1$

After extensive analysis of the Medicaid subsidy rates for the health and consumption transfers the baseline values, are set to yield the government's best choice in terms of maximizing the welfare of individuals in the economy. There is a lower bound on the amount that the government pays out for the Medicaid health and consumption transfers as it must be more than the τ^w % of wealth that it collects from each of the p% of the old hit with a catastrophic illness. Otherwise the old would be subsidizing the young such that τ^m would be a subsidy and in that case the old would be better off to pay out-of-pocket. These values meet that requirement and further analysis of the choice of the health and consumption transfers is taken up in Result 2. The tax rate on the old hit with a catastrophic illness is set to 99%. As the program works now, individuals must spenddown much of their assets so that very little of their wealth remains after spenddown. In 1993, the maximum amount of assets that could be retained was about $2,000 in nonhousing assets for an unmarried individual where all income must be

contributed except for a personal needs allowance of $30 per month (Wiener et al., 1995).

Although the price of long-term care is observed to be greater than the price of consumption the price of long-term care is normalized to one. Doing this isolates the effects of the various funding regimes so as not to be intertwined with any price effects although there is some discussion of the variation of the price of long-term care on the following page. The proportional transactions costs of private insurance are initially set equal to 0 such that the private insurance is actuarially fair.

The incidence of functional limitations such as difficulties with activities of daily living (ADLs)[11] is an indicator of the need for long-term care of which nursing home care is included but not exclusive. However, it is the primary type of long-term care in mind in this analysis. As many as 20% of those over 65 have at least one disability as measured by ADLs (Williams et al., 1996). The use of long-term care is concentrated among the oldest of the old so that estimates of disability of the elderly (over 65) vary dramatically with age. Focusing only on nursing home care, estimates can range from 10-12% for an individual between 65-74 and over 50% for an individual over 85. However, approximately only 22% of those that use long-term care use formal nursing home care (Wiener et al., 1994). In the model, the estimate of the probability of a catastrophic illness, p, is an attempt to capture the percentage of retirees in the economy who are disabled and will most likely need nursing home care. The baseline value is .10 which is an average across all those over 65, however a range of values was tested with no significant change in the qualitative results.

[11] Activities of daily living include eating, bathing, dressing, toileting and getting in and out of bed.

The elasticities of well-being when young and old, with respect to consumption and health, were chosen such that they maintain the assumption of a constant returns to scale well-being function. There is no consensus on the size of these elasticities and with this uncertainty extensive sensitivity analyses were done and show that the qualitative findings of this paper hold for a wide range of values. Capital's share of output, α, and the intertemporal discount rate, β, have been estimated in numerous studies. In choosing the baseline value of the health stock, h, there is the issue of its size relative to consumption as there is not a standard measure that is easily interpretable relative to consumption. Sensitivity analyses show that the qualitative welfare results reported in this paper hold for a wide range of health stocks.

Before choosing the size of the catastrophic illness shock the nature of a true catastrophe in this model must be defined. A truly catastrophic event is one in which an individual's health is devastated to such a degree that she cannot finance the recovery from the shock on her own with only out-of-pocket medical expenditures. Thus, self-payment of a catastrophic illness is eliminated as option. The choice of the catastrophic illness shock is set sufficiently large so that the catastrophe cannot be recovered from in the self-payment regime. Thus, given the baseline health stock, h=.05, the catastrophic shock that was chosen destroys 410% of an individual's health stock. Note, this is based on the assumption that the baseline price of long-term care (=1) is equal to the price of consumption. However, it is generally thought that in the real world, the price of long-term care is greater than the price of consumption. If that is the case and the price of long-term care is doubled (=2) while the price of consumption remains equal to 1, the health shock that generates the same results is not as large. The catastrophic

shock that eliminates self-payment as an option destroys 260% of an individual's health stock. Thus, the size of the catastrophic shock is sensitive to the price of long-term care. Individuals must rely on either Medicaid or private long-term care insurance in order to recover from the health shock.

In 1996 median income for all those aged 65 and over was $16,099 (SSA, 1998). Only 10% have annual income greater than $50,000. Many of these individuals' only sizeable asset is their housing which for the purposes of Medicaid means-testing is excluded. At the same time, the average cost of one year in a nursing home is between $40-46,000 (HIAA, 1997). Approximately 90% of individuals would not be able to pay for one year of nursing home care solely out of their current income(Wiener et al., 1994). Some may be able to pay for nursing home care with current income and non-housing assets combined, although not indefinitely. The average stay in a nursing home for long-stay patients (more than 3 months) is 2.5 years (Moon et al., 1989). To the extent that individuals live more than one year in a nursing home, it is not unreasonable to believe that the financial shock due to a catastrophic illness (health shock) could be of the order of 2.6 or even 4.1 times the amount that individuals could afford out-of-pocket without any other sources of financing.

Some restrictions must be put on the models of the remaining regimes: private insurance and Medicaid. Individuals, at best, recover their health stock to its original level. This implies that the amount spent on recovery from the shock, either through an insurance policy or Medicaid, is restricted to, at most, the size of the shock. In the private insurance regime, individuals choose the size of the long-term care insurance policy; however, they are constrained to buying a policy that does not pay out more than that

needed to recover from the shock. Thus, there is a limit on the amount of insurance they can purchase. If they want to buy more than the maximum policy then they are forced to the corner solution where they purchase the maximum size policy. The same restriction applies in the Medicaid regime, however it is the government making the decision as to the size of the health and consumption transfers. The health transfer is restricted to, at most, the size of the health shock. The government could actually allocate a higher percentage of income to the health transfer, but it is not sensible to think that health can actually improve beyond its pre-shock level. Thus, the government would be throwing away resources that could be spent on the consumption transfer instead. The amount spent on recovery from the shock, whether via a Medicaid health transfer or a long-term care insurance policy, is no more than the amount needed to completely recover from the shock.

V. Welfare

With the self-payment regime ruled out in the case of a truly catastrophic illness shock, only the Medicaid and private long-term care insurance regimes remain. The measure of comparison for these sources of long-term care financing is steady-state equilibrium social welfare. In the case of the Medicaid regime, the effects of the policy parameters on lifetime well-being are examined. These results are then compared to those under the private long-term care insurance regime with varying amounts of transactions costs. The social welfare function is defined as the steady-state lifetime well-being of an individual.

$$U^{*} = \ln\left[\Theta^{*}(t)\right] + \beta(1-p)\ln\left[\Theta^{1*}(t+1)\right] + \beta p \ln\left[\Theta^{2*}(t+1)\right] \tag{19}$$

Upon substitution of the equilibrium values of consumption and health, social welfare under the Medicaid regime is represented by (20) where the steady-state capital stock is defined by (16).

$$\begin{aligned} U^{*\text{Medicaid}*} = {} & \ln\left[\left(Ak^{\alpha}(1-\alpha-p(\zeta^{c}+\zeta^{h}-\tau^{w}\alpha))-k\right)^{\delta}(h)^{1-\delta}\right] + \beta(1-p)\ln\left[(\alpha Ak^{\alpha})^{\gamma}(h)^{1-\gamma}\right] \\ & + \beta p \ln\left[\left((\alpha(1-\tau^{w})+\zeta^{c})Ak^{\alpha}\right)^{\gamma}\left(h(1-\varepsilon)+\zeta^{h}Ak^{\alpha}\right)^{1-\gamma}\right] \end{aligned} \tag{20}$$

Upon substitution of the equilibrium values of consumption and health, social welfare under the private insurance regime is represented by (21) where the steady-state capital stock is defined by (17a).

$$\begin{aligned} & U^{*\text{private insurance}*} = \\ & \ln\left[\left(Ak^{\alpha}(1-\alpha)-k\right)^{\delta}(h)^{1-\delta}\right] + \beta(1-p)\ln\left[\left(\frac{\gamma(1-\sigma)\alpha Ak^{\alpha}+\gamma p\phi h(1-\varepsilon)}{(\gamma+(1-\gamma)p)(1-\sigma)}\right)^{\gamma}(h)^{1-\gamma}\right] \\ & + \beta p \ln\left[\left(\frac{\gamma(1-\sigma)\alpha Ak^{\alpha}+\gamma p\phi h(1-\varepsilon)}{(\gamma+(1-\gamma)p)(1-\sigma)}\right)^{\gamma}\left(\frac{(1-\gamma)(1-\sigma)\alpha Ak^{\alpha}+(1-\gamma)p\phi h(1-\varepsilon)}{\phi(\gamma+(1-\gamma)p)}\right)^{1-\gamma}\right] \end{aligned} \tag{21}$$

Result 1: Economies under the private long-term care insurance regime with actuarially fair insurance (zero transactions costs) have greater social welfare (lifetime well-being) than economies under the Medicaid regime. However over some range of positive transactions costs on a long-term care insurance policy, economies under the

Medicaid regime have greater social welfare than economies under the private insurance regime. This result can be seen in Table 1.

Economies with actuarially fair (zero transactions costs) insurance, yield the greatest lifetime well-being of all model variations, as expected. However, it is not widely believed that long-term care insurance policies are priced at actuarially fair rates. Given this, proportional transactions costs per insurance policy are built into the model and then these economies with different transactions costs are compared to economies under the Medicaid regime. Economies under the private insurance regime with transactions costs less than or equal to 42% yield higher lifetime well-being of individuals than the economy under the Medicaid regime that maximizes individuals' lifetime well-being. Under the Medicaid regime, the government has the ability to set the size of the health and consumption transfers in order to maximize the lifetime well-being of individuals. Thus, economies under private insurance, with transactions costs greater than 42%, will always yield worse lifetime well-being than the economy under the Medicaid regime with the maximizing health and consumption transfer pair so that Medicaid becomes the better source of finance.

Although Medicaid eventually becomes the better source of long-term care finance, that does not occur until transactions costs are somewhat high.[12] However, upon

[12] Although there is no information regarding the load factor on private long-term care insurance (that is the difference in price from the fair actuarial value), there has been some research done in the annuities market literature. Notably Friedman and Warshawsky (1988) find that the load factor on annuities purchased from the 10 largest insurance companies range for the general population range from 1.20 to 1.55 for each $1 of premium. For example, a 65 year old U.S. male randomly selected from the population typically pays $1.32 for $1.00 of expected value when he purchases a life annuity. Of the 32 cents per dollar load factor to the general population, 14 cents represents the cost of adverse selection and the remaining 18 cents the combination of transactions costs, taxes and profits to the insurer. If the research in the annuities market is any indicator of what may be occurring in that of private long-term care insurance market then the results found here may not be too far off.

examination of long-term care insurance policies in practice, along with transactions costs in the narrow sense of administrative costs, processing claims etc., there are many policy terms and restrictions that translate into the transactions costs of this model. First, there is the issue of whether these policies are sold at actuarially fair rates. There is discussion in the literature that these policies are not sold at actuarially fair rates, see for example Gravelle et al. (1989). This is partly due to issues of adverse selection in the pool of elderly that purchase long-term care insurance. Those who believe they have a relatively higher probability of being hit with a catastrophic illness will be more likely to buy the insurance. Adverse selection is not explicitly modeled due to this being a first round attempt at addressing the issue of non-actuarially fair private long-term care insurance although it is a potential extension for future work. Second, many of these policies are sold to individuals that are likely not to make a claim for 20-30 years, and do not give unlimited coverage but instead cap the benefits at a nominal daily rate for the various types of care whether it be a nursing home or home health aid. See, for example, Cutler (1993). Because of no inflation adjustment, many policies end up with an implicit deductible. Of those policies that do offer yearly inflation adjustment at a specified rate such as 5%, often the rate of adjustment is lower than the increased costs of long-term care so that there is still some amount that individuals must pay to make up the difference. Third, the availability of long-term care insurance policies is somewhat limited as not all insurance companies write these policies. The insurance market for long-term care is not fully developed and in that sense the companies that write these policies may be able to sell these policies for more than the actuarially fair price.

A word of caution may be in order regarding the ranking of the Medicaid and non-actuarially fair private long-term care insurance funding regimes. This analysis has concentrated only on the financing mechanisms of these two alternatives. However, that is not to say that there may be some inefficiencies introduced by the government in the Medicaid regime e.g., bureaucratic costs, that are not captured here. Regardless, some of the inefficiencies in the private long-term care insurance regime are still present. It may come down to a discussion of which inefficiencies are greater. For example, private long-term care insurance with transactions costs may be more efficient than Medicaid such that it is cheaper. Although this may require the government to step in and, at the very least, mandate its purchase by all those over 65.

Because this Medicaid policy dominates private insurance with some positive transactions costs, that does not necessarily mean that this intergenerational tax and transfer program is the best government policy to deal with long-term care. Medicaid is essentially acting as an insurance program however it is not pooling risk across the old that can be hit with a catastrophic illness as in the standard insurance case. Instead it is pooling across the young who do not face such a risk through a proportional Medicaid tax on their labor income. They are then paying for a large share of the program costs. There may be, in fact, a better design for this aspect of the Medicaid program. When Medicaid was created in 1965 its intended goal was to provide medical care to low-income families while its financing of long-term care for the elderly came as an afterthought due to there being no alternative source of financing. Individuals may be better off if the government opened an insurance market for the long-term care of the old thereby pooling across the old who face the risk of a catastrophic illness rather than young workers. If all old

purchased long-term care insurance, for example through a monthly reduction in Social Security benefits or as part of Medicare, then the insurance could be sold at actuarially fair rates. Adverse selection would be eliminated and then the Medicaid regime would yield the same lifetime well-being for individuals as actuarially fair private insurance.

Result 2: In economies under the Medicaid regime, for a given level of total program funding, there is a health and consumption transfer pair that maximizes lifetime well-being. It is the one that attempts to restore an individual's health stock to it pre-shock level. The transfers are each a fraction of output where output is endogenously determined by the amount of capital accumulation in the economy, thus impacting the amount of each transfer. This leads to there being an optimal pair of health and consumption transfers for a given level of funding. This result can be seen in Table 2.

The way in which the consumption and health transfers are distributed has an impact on lifetime well-being so that the choice of the policy parameters is an important issue. The Medicaid program is similar to private insurance to the extent that it is trying to restore health to its pre-shock level. The health transfer is restricted such that health cannot improve beyond its pre-shock level. If the government were to allocate an amount greater than that it would be throwing away resources that could be spent on the consumption transfer instead. It is interesting to note the connection between the health and consumption transfers, T^h and T^c, and capital accumulation because, by definition, the transfers are not exogenous. The transfers are each a fraction of output in the economy so only the percentages are set, whereas average income in the economy is

endogenously determined by the amount of saving and thus capital accumulation in the economy. Thus, for a given funding level of Medicaid in an economy, as the fraction of output for the health transfer, ζ^h, increases (the fraction of output for the consumption transfer, ζ^c, decreases), capital accumulation increases. A decrease in the generosity of the consumption transfer for the old hit with a catastrophic illness decreases expected income when old, so there is a negative income effect on the old which acts as an incentive to save more when young. Thus, the health and consumption transfer pair that maximizes lifetime well-being is the one that attempts to restore an individual's health stock to it pre-shock level. Although at first glance one may want to set the consumption transfer to zero, lifetime well-being is not maximized for the baseline economy. This is because the income of the old hit with the catastrophic illness has been confiscated by the government due to the means-tested nature of Medicaid. Thus, it is important for individuals to receive some positive consumption transfer.

VI. Comparisons to Kotlikoff

At this time it is beneficial to draw some parallels between the results in this paper and those of Kotlikoff. Three items should be noted about Kotlikoff's comparison of the Medicaid, private insurance and self-payment regimes. First, all of Kotlikoff's analysis is partial equilibrium, in a two period life-cycle framework where individuals work when young and consume when young and old. In the first period, individuals are healthy and in the second period they become ill with probability p. This is similar to the analysis in this paper however, in Kotlikoff's partial equilibrium framework the consumption/saving decision is chosen assuming an exogenous wage, interest rate and amount of health care

expenditures necessary to recover from the shock. The medical care is financed though various regime-dependent sources: minimum consumption transfer under Medicaid, actuarially fair insurance or out-of-pocket under self-payment. This paper, using a general equilibrium model, endogenizes these prices and allocations and then examines the steady-state lifetime well-being effects under the Medicaid and private insurance regimes.

Second, he examines the same three regimes but agents receive utility from consumption alone. The disutility of illness only appears implicitly through a decrease in consumption. They give up consumption in order to pay health expenditures, e. Agents have no choice in the amount of health expenditures; either they pay for treatment or live with the illness (which in many instances is not a viable option in the real world). Kotlikoff places this discussion in the context of precautionary saving for health expenditures, however there is nothing in the model that differentiates this health shock from any other sort of income shock. He simply examines the effects of an exogenous loss and recovery from that loss under various regimes: self-payment, private insurance and Medicaid.

However, in this paper, agents gain utility, explicitly, from both consumption and health. Agents have the ability to choose how much income to allocate to consumption and a long-term care insurance policy in the private insurance regime (medical care in the self-payment regime). Individuals must pay for long-term care which decreases their second period income, however, they also receive increased utility upon purchasing medical care to recover from the health shock. In the Medicaid regime, agents do not choose the amount of long-term care. If an agent does get hit with a catastrophic illness in

old age then the government will provide for her through consumption and health transfers.

This leads to a third issue in Kotlikoff's models: the way in which the government transfer is modeled. The government transfer, in his model, is funded simply through the confiscation of assets from those that are hit with a catastrophic illness. Once an individual falls ill due to a catastrophic shock, the government collects all of her assets and then the government program pools all of the individuals' assets and redistributes them to guarantee everyone a minimum level of consumption. This type of program very much depends on the income distribution. If those that were very poor were disproportionately hit with catastrophic illness, the average consumption level that the government would provide could possibly be less, for some, than with no government program. In reality, the Medicaid benefit that the government provides to those hit with a catastrophic shock does not fluctuate with the amount of assets it confiscates.

In this paper, Medicaid is funded not only by the confiscated assets of those hit with a catastrophic illness but also a proportional Medicaid tax on the labor income of the young which provides for the health and consumption transfers. The government's confiscation of assets, in this model, is equivalent to individuals spending down on their own before qualifying for means-tested Medicaid. This may appear an unconventional way in which to model the program. However, there is no uncertainty as to the time of death of those with a catastrophic illness and so implicitly the model assumes that individuals will use up all of their resources before they die and will ultimately become dependent on Medicaid. Thus, the timing of the means-test whether at the beginning of the period or after the spenddown, is equivalent. In this paper, the issue of fluctuations in

Medicaid transfers, depending on the amount of assets confiscated, is avoided. This is because the government provides a standard health and consumption transfer to everyone hit with a catastrophic illness which it provides, in part, through a pay-as-you-go system in which all agents are taxed when young to help pay for the current old that are hit with a catastrophic illness. Medicaid pools the risk of a catastrophic illness across the entire population of the young through the tax on their labor income.

Wealth is only the savings of the old in a two period model in the regimes that Kotlikoff outlines. Obviously more consumption when young implies less savings. He assumes that there is a precautionary motive for saving, $U''' > 0$, which leads to the following ranking: saving is largest under self-payment, then saving under actuarially fair insurance and saving is smallest under Medicaid. Thus, the reverse is true for consumption when young under all three regimes. If $U''' > 0$, the concern about saving too little if hit with the catastrophic illness outweighs the concern about oversaving *ex post*. The choice of regime (Medicaid, self-payment, private insurance) depends ultimately on that which provides the greatest expected utility not the greatest saving. Kotlikoff finds that expected utility under the private insurance regime dominates that under self-payment, as individuals cannot be made worse off with the option of buying insurance. Next, he finds that expected utility under self-payment dominates that under Medicaid because the individual who falls ill is effectively forced to purchase her own care and is constrained in her choice of consumption after becoming sick. Kotlikoff concludes that Medicaid would exist then only if it were a compulsory program run by the government.

In this analysis self-payment of a catastrophic illness is ruled out as an option in this economy thus the rankings of capital accumulation and social welfare are only for the

private insurance and Medicaid regimes. Saving is greater under private long-term care insurance, for any size transactions costs, than saving under the Medicaid regime. Actuarially fair private insurance has the least amount of saving relative to private insurance with any positive transactions costs. Saving under private insurance is always greater than saving under the Medicaid regime. In fact, saving is monotonically increasing as transactions costs increase under private insurance. See Table 3. There is also a precautionary motive for saving ($U''' > 0$) as can be seen by the assumption of log utility. Unlike Kotlikoff's ranking, greater saving under private insurance does not necessarily mean that the reverse is true for consumption when young. This is due to health being explicitly modeled in the utility function. Also, in this model Medicaid is funded in part by a proportional labor tax on the young which further alters consumption when young. What may be of more interest in terms of the choice of regime is that which provides the greatest lifetime well-being. Unlike Kotlikoff's ranking this paper finds that Medicaid need not be a compulsory government program in order to exist. In fact, it is the preferred choice of finance relative to private insurance over some range of positive transactions costs.

VII. Conclusion

This model attempts to examine the aspect of Medicaid that deals with long-term care along with the private funding sources of long-term care private insurance and self-payment as did Kotlikoff (1989). He considers each of these sources of long-term care financing as potential alternatives and ranks them accordingly: actuarially fair private insurance, self-payment and lastly Medicaid.

The results in this paper quickly rule out self-payment as an alternative because a truly catastrophic illness shock is thought to devastate individuals' health so that they cannot finance the recovery from the shock on their own with only out-of-pocket medical expenditures. That leaves only the Medicaid and private long-term care insurance regimes. Not only is actuarially fair insurance examined but also non-actuarially priced insurance, as is often observed in reality. These two regimes are compared in terms of their effect on steady-state equilibrium social welfare (lifetime well-being). Social welfare in economies under the private long-term care insurance regime with actuarially fair insurance (zero transactions costs) is greater than in economies under the Medicaid regime. However, for some range of positive transactions costs on long-term care insurance policies, economies under the Medicaid regime yield greater social welfare than economies under the private insurance regime. This is true given that private long-term care insurance relies on pooling risk across all old agents who face the risk of a catastrophic illness. The Medicaid program relies mainly on pooling across young agents who do not face the risk of a catastrophic illness, via their payroll tax. However, individuals may be better off under the Medicaid regime if the government opened an insurance market for the long-term care of the old. The government would then be pooling risk across the group that faces the risk of a catastrophic illness rather than young workers. If all old were required to purchase long-term care insurance, for example through a monthly reduction in Social Security benefits or as part of Medicare, then the insurance could be sold at actuarially fair rates. Adverse selection would be eliminated and then the Medicaid regime would yield the same lifetime well-being for individuals as actuarially fair private insurance. This analysis has concentrated on the financing

mechanisms of these alternatives where under certain conditions individuals may be better off under the Medicaid regime. However, that is not to say that there may be some inefficiencies introduced by the government in its operation of Medicaid, e.g., bureaucratic costs that are not captured here. Regardless, some of the inefficiencies in the private long-term care insurance regime still remain such that the discussion may be one relative inefficiencies.

The analysis in this paper suggests a closer review of the goals and design of the long-term care portion of Medicaid. Currently this government program costs taxpayers, specifically young workers, a nontrivial amount to finance a sort of public long-term care insurance for the old. It may be that society values the protection of the health and well-being of the old so much that the cost in terms of taxes when young is not too high and it is willing to pay for this program. However it is not clear that pooling across the young, who are not at risk, is the best way to finance this program.

APPENDICES

APPENDIX A

NON-CATASTROPHIC HEALTH SHOCK

The following examines an illness in which it is possible for individuals to recover from with only their out-of-pocket medical expenditures. Thus, it is not catastrophic in health or financial terms so the size of the shock, εh, is smaller than it is with a catastrophic shock. For the baseline economy, the non-catastrophic shock destroys 242% of an individual's health stock. Since individuals would not meet the Medicaid means-test the remaining possible source of financing are self-payment and private long-term care insurance. The steady-state social welfare of these two regimes is compared.

Result A1: For non-catastrophic illnesses, economies under the private long-term care insurance regime with actuarially fair insurance (zero transactions costs) have greater social welfare (lifetime well-being) than economies under the self-payment regime. However over some range of positive transactions costs on a long-term care insurance policy, economies under the self-payment regime have greater social welfare than economies under the private insurance regime. See Table 4.

Economies with actuarially fair (zero transactions costs) insurance, yield the greatest lifetime well-being of all model variations, as expected. However, it is not widely believed that, of those that exist, long-term care insurance policies are priced at actuarially fair rates. Given this, proportional transactions costs per insurance policy are built into the model and then these economies with different transactions costs are compared to economies under the self-payment regime. Economies under the private insurance regime

with transactions costs greater than 33% yield worse lifetime well-being of individuals than the economy under the self-payment regime.

Observation suggests that, although growing, the private long-term care insurance market is relatively thin for a number of reasons outlined in the paper. If the policies are sold at non-actuarially fair rates that are sufficiently large this would suggest that individuals would be better off in other payment regimes. Individuals would choose self-payment for non-catastrophic shocks, in health and financial terms, and Medicaid when the illness turns catastrophic.

APPENDIX B

Table 1
Result 1.1

Transactions costs (σ)	Lifetime well-being private insurance	Health in state 2 of old age	Size of L-T care insurance policy
.00	-3.42477	.05	.205
.25	-3.43527	.05	.205
.42	**-3.44839**	.05	.205
.43	**-3.44944**	.05	.205
.44	-3.45054	.05	.205
.60	-3.47726	.05	.205
.61	-3.47984	.0485352	.203535
.62	-3.48255	.0470384	.202038

Fraction of output for health and consumption transfers	Lifetime well-being Medicaid	Health in state 2 of old age	Size of health and consumption transfer
$\zeta^h = .40$	**-3.44907**	.0492469	$T^h = .204247$
$\zeta^c = .19$			$T^c = .0970173$

Table 2
Result 1.2

Fraction of output for health and consumption transfers		Size of health transfer	Size of consumption transfer	Capital stock	Health in state 2 of old age	Lifetime well-being Medicaid
$\zeta^h = .37$	$\zeta^c = .22$	.188915	.112328	.106386	.0339154	-3.45479
$\zeta^h = .38$	$\zeta^c = .21$	.194025	.107225	.106394	.0390253	-3.45443
$\zeta^h = .39$	$\zeta^c = .20$	.199136	.102121	.106402	.0441357	-3.45055
$\zeta^h = .40$	$\zeta^c = .19$	.204247	.0970173	.106411	.0492469	-3.44907
$\zeta^h = .41$	$\zeta^c = .18$	.209359	.0919137	.106421	.0543589	-3.44792

Table 3
Relationship between transactions costs (government transfers) and the capital stock

Transactions costs (σ)	Capital stock
.00	.141303
.25	.147218
.42	.154495
.43	.155074
.44	.155676
.60	.170111
.61	.171083
.62	.172104

Fraction of output for health and consumption transfers	Capital stock
$\zeta^h = .40$	.106411
$\zeta^c = .19$	

Table 4
Result 1.A1

Transactions costs (σ)	Lifetime well-being private insurance	Health in state 2 of old age	Size of L-T care insurance policy
.00	-3.41265	.05	.121
.15	-3.41565	.05	.121
.30	-3.42003	.05	.121
.33	**-3.42077**	.05	.121
.34	**-3.42156**	.05	.121
.35	-3.42197	.05	.121
.38	-3.4233	.05	.121
.40	-3.42427	.05	.121

	Lifetime well-being self-payment	Health in state 2 of old age	Amount of medical care
	-3.42155	.0498423	.120842

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HEALTH AND MEDICAL BENEFITS

I. Introduction

The public and private health care programs that currently exist in the US, Medicare, Medicaid and the beneficial treatment of employer provided medical benefits, while subsidizing medical care, were designed not only to improve individual health but also general well-being. Well-being in the economy is a broadly defined measure and includes not only the health and welfare of the programs' target groups but that of all individuals in the economy as well. These programs are intended to make individuals better off over their lifetimes, not only in terms of the medical care they receive but also in terms of their overall standard of living. This paper examines these health care programs to see if they have achieved this broader goal.

This paper, using an overlapping generations framework, examines the long-run effects of various health care programs (or absense thereof) and their financing on two indicators of economic welfare: lifetime well-being of individuals and capital accumulation. As in the real world, individuals are assumed to differ in their productivity, thus income, and in the medical subsidies they receive when young. Since subsidies can vary by type of agent, a total of six model variations are examined. The tax- benefit system is examined in terms of its effect on different socio-economic groups both within and across generations.

The key results of the paper are as follows. First, in the steady-state equilibria of the model variations, comparative static results show that increases in the Medicare subsidy rate reduce steady-state lifetime well-being. Subsidies to medical care of the young, whether via Medicaid or an employer are beneficial as they increase individuals' well-being when young as well as over their lifetimes. If medical care for the young is

subsidized, more can be spent on non-medical care for health and well-being (nutrition, exercise, health knowledge) which may be at least as important as medical care. At the same time, if medical care is subsidized this may cause a distortion in the allocation between medical and non-medical inputs. Capital accumulation is examined because the medical care subsidies affect it differently and it provides a broad, potentially directly measurable, indicator of social welfare. Capital accumulation is negatively affected by increases in Medicare or Medicaid subsidy rates while it is positively affected by employer provided medical benefits.

Second, and perhaps, not surprisingly, the schemes of medical subsidies that most benefit high productivity workers may not be the ones that most benefit low productivity workers. For example in the regime that most benefits high productivity workers they receive employer provided medical benefits while low productivity workers receive no medical subsidy of any kind when young. This regime is ranked fifth out of six for low productivity workers. This result is a direct outcome of who pays for the programs and who receives the benefits. The tax burden on high productivity workers is at its minimum as they receive an implicit tax break via employer provided benefits. At the same time, low productivity workers neither receive any more government benefits (only Medicare) than high productivity workers nor any employer provided medical benefits. They must pay for all of their own medical care as well as face a higher tax rate to compensate for the tax break received by high productivity workers, holding the size of the government programs constant.

Third, different social welfare rankings were examined and policy experiments were conducted. Using variations of a Benthamite social welfare function, the economy-

wide, welfare maximizing Medicare subsidy rate is less than what it is believed to be in practice even if more weight is placed on the well-being of the old than the young. Also, the effectiveness of any medical subsidies to the young is lessened if the well-being of the old is valued more than that of the young. Policy changes that were examined include means-testing Medicare, progressive tax rates, and increasing the Medicaid subsidy via increased taxes or decreased Medicare subsidies. Generally these results are in line with earlier findings. Medical subsidies to the old reduce lifetime well-being while subsidies to the young tend to increase lifetime well-being.

II. Literature Review

There has been very little theoretical study of multiple health care programs that exist simultaneously in a general equilibrium framework. There is one exception. Pecchenino, Stearns and Jenkins (1998) examine the Medicare and Social Security programs and their inter-generational funding along with government medical subsides for the young. They find that more generous Medicare systems can have negative effects on individuals' health over their lifetimes and medical subsides for the young tend to improve lifetime healthiness.

Much of the work that has been done to date examines a single health care program and its effect on such things as pay-as-you-go tax system, distribution of benefits, saving, labor supply, the effect on private insurance or the size of the tax subsidy of employer provided insurance. In the face of increasing costs, Feldstein (1999) examines whether Medicare should continue to be funded by a pay-as-you-go system. He believes that simply because those over 65 cannot finance their health care via current employment

or other retirement income does not necessarily mean it should be financed in its current manner. This is due to projected increased deadweight losses with higher taxes that would be needed to support this increasingly expensive program. He suggests an investment based program for individual health care costs called Retiree Health Accounts where the government contributes on behalf of individuals during their working years and then returns the fund to individuals at retirement. McClellan and Skinner (1997) consider the incidence of Medicare transfers from taxpayers to beneficiaries through examination of the net tax payments and program expenditures for individuals across various lifetime income groups. They find that the program has led to net transfers from the poor to the wealthy due to the relatively regressive financing mechanisms and higher expenditures of the wealthier beneficiaries. Lee, et al. (1999) measure the flow of Medicare benefits among high-income and low-income neighborhoods. Their results suggest that per capita Medicare spending increased much more for low-income neighborhoods than high or middle-income neighborhoods from 1990 to 1995, particularly the home health care spending component of Medicare. It appears that the distribution of program benefits may be sensitive to changes in specific components of the program.

Although Medicare is the biggest of the government funded health care programs, Medicaid has also received a fair amount of attention. Hubbard, et al. (1995) show in context of a dynamic programming model that the differential wealth between low and high income groups is, in part, a response to means-tested programs such as Medicaid. Yelowitz (1995) assesses the impact of losing public health insurance (Medicaid) for a woman's children on her labor market participation. Cutler and Gruber (1996) examine whether an increase in public health insurance coverage is associated with a reduction in

private insurance coverage. They find that approximately 50% of the increase is due to employees taking-up private insurance less frequently. As for the study of employer provided medical benefits, Gruber and Poterba (1996) attempt to measure the net tax subsidy of employer benefits using the NBER tax model to estimate the taxes paid by individuals and the 1987 National Medical Expenditures Survey (NMES) for insurance plans available through employers. The effect of these health care programs on healthiness is often overlooked with some exceptions such as Currie and Gruber (1996) and Kaestner, Joyce and Racine (1999). They, along with most, deal with the effect of increased Medicaid coverage on children's, not adults', health status.

With few notable exceptions including McClellan, et al. (1997) and Hubbard, et al. (1995), most Medicare/Medicaid studies examine the distributional effects within a generation, but not across generations. While this is reasonable for Medicaid, it is less so for Medicare given that it is financed in a pay-as-you-go manner. Since Medicare is just 35 years old, it is only the newly retired who will have both paid into the system throughout their working lives and received benefits from the system. Thus, the lifetime effects of Medicare on these beneficiaries is as yet unknown. Just now will individuals who have paid into the system for their entire working life begin to reap the benefits so that even with health status information on adults the programs are so young that it may be difficult to measure the true lifetime effect.

These health care programs, however, can be examined within the context of the general equilibrium macroeconomic model developed in this paper. Further, since the model economy is constructed so that some workers receive employer provided medical benefits, while others receive Medicaid or no benefits at all and retirees receive Medicare

at potentially different subsidy rates, the effects of the programs, both direct and indirect, can be studied simultaneously.

III. The Model and its Variations

Consider an infinitely lived economy composed of two types of finitely lived individuals, firms and a government. A new generation of each type of individual is born at the beginning of each period t, (t=1, 2, 3...) and lives for two periods: youth and retirement. Call this generation t and index type by j, j=1, 2. The two types of agents differ in their productivity, ϕ_j. Higher productivity (j=1) in this model reflects higher income. In youth, individuals of type j receive well-being from current medical and non-medical inputs and heredity (inherited well-being from parents). In retirement, individuals also receive well-being from current medical and non-medical inputs, as well as well-being when young. There is no population growth. Without loss of generality assume N_j of type j, j=1, 2, are born at each date where $\Sigma N_j=1$.

Both types of agents, in the first period of their lives, work and divide their labor income among current medical expenditures, current non-medical expenditures, saving for retirement and payroll Medicare/Medicaid taxes. Non-medical expenditures include all expenditures that also contribute to well-being but are not directly medical. This composite good includes consumption/nutrition, exercise, and health knowledge. Such life-style factors have been shown to be important determinants of well-being by Gilleskie and Harrison (1998) and Kenkel (1991) among others. Furthermore, non-medical efforts when young may reduce the need for subsequent medical expenditures when old as explored by Grembowski et al. (1993) and Stearns et al. (1998).

At the beginning of the second period of a type j agent's life she will contract an illness of type i, with probability π_i, i=1,2[1]. The illnesses are of varying degrees, with i=1 representing a minor illness, and i=2 representing a relatively more serious illness. Each illness is of the same severity for all type j agents. Agents divide their accumulated saving between current medical and non-medical expenditures. Medicare subsidizes only medical expenditures.

Let the representative type j member of generation t's preferences be represented by

$$U^j(t) = \ln h_t^j(t) + \beta \sum_i \pi_i \ln h_{it}^j(t+1) \tag{1}$$

where $h_t^j(t)$ is the well-being of a type j member of generation t while young, $h_{it}^j(t+1)$ is the well-being of a type j member of generation t with illness i while old, and β is the discount rate.

Assume that the well-being of a young type j member of generation t is a constant-returns-to-scale function of her medical inputs, $m_t^j(t)$, non-medical inputs, $e_t^j(t)$, and inherited well-being from her parents, $h_{t-1}^j(t-1)$. Specifically, $h_t^j(t) = h_{t-1}^j(t-1)^{\alpha_1} m_t^j(t)^{\alpha_2} e_t^j(t)^{1-\alpha_1-\alpha_2}$ where $\alpha_1, \alpha_2 \in [0,1]$ and $\alpha_1 + \alpha_2 < 1$. Similarly, the well-being of an old type j member of generation t with illness i is a constant-returns-

[1] The probability of an illness is exogenous and is not a function of well-being when young. The extent of the effect of well-being when young on the probability of an illness when old is unclear and, further, endogenous probabilities are not tractable in this model. However, inter-generational links are included in this model as well-being when young does directly have an impact on well-being when old.

to-scale function of medical inputs, $m_{it}^j(t+1)$, non-medical inputs, $e_{it}^j(t+1)$, and well-being while young, $h_t^j(t)$. Specifically,

$h_{it}^j(t+1) = h_t^j(t)^{\gamma_1}(m_{it}^j(t+1) - \vartheta_{im})^{\gamma_2}(e_{it}^j(t+1) - \vartheta_{ie})^{1-\gamma_1-\gamma_2}$ where

$\gamma_1, \gamma_2 \in [0,1]$ and $\gamma_1 + \gamma_2 < 1$. An illness i shock affects the ability of an individual to produce well-being and as such affects the components of well-being determined at present, which means both the medical and non-medical elements are affected. The portion of illness shock i that affects medical inputs is ϑ_{im} while the portion that affects non-medical inputs is ϑ_{ie}.[2]

The firms in this economy are perfectly competitive profit maximizers that produce a single non-medical good using the constant returns to scale production function $Y(t) = AK(t)^{\nu}(\sum_j N_j\phi_j)^{1-\nu}$ where A>0 is a productivity constant, K(t) is the capital stock at date t and $\sum_j N_j\phi_j$ is effective labor at date t. Effective labor is comprised of labor hours, N_j and the productivity, ϕ_j of each type of agent. Capital fully depreciates in the production process.

With no subsidy of medical expenditures, young agents of type j produce medical goods by converting non-medical goods into medical goods at rate p_m^j. With subsidization of medical expenditures by Medicaid, at rate η, young agents of type j produce medical goods by converting non-medical goods into medical goods at rate

[2] Many illnesses affect not only the medical component of well-being but also the non-medical component. Examples of shocks to the non-medical component include the inability to cook one's own meals, bathe or dress oneself or go grocery shopping.

$p_m^j(1-\eta)$. Note that this government program will be targeted toward the lower productivity/income workers. With employer provided medical benefits, current medical care, $m_t^j(t)$, is augmented by the employer benefit, $\phi_j m$, which is productivity dependent. This employer provided benefit is converted from non-medical goods into medical goods by the employer at a rate of p_f^j. Thus, well-being when young with an employer provided medical benefit is $h_t^j(t) = h_{t-1}^j(t-1)^{\alpha_1}(m_t^j(t)+\phi_j m)^{\alpha_2} e_t^j(t)^{1-\alpha_1-\alpha_2}$.

Old agents of type j produce medical goods by converting non-medical goods into medical goods at a rate of p_i^j. The price may vary according to the severity of the shock such that the price of medical care for the less severe illness may be less than the price of the more severe illness. Under Medicare, subsidization of medical care is universal for all old, for any type j and illness i, at a rate of σ. Thus, all old pay only (1-σ)% of their medical expenditures, no matter what illness they face.

The government in this economy imposes a uniform proportional tax on the wages of all young workers. The revenues from these taxes support both the Medicare and Medicaid (when in operation) programs. Medicare sets a subsidy rate on medical expenditures of the old and the level of benefits each old individual receives is ultimately determined by her choice of medical care. Medicaid (when in operation) also sets a subsidy rate for medical expenditures of the young and then the level of benefits received will be determined by her choice of medical care. The government funds its current expenditures with current tax receipts as is the case with the existing Medicare and Medicaid programs. Thus, it must adjust the tax rate that all young workers face such that its budget is balanced.

The representative type j agent at date t faces several constraints, partially dependent on the medical care benefits, if any, received by a young worker of type j. If no medical care subsidies are given to a young worker, well-being in youth is defined by (2a) while the budget constraint when young is defined by (2b). If Medicaid subsidizes a young worker's medical care expenditures at a rate of η then this simply acts as a reduction in the price of medical care. Then, well-being in youth in this case, (3a) is identical to that in (2a) but the budget constraint takes the medical care subsidy rate into account in (3b). If employer provided medical benefits are given to a young worker, the benefits, $p_f^j \phi_j m$, come out of her before-tax wage and in return she receives a minimum level of medical care, $\phi_j m$, which then directly affects her well-being, $h_t^j(t)$ through her choice of medical care, $m_t^j(t)$. The constraints are as follows in (4a) and (4b).

(2a)	$h_t^j(t) = h_{t-1}^j(t-1)^{\alpha_1} m_t^j(t)^{\alpha_2} e_t^j(t)^{1-\alpha_1-\alpha_2}$
(2b)	$\phi_j w(t)(1-\tau(t)) = p_m^j m_t^j(t) + e_t^j(t) + s^j(t)$
(3a)	same as (2a)
(3b)	$\phi_j w(t)(1-\tau(t)) = (1-\eta)p_m^j m_t^j(t) + e_t^j(t) + s^j(t)$
(4a)	$h_t^j(t) = h_{t-1}^j(t-1)^{\alpha_1} (m_t^j(t) + \phi_j m)^{\alpha_2} e_t^j(t)^{1-\alpha_1-\alpha_2}$
(4b)	$\phi_j (w(t) - p_f^j m)(1-\tau(t)) = p_m^j m_t^j(t) + e_t^j(t) + s^j(t), \qquad m_t^j(t) \geq 0$

The constraints for a type j old agent with illness i are identical, no matter what subsidies might be available to the young, because they all receive Medicare subsidization

at the same rate and an illness i shock affects both the medical and non-medical components of old age well-being with the same type independent probability.

$$(5) \qquad h_{it}^{j}(t+1) = h_{t}^{j}(t)^{\gamma_1}(m_{it}^{j}(t+1) - \vartheta_{im})^{\gamma_2}(e_{it}^{j}(t+1) - \vartheta_{ie})^{1-\gamma_1-\gamma_2}$$

$$(6) \qquad (1+\rho(t+1))s^{j}(t) = (1-\sigma)p_{i}^{j}m_{it}^{j}(t+1) + e_{it}^{j}(t+1)$$

The representative type j agent at date t takes as given the return to saving when old, $(1+\rho(t+1))$, the wage rate, w(t), and the tax rate, $\tau(t)$. She chooses medical and non-medical care when young, $m_{t}^{j}(t), e_{t}^{j}(t)$, and old, $m_{it}^{j}(t+1), e_{it}^{j}(t+1)$, across all illnesses i, and saving, $s^{j}(t)$, to maximize (1) subject to: (2a)-(2b) and (5)-(6) if no medical subsidies are given to young workers; (3a)-(3b) and (5)-(6) if Medicaid subsidies are given to young workers; (4a)-(4b) and (5)-(6) if employer provided medical benefits are given to young workers.

IV. Steady-State Equilibrium

A competitive steady-state equilibrium for this economy is a time invariant price vector {w, r, ρ}, a time invariant allocation $\{m^{j}, m_{i}^{j}, e^{j}, e_{i}^{j}, s^{j},\ j, i = 1,2\}$ such that given these prices and allocations, agents' well-being is maximized, firms' profits are maximized and the government budget constraint is satisfied.

The first set of first-order conditions (FOC), (7a)-(7c), is derived under the assumption that medical benefits for young workers are not subsidized. Substituting (2a) and (5) into the objective function (1) and maximizing subject to (2b) and (6) yields the

first-order conditions of type j agent's problem with respect to saving, medical care when young, and medical care for illness i when old, respectively.

The second set of FOC, (8a)-(8c), is derived under the assumption that the government, via Medicaid, subsidizes medical care for a type j young agent. This effectively lowers the price of medical care for young agents as can be seen in the first-order conditions for saving (8a) and medical care when young (8b) which are analogous to those in (7a) and (7b). The first-order condition for medical care for old agent j with illness i is identical to that in (7c).

The third set of FOC, (9a)-(9c), is derived under the assumption that the employer provides medical benefits to the young through a before-tax deduction to her wage. In this case the first-order condition for medical care for old agent j with illness i (9c) is identical to that in (7c) while the first-order conditions for saving (9a) and medical care when young (9b) are analogous to those in (7a) and (7b) in an interior equilibrium.

(7a) $$\frac{-(1-\alpha_1-\alpha_2)(1+\beta\gamma_1)}{\phi_j w(t)(1-\tau(t))-s^j(t)-p_m^j m_t^j(t)}+\sum_i \frac{\pi_i\beta(1-\gamma_1-\gamma_2)(1+\rho(t+1))}{(1+\rho(t+1))s^j(t)-(1-\sigma)p_i^j m_{it}^j(t+1)-\vartheta_{ie}}=0$$

(7b) $$\frac{\alpha_2}{m_t^j(t)}-\frac{(1-\alpha_1-\alpha_2)p_m^j}{\phi_j w(t)(1-\tau(t))-s^j(t)-p_m^j m_t^j(t)}=0$$

(7c) $$\frac{\gamma_2}{m_{it}^j(t+1)-\vartheta_{im}}-\frac{(1-\gamma_1-\gamma_2)(1-\sigma)p_i^j}{(1+\rho(t+1))s^j(t)-(1-\sigma)p_i^j m_{it}^j(t+1)-\vartheta_{ie}}=0$$

(8a)
$$\frac{-(1-\alpha_1-\alpha_2)(1+\beta\gamma_1)}{\phi_j w(t)(1-\tau(t))-s^j(t)-(1-\eta)p_m^j m_t^j(t)}+$$
$$\sum_i \frac{\pi_i\beta(1-\gamma_1-\gamma_2)(1+\rho(t+1))}{(1+\rho(t+1))s^j(t)-(1-\sigma)p_i^j m_{it}^j(t+1)-\vartheta_{ie}}=0$$

(8b)
$$\frac{\alpha_2}{m_t^j(t)}-\frac{(1-\alpha_1-\alpha_2)(1-\eta)p_m^j}{\phi_j w(t)(1-\tau(t))-s^j(t)-(1-\eta)p_m^j m_t^j(t)}=0$$

(8c) same as (7c)

(9a)
$$\frac{-(1-\alpha_1-\alpha_2)(1+\beta\gamma_1)}{\phi_j(w(t)-p_f^j m)(1-\tau(t))-s^j(t)-p_m^j m_t^j(t)}+$$
$$\sum_i \frac{\pi_i\beta(1-\gamma_1-\gamma_2)(1+\rho(t+1))}{(1+\rho(t+1))s^j(t)-(1-\sigma)p_i^j m_{it}^j(t+1)-\vartheta_{ie}}=0$$

(9b)
$$\frac{\alpha_2}{\phi_j m+m_t^j(t)}-\frac{(1-\alpha_1-\alpha_2)p_m^j}{\phi_j(w(t)-p_f^j m)(1-\tau(t))-s^j(t)-p_m^j m_t^j(t)}=0$$

(9c) same as (7c)

In the cases of no subsidization of medical care in youth or subsidization via Medicaid, substitution of (7b)[8b] and (7c) into (7a)[8a] yields (10) which fully characterizes type j agent's problem. These two cases can be characterized by the same equation because of the way the Medicaid medical care subsidy to young agents enters the problem: simply as a reduction in the price of medical care when young. Note, these two cases will not be identical problems because the government budget constraints will be different.

Analogously, if a type j agent receives employer provided medical benefits, equations (9b) and (7c) can be substituted into (9a), to yield (11), which fully characterizes type j agent's problem.

(10) $$\frac{-(1-\alpha_1)(1+\beta\gamma_1)}{\phi_j w(t)(1-\tau(t))-s^j(t)}+\sum_i \frac{\pi_i\beta(1-\gamma_1)(1+\rho(t+1))}{(1+\rho(t+1))s^j(t)-\vartheta_{ie}-(1-\sigma)p_i^j\vartheta_{im}}=0$$

(11) $$\frac{-(1-\alpha_1)(1+\beta\gamma_1)}{\phi_j(w(t)-p_f^j m)(1-\tau(t))-s^j(t)+p_m^j\phi_j m}+\sum_i \frac{\pi_i\beta(1-\gamma_1)(1+\rho(t+1))}{(1+\rho(t+1))s^j(t)-\vartheta_{ie}-(1-\sigma)p_i^j\vartheta_{im}}=0$$

In equilibrium, the representative firm maximizes profits, takes wages and rental rates as given. It hires effective labor from each type and capital until their marginal products equal their factor prices.

(12) $$w(t)=(1-\nu)AK(t)^{\nu}\left(\sum_j N_j\phi_j\right)^{-\nu}$$

(13) $$r(t)=\nu AK(t)^{\nu-1}\left(\sum_j N_j\phi_j\right)^{1-\nu}$$

Because of the assumption of constant returns to scale and agents' inelastic supply of effective labor, equations (12) and (13) also define factor market clearing.

The government must maintain a balanced budget at each date t in equilibrium. To do this it must adjust taxes to meet the Medicare subsidy bill

(14) $$\sigma\sum_j\sum_i N_j\pi_i p_i^j m_{i,t-1}^j(t)=\frac{\sigma}{(1-\sigma)(1-\gamma_1)}\sum_j\sum_i N_j\pi_i[\gamma_2 s^j(t-1)(1+\rho(t))-\gamma_2\vartheta_{ie}+(1-\sigma)(1-\gamma_1-\gamma_2)p_i^j\vartheta_{im}]$$

and in the case where it subsidizes medical care for the young, the Medicaid subsidy bill.

(15) $$\eta \sum_j N_j p_m^j m_t^j(t) = \frac{\eta \alpha_2}{(1-\eta)(1-\alpha_1)} \sum_j N_j [\phi_j w(t)(1-\tau(t)) - s^j(t)]$$

The revenue generated by type j agents, in the case of no subsidization or government subsidization of medical care for the young, is simply a fraction of their wages, as seen in (16) however the tax rates will be different because of the variation in the number of programs funded. With no subsidies to the young, the government only pays the Medicare subsidy bill whereas with government medical subsidies to the young, it pays both the Medicare and Medicaid subsidy bills. In the case of employer provided medical benefits, the revenue generated by type j agents, is a fraction of their wages after employer provided medical benefits have been taken out as seen in (17).

(16)	$\sum_j N_j \phi_j \tau(t) w(t)$
(17)	$\sum_j N_j \phi_j \tau(t)(w(t) - p_f^j m)$

The goods market clears when demand for goods equals supply of goods. Goods market clearing implies that the saving of the young today totally determine the capital stock tomorrow.

(18) $$\sum_j N_j s^j(t-1) = \sum_j N_j K(t)$$

and also by arbitrage

(19) $$(1 + \rho(t)) = r(t).$$

Thus, steady-state equilibrium with no subsidization of medical care for a type j youth, using equations (10), (12)-(14), (16) and (18)-(19), is characterized by (20a), (20b) and (23)-(24). Steady-state equilibrium with subsidization of type j young workers via Medicaid has a different tax rate than the above case and is defined using equations (10), (12)-(16) and (18)-(19). Thus, this equilibrium is characterized by equations (21a), (21b) and (23)-(24). Steady-state equilibrium with employer provided medical benefits for type j young workers is characterized, using equations (11)-(14), (17) and (18)-(19), by equations (22a), (22b) and (23)-(24).

(20a) $$\frac{-(1-\alpha_1)(1+\beta\gamma_1)}{\phi_j w(1-\tau^{\text{no subsidy}})-s^j}+\sum_i \frac{\pi_i\beta(1-\gamma_1)r}{s^j r-\vartheta_{ie}-(1-\sigma)p_i^j\vartheta_{im}}=0 \qquad j,i=1,2$$

(20b) $$\tau^{\text{no subsidy}}=\frac{\frac{\sigma}{(1-\sigma)(1-\gamma_1)}\sum_j\sum_i[\gamma_2 N_j s^j r-\gamma_2(\pi_i\vartheta_{ie})+(1-\sigma)(1-\gamma_1-\gamma_2)(p_i^j\pi_i\vartheta_{im})]}{w\sum_j N_j\phi_j}$$

(21a) same as (20a)

(21b) $$\tau^{\text{Medicaid}}=\frac{\frac{\sigma}{(1-\sigma)(1-\gamma_1)}\sum_j\sum_i[\gamma_2 N_j s^j r-\gamma_2(\pi_i\vartheta_{ie})+(1-\sigma)(1-\gamma_1-\gamma_2)(p_i^j\pi_i\vartheta_{im})}{w(1+\frac{\eta\alpha_2}{(1-\eta)(1-\alpha_1)})\sum_j N_j\phi_j}$$
$$+\frac{\frac{\eta\alpha_2}{(1-\eta)(1-\alpha_1)}N_j(\phi_j w-s^j)]}{w(1+\frac{\eta\alpha_2}{(1-\eta)(1-\alpha_1)})\sum_j N_j\phi_j}$$

(22a) $$\frac{-(1-\alpha_1)(1+\beta\gamma_1)}{\phi_j(w-p_f^j m)(1-\tau^{employer})-s^j+\phi_j p_m^j m}+\sum_i \frac{\pi_i\beta(1-\gamma_1)r}{s^j r-\vartheta_{ie}-(1-\sigma)p_i^j\vartheta_{im}}=0 \qquad j,i=1,2$$

(22b) $$\tau^{employer}=\frac{\frac{\sigma}{(1-\sigma)(1-\gamma_1)}\sum_j\sum_i[\gamma_2 N_j s^j r-\gamma_2(\pi_i\vartheta_{ie})+(1-\sigma)(1-\gamma_1-\gamma_2)(p_i^j\pi_i\vartheta_{im})]}{\sum_j N_j\phi_j(w-p_f^j m)}$$

(23) $$w=(1-\nu)A(\sum_j N_j s^j)^{\nu}(\sum_j N_j\phi_j)^{-\nu}$$

(24) $$r=\nu A(\sum_j N_j s^j)^{\nu-1}(\sum_j N_j\phi_j)^{1-\nu}$$

Up to this point the various medical subsidies or lack thereof, have been uniformly applied to all young agents. This was for ease of exposition and need not necessarily be the case. The economy may be a mixed regime with each group receiving a different subsidy and from this point on such heterogeneity will be allowed. Instead of only the three models outlined in the previous section, three more variations will now be added. First, suppose that high productivity workers (j=1) receive employer provided medical benefits while low productivity workers (j=2) receive no subsidy. Second, suppose high productivity workers receive employer provided medical benefits while low productivity workers receive the income-tested Medicaid subsidy. Third, suppose high productivity workers receive no benefits at all while the low productivity workers receive the income-tested Medicaid subsidy.

Note that other possible hybrid subsidy schemes will not be analyzed, as they are not observed in practice. For example, an income-tested Medicaid subsidy will be given to only low income workers or both low and high income workers but not high income workers only. Also, it is generally observed that high productivity/income workers receive employer provided medical benefits more often than low productivity/income workers. Therefore, it will be assumed that if employer benefits are provided they are given to high productivity workers only or both high and low productivity workers, but not low productivity workers alone.

To summarize, due to variation of subsidies by type of agent, the total number of model variations is now six:

a. both productivity groups of workers receive no subsidy;

b. high productivity workers receive no subsidy, low productivity workers receive Medicaid;

c. both productivity groups of workers receive Medicaid;

d. high productivity workers receive employer provided medical benefit, low productivity workers receive no subsidy;

e. high productivity workers receive employer provided medical benefit, low productivity workers receive Medicaid;

f. both productivity groups of workers receive employer provided medical benefit.

The analytical solutions for these six model variations do not generally yield decisive results and so numerical solutions have been sought. The baseline set of parameters is listed below and was chosen for the following reasons. The Medicare subsidy rate, σ, is approximately the share of medical health care expenditures by the old

(not including nursing home expenditures) that is paid for by Medicare (Hahn and Lefkowitz, 1992). The Medicaid subsidy rate, η, is the share of medical expenditures by the young who meet the income-test that is paid for by Medicaid[3]. Medicaid subsidization of the working poor is a relatively new phenomenon and has mainly come about as a result of the Welfare-to-Work legislation in 1996. The program is very much state specific and to this point data is not readily available. However, any changes in the Medicaid subsidy rate affect savings and lifetime well-being monotonically for all the simulations conducted in this paper. The employer provided medical benefit, m, is a percentage of the average worker's total compensation package that she receives in medical benefits (EBRI, 1998)[4]. The results of this paper hold independent of the choice of the baseline value of employer provided medical benefits as all changes in savings and well-being are monotonic. Productivity levels were chosen in order to generate sufficiently large differences in income, and thus well-being, of various groups. The prices of medical care for the young, old and firms are all normalized to one. In doing this, the effects of medical subsidies, to both young and old, on capital accumulation and well-being are isolated and are not intertwined with any price effects. The size of the severe shock is such that individuals in this economy can recover from it with their own income. The amount that individuals can spend on medical or non-medical care is bounded by zero thus, they cannot

[3] Medicaid may be modeled as a direct subsidy/reduction in price of medical care due to the means-testing of the program. Individuals may pay for some medical care out-of-pocket before receiving Medicaid as well as incur implicit costs such as waiting for public medical care or transportation.

[4] Estimates of the share of total compensation that employer spending on medical benefits range from 6%-16%. In 1996 employer spending on medical benefits was $262.7 billion while total compensation was $4,425.7 billion so that the share going to employer medical benefits is 6%. Other estimates suggest that the share is as high as 15% if employer contributed medical benefits is taken as a percentage of the average wage. This paper uses the share of employer medical benefits that is close to that of the average worker.

spend negative amounts on either medical or non-medical care to spend more on the other. The shocks are adjusted accordingly to meet the above requirement. An illness (severe or minor) adversely affects both medical and non-medical care by the same amount in the baseline. However, varying sizes of shocks to the medical and non-medical components of well-being for a given illness were explored such that θ_{ic} may be less than or greater than θ_{im}. There were no significant differences in the results when either of these other two parameter variations were considered. Sensitivity analyses on the probability of contracting illness i and the proportion of the population in productivity group j have been done and suggest that the qualitative results in this paper are not affected by changes in these parameters. Thus, the baseline values were chosen simply as initial values. Capital's share of output, ν, and the intertemporal discount rate, β, have been estimated in numerous studies.

While maintaining the assumption of a constant returns to scale well-being production function when young and old, the elasticities of well-being with respect to inherited well-being/well-being when young, medical and non-medical care were chosen as a starting point and the findings of this paper hold for a wide range of values. There is no consensus on the size of elasticities with respect to medical care, however the elasticity that is most often quoted by health economists is that from the RAND Health Insurance Experiment which reports empirical estimates that are not significantly different from zero (Manning et al., 1987). Empirical estimates of the elasticities with respect to inherited well-being/well-being when young and non-medical care are virtually non-existent. With this uncertainty, extensive sensitivity analyses of the elasticities were done including

minimizing or eliminating the link between inherited well-being from parents or youth and current well-being. Still the results are qualitatively similar to those reported in this paper.

Medicare subsidy rate	σ=.65
Medicaid subsidy rate (to those that meet the income-test)	η=.5
Employer provided medical benefit	m=w/8
Price of medical care for young workers	$p_m^j = 1$
Price of medical care that firms pay for the medical benefit they give to workers	$p_f^j = 1$
Price of medical care for the old that contract the relatively minor illness	$p_1^j = 1$
Price of medical care for the old that contract the more severe illness	$p_2^j = 1$
Productivity level for high productivity workers	ϕ_1=2
Productivity level for low productivity workers	ϕ_2=1
Probability of contracting illness i	π_i=.5
Proportion of the population in each productivity group j (sums to one)	N_j=.5
Size of the relatively minor shock when old (affects both medical and non-medical components of well-being)	$\theta_{1c}=\theta_{1m}$=.02
Size of the more severe shock when old (affects both medical and non-medical components of well-being)	$\theta_{2c}=\theta_{2m}$=.04
Elasticity of well-being when young with respect to inherited well-being and medical care	$\alpha_1=\alpha_2$=.333
Elasticity of well-being when old with respect to well-being when young and medical care	$\gamma_1=\gamma_2$=.333
Capital's share of output	ν=.3
Intertemporal discount rate	β=.5
Total factor productivity	A=1

V. Results

At this point two veins of analysis will be pursued. First the comparative static properties of the model variations will be summarized. These will deal first with the policy parameters: the Medicare and Medicaid subsidy rates and the size of the employer provided medical benefit. Also to be considered are the relative productivities of the two types of agents, the price of medical care for firms and individuals through their lifetimes, population weights and illness probabilities. In general these results, across all model variations, yield similar results and exceptions will be noted accordingly. Of all the

variables affected, the focus will be on young, old and lifetime well-being as well as savings of each group. The second vein of analysis will compare and contrast model variations in terms of the tax rate, relative lifetime well-being of the different types of agents. Also, the government programs' effects on savings rates and redistribution of income and well-being are examined.

A. Comparative Statics

Result 1: For all $\sigma \in [0, .78]$, [5] economies with more generous Medicare systems have lower saving for both types, thus lower capital accumulation, lower well-being of the young of both types and lower well-being of agents over their lifetime. Well-being of the old of both types, across all illnesses, increases until the maximum level of well-being for both types of old agents is at σ=.5 and then well-being decreases. This peak does not impact the effect on lifetime well-being and savings of both types of agents as they are both monotonically decreasing regardless of the baseline economy σ. This result can be seen in Table 1.

An increase in the Medicare subsidy rate for any type of agent positively affects the tax rate and reduces the after-tax income of all types of agents. This reduction in income causes agents to save less and decrease all current medical and non-medical expenditures which reduces their well-being when young. Also, the reduction in saving when young

[5] The greatest Medicare subsidy rate that the tax regime of the baseline economy can support is σ=.78.

reduces income when old. The groups of agents that receive Medicare view it as a reduction in the cost of medical care when old so that they spend a greater share of their reduced income on medical care. The subsidy increases the well-being of old agents however it is at the cost of reducing overall lifetime well-being of agents. This result continues to hold even if the linkage between well-being when young and well-being when old, as summarized by the parameter γ_1, is substantially weakened or set equal to zero.

Result 2: For all $\eta \in [0,1]$, economies with more generous Medicaid systems have lower saving for both types and thus lower capital accumulation. When only low productivity workers satisfy the income test and receive Medicaid, they have greater well-being when young and when old with the minor illness (i=1). When low productivity old agents contract the more severe illness (i=2), their well-being is at its maximum in an economy with η=.5. After that, in an economy with η>.5 their well-being decreases relative to the baseline. Regardless of this anomaly, (when old with the more severe illness) low productivity individuals have greater well-being over their entire life. High productivity agents are less well-off when young and old. See Table 2. These results hold independent of the baseline η as all changes in savings and lifetime well-being are monotonic. In economies in which both types of workers satisfy the income test, the saving of both types are lower, all young workers are better off for any η < .50 and worse off for η> .5 as seen in Table 3. Further the maximum level of well-being for high productivity workers is η=.15 and for low productivity workers it is η=.11. All old agents are worse off and the net effect over individuals' entire life is also negative.

An increase in the Medicaid subsidy rate for any type of agent positively affects the tax rate and reduces after-tax income and thus the saving and current medical and non-medical expenditures of all types of individuals. When only low-productivity workers meet the income-test, although their saving is reduced, the reduced price they face for medical care via Medicaid, more than compensates for the reduced income so that they are better off when young. Although they enter old age with less income, due to increased taxes to pay for the subsidy when young, they are better off (healthier) than they otherwise would have been and so their well-being is improved over their entire life. High productivity workers are less well-off when young and old and thus over their lifetime as they do not qualify for Medicaid, yet they pay for a portion of it.

When both productivity groups qualify for Medicaid, young agents are better off for any $\eta < .50$ and worse off for any $\eta > .50$. Further for $\eta = .15$ ($\eta = .11$) high productivity workers (low productivity workers) reach a maximum level of well-being, but any $\eta < .50$ yields improved well-being over $\eta = .50$. Old agents are worse off as the generosity of Medicaid increases. Both groups of workers' tax burdens become so large and their lifetime income is reduced so dramatically that Medicare and Medicaid benefits cannot compensate for this loss of income. Even in the range where their well-being when young is improving, it is not enough to offset the decline in old age well-being. Thus, the net effect for both productivity groups is lower lifetime well-being.

Result 3: For all $m \in [4\%w, 20\%w]$, economies with more generous employer provided medical benefits (higher m) have greater saving by high productivity workers and

lower saving by low productivity workers with a net positive effect on capital accumulation when only high productivity workers receive the employer provided medical benefits. These economies have better off high productivity young and old, while low productivity young and old are worse off. See Table 4. If both groups receive employer provided medical benefits when young, an increase in m has no effect on the saving or well-being of any individual using the baseline values of $p_f^j = p_m^j = 1$ as in Table 5.

An increase in employer provided medical benefits for any and all types of agents positively affects the tax rate that all young agents face. When only high productivity workers receive employer provided medical benefits less of their wage income is taxed at the higher rate because the increased employer benefits are taken out of before-tax earnings so that these workers implicitly receive a tax break. The direct effect of employer provided medical benefits reduces the amount high productivity workers choose to contribute to their own current medical care which allows them to increase their saving and current non-medical spending. High productivity workers enter old age better off and with increased income to spend on medical and non-medical care, so they are also better off when old as is true over their lifetime. Low productivity workers lose when employer provided medical benefits for only high productivity workers increase. They face a higher tax rate which decreases their after-tax income, and thus saving and all current medical and non-medical expenditures, without receiving any employer provided medical benefits/implicit tax break. They are worse off when young. They enter old age worse off and with less income to spend on medical and non-medical care and so are also worse off when old and over their entire life. If both groups receive employer provided medical

benefits, then each group faces the same costs via higher taxes and receive the same benefits. Each productivity group shoulders an equal share of the tax burden as the other group. Neither saving nor well-being is affected, although their choice of medical inputs when young is decreased.

Result 4: For all $\phi_1 - \phi_2 \in [0,5]$, economies with greater income disparity, have greater saving by high productivity workers and lower saving by low productivity workers with a positive net effect on capital accumulation. These economies also have better off high productivity young and old agents as well as over their lifetime. Low productivity young agents are worse off, as seen in Table 6. Low productivity old agents are better off in all model variations except the one in which they receive no medical subsidy when young yet high productivity workers receive employer provided medical benefits as seen in Table 7. In all variations, lifetime well-being of low productivity workers is lower except in cases where only low productivity workers receive Medicaid as can be seen in Table 8.

An increase in income disparity via an increase in ϕ_1, holding ϕ_2 constant, (or a decrease in ϕ_2, holding ϕ_1 constant) works to directly increase the total wage income, $\phi_1 w$, of high productivity workers however it negatively affects the wage per effective unit of labor, w. The net effect on high productivity workers' after-tax income, saving and current medical and non-medical expenditures is positive such that they have greater well-being when young. They enter old age with more income to spend on medical and non-medical care and are better off. Thus, high productivity workers are better off over their

lifetime with increased income disparity. An increase in ϕ_1, holding ϕ_2 constant, affects the total wage income, $\phi_2 w$, of low productivity workers negatively via a reduction in the wage per effective unit of labor, w. Even if the tax rate is falling due to a larger portion of revenue generated by high productivity workers, low productivity workers will see a net reduction in their income and thus they will save and spend less on current medical and non-medical care. They are worse off when young when there is greater income disparity in the economy. Although low productivity workers may enter old age worse off, their old age income increases because the return to saving increases more than the saving of low productivity workers decreases. This then allows them to spend more on medical and non-medical care which yields improved well-being in old age. Along with increased income in old age they receive Medicare subsidization of medical expenditures. In the variation where they receive no medical subsidy when young and high productivity workers receive employer provided medical benefits, old age income still increases due to the increase in the return to saving. However, the disparity in medical benefits when young, due to the increased tax burden, reduces the well-being of low productivity workers. Even with increases in medical and non-medical expenditures in old age low productivity agents do not see an increase in their overall old age well-being. In all model variations except those where only low productivity workers receive Medicaid, the improvement or deterioration of well-being in youth is the dominant force in determining lifetime well-being even if the link between well-being when young and well-being when old is weakened. Thus, if well-being when young decreases but increases when old, the net effect is lower lifetime well-being. In the variations where only low productivity workers receive Medicaid when young (and high productivity workers may receive no

medical subsidy or employer provided medical benefits), their well-being when young decreases with greater income disparity. However as in the other variations, their well-being when old increases and enough so that the effect on lifetime well-being is positive.

Result 5: For all $N_1 \in [0,1]$, economies with greater shares of high productivity workers have lower saving and thus lower capital accumulation, lower well-being of the young and lower lifetime well-being of both types except in the model variations in which only low productivity workers receive Medicaid as seen in Table 9. The economies where only low productivity workers receive Medicaid have greater saving and thus greater capital accumulation, greater well-being of the young of both types and greater lifetime well-being as seen in Table 10. All economies have greater well-being of the old of both types across all illnesses with the exception of economies in which high productivity workers receive employer provided medical benefits and low productivity workers receive no medical subsidy when young; in that variation the old have lower well-being across all illnesses.

An increase in the share of high productivity workers decreases saving of all types of agents yet increases the return to saving with the exception of model variations where only low productivity workers receive Medicaid (and high productivity workers may receive no medical subsidy or employer provided medical benefits). In these variations saving of all types of agents increases because the tax burden on all young agents is decreased due to fewer low productivity agents in the economy and thus, a reduced Medicaid subsidy bill. The increase in the fraction of high productivity agents is greater

than the increase in saving so that the return to saving decreases. In all variations the net effect is greater old age income. This allows greater spending on medical and non-medical inputs in old age in all model variations except where high productivity workers receive employer provided medical benefits and low productivity workers receive no medical subsidy. This is because, although expenditures on medical and non-medical inputs when old increase, their effect is outweighed by that of well-being when young (which affects health when old) due to the adverse effect of higher taxes such that there is lower saving and lower medical and non-medical expenditures when young. Unlike in the other model variations, the effect of increased spending on medical and non-medical inputs when old outweighs the negative effect of decreased well-being when young such that well-being when old is increased. In the model variations where only low productivity workers receive Medicaid, the government savings by subsidizing fewer low productivity Medicaid recipients (even if it is at the cost of implicitly subsidizing more employer provided medical benefits) is so great that the tax rate is lower. This allows greater after-tax income and greater saving and spending on medical and non-medical care when young and thus greater well-being when young. In all variations the improvement or deterioration of well-being in youth is the dominant force in determining lifetime well-being even if the link between well-being when young and well-being when old is weakened. Thus, if well-being when young decreases and increases when old, the net effect is lower lifetime well-being.

Result 6: For all $\pi_1 \in [0,1]$, economies with greater probabilities of a minor illness in old age have lower saving for both types, thus lower capital accumulation, lower well-

being of high productivity workers, greater well-being of low productivity workers and lower well-being of the old of both types across all illnesses, however greater well-being of agents over their lifetimes. See Table 11.

An increase in the probability of a minor illness in old age (simultaneously decreases the probability of a severe illness in old age) positively affects the tax rate and reduces the after-tax income of all types of agents. Medicare subsidizes the medical expenditures for all illnesses in old age and the tax rate increases because the probability weighted cost of medical care with the minor illness is greater than the probability weighted cost of medical care with the severe illness. The increased probability of a minor illness works to increase the saving of all types of agents, while it also has a negative effect on saving due to increased taxes along with a reduction in income when young.

For high productivity workers, the reduction in after-tax income causes a reduction in saving as well as a reduction in current medical and non-medical inputs. Thus they are worse-off when young. For lower productivity workers, the reduction in after-tax income causes a reduction in saving, however they slightly increase the amount of current medical and non-medical inputs, thus, their well-being is improved when young. All old agents across all illness states are worse off due to the decreased saving when young and thus have less to spend on current medical and non-medical inputs. Although well-being when young and in both states of old age is decreased for high productivity agents, lifetime well-being (weighted, in part, by the probability of illness) increases as the probability of a minor illness increases. For low productivity agents, well-being when young is increased

and that in combination with the increased probability of a minor illness in old age increases lifetime well-being.

Result 7i. For $p_m^j \in [.5, 3]$, economies with greater prices of medical care for the young have greater saving if one or both groups of young agents receive employer provided medical benefits as seen in Table 12. Otherwise, there is no effect on saving and thus capital accumulation as seen in Table 13. All economies have less well-off young agents. In all illness states old agents that received employer provided medical benefits when young have greater well-being when the price of medical care for the young is different from the price of medical care that firms face. Otherwise, in the other model variations, old agents have lower well-being. Regardless of whether they receive employer provided medical benefits when young, all agents have lower lifetime well-being.

An increase in the price of medical care for the young decreases the amount of medical inputs purchased when young which decreases well-being when young in all model variations. In the variations in which one or both groups of young agents receive employer provided medical benefits, the negative effect on well-being when young dominates despite increases in saving and the amount of non-medical inputs purchased. This is because the prices of medical care that young agents and firms face enter into the saving decision which will be further discussed in Result 8. Agents have lower well-being in old age if they have not received any employer provided medical benefits because they enter old age less well-off due to the decreased medical inputs when young. If agents have received employer provided medical benefits when young, they have greater well-

being when the price of medical care for the young is different from the price of medical care that firms face. Regardless, all agents have lower lifetime well-being due to the negative effect on well-being when young being dominant.

Result 7ii. For $p_i^j \in [.5, 3]$, economies with greater prices of medical care for the minor illness (i=1) in old age have lower saving by high productivity workers and greater saving by low productivity workers when neither group of young agents receives Medicaid as seen in Table 14. If at least one of the groups of young agents receives Medicaid then both productivity groups have greater saving as they spend less on medical inputs with the Medicaid subsidy when young. See Table 15. In all variations this yields a positive net effect on capital accumulation. These economies also have lower well-being for the young and old of both types, across all illness states as well as over their lifetimes.

An increase in the price of medical care for the minor illness in old age directly works to increase saving in order to pay for the increased cost of medical inputs in state 1 of old age and indirectly works via an increased tax rate to decrease saving. In the variations where neither group of young agents receives Medicaid the net effect on saving for high productivity workers is negative and the net effect on low productivity workers is positive. If one or both groups receive Medicaid when young the net effect on saving for both groups is positive. The Medicaid subsidy allows agents to reduce the medical inputs purchased thus allowing for increased saving. For all types of agents, well-being when young is decreased because of the decrease in medical and non-medical inputs when

young. Thus they enter old age less well-off and can purchase fewer medical inputs such that their well-being is decreased when old as well as over their lifetimes.

Result 7iii. For $p_2^j \in [.5, 3]$, economies with greater prices of medical care for the more severe illness (i=2) in old age have greater saving for both types, thus greater capital accumulation, less well-off young of both types as well as high productivity retirees across all states. Low productivity retirees also have lower well-being upon receiving the severe illness (i=2) however they have greater well-being if they contract the minor illness (i=1) because they saved more due to the increased cost of the severe illness. Still, all agents have lower well-being over their lifetimes. See Table 16.

An increase in the price of medical care for the more severe illness in old age increases saving of all types of young agents which leaves less income to spend on medical and non-medical inputs when young and decreases well-being when young. All high productivity agents and low productivity agents with a more severe illness have lower well-being when old due to the increased cost of medical inputs. However those with the less severe illness have greater well-being because they have saved more due to the increase in the cost of a severe illness and so are able to spend more on medical and non-medical inputs. Regardless of this anomaly individuals are worse-off over their entire lifetimes.

Result 7iv. For $p_f^j \in [.5, 3]$, economies with greater prices of medical care for firms who give medical benefits have lower saving for both types and thus lower capital

accumulation. Young and old agents of both types, across all illness states as well as over their lifetimes have lower well-being. See Table 17.

An increase in the price of medical care that firms face decreases saving for those who receive employer provided medical benefits that are taken out of before-tax earnings. Those that do not receive employer provided medical benefits also save less because they must pay increased taxes to make up for the tax break that the other agents receive. Decreased saving along with decreased amounts of medical and non-medical inputs decrease well-being when young and old and ultimately over an agent's lifetime.

B. Model Variations

Result 8i: Economies in which the price of medical care that firms face, p_f^j, is the same as the price of medical care that young agents face, p_m^j, and both types of workers receive employer provided medical benefits, there is no change in their saving and thus capital accumulation relative to economies in which both types of workers receive no medical subsidy. Lifetime well-being remains the same whether both groups do or do not receive employer provided medical benefits. However, all types will choose a lesser amount of medical inputs when young and face a higher tax rate due to the employer provided medical benefit. See Table 18.

The results of these two model variations are identical only when the price of medical care that firms face is identical to the price of medical care that young agents face.

This is because when the firms purchase medical benefits for the workers the firms cannot purchase any more or fewer inputs than the worker for a given expenditure. When the two prices are the same the total amount of medical inputs young workers demand is the same whether they purchase it all on their own or in combination with their employer. Both groups of workers receive the employer provided medical benefits and then add to it their own purchase and ultimately end up with the same amount of medical inputs as if they purchased all medical inputs on their own. Thus, when the price that firms face for medical care is identical to the price of medical care that young agents face the employer provided medical benefits acts as a lump sum benefit.

Result 8ii. Economies in which the price of medical care that firms face, p_f^j, is less than the price of medical care that young agents face, p_m^j, both types of agents save more and thus capital accumulation is higher relative to when the two prices are identical. Well-being of all agents when young and old and over their lifetime is greater. Those that receive employer provided medical benefits will choose a greater amount of medical inputs when young and all will face a lower tax rate. See Table 19.

All agents will face a lower tax rate as the amount taken out of their before tax wages is lower due to the lower price that firms pay for medical benefits. This increases the after-tax income of all types of agents and allows them to increase their saving and spending on medical and non-medical inputs. Firms may face a lower price of medical care due to the large volume purchase of benefits for its employees. Such a group purchase of health benefits for all employees in a firm is advantageous to insurance

companies as it spreads the risk of across a large number of individuals and works to decrease or eliminate adverse selection. When the price that firms face for medical care is lower than that which individuals face on their own, they would choose to take the maximum employer benefit, in other words, they would choose to be at the corner.

Result 9:

Ranking of proportional uniform tax rate that all young workers face (greatest to least)	Ranking of high product. agent lifetime well-being	Ranking of low product. agent lifetime well-being
c. both productivity groups of workers receive Medicaid	d	b
e. high productivity workers receive employer provided medical benefit, low productivity workers receive Medicaid	f=a	e
b. high productivity workers receive no subsidy, low productivity workers receive Medicaid	c	f=a
f. both productivity groups of workers receive employer provided medical benefit	e	d
d. high productivity workers receive employer provided medical benefit, low productivity workers receive no subsidy	b	c
a. both productivity groups of workers receive no subsidy		

The ranking of the proportional uniform tax rate that all young agents face, across all six model variations, from greatest to least, is listed in the above table. The tax rate in regime c is the highest because not only is it paying for medical care subsidization to all old (Medicare) but also to all young (Medicaid). In regime e only low productivity workers receive Medicaid benefits when young however the tax revenue that the government collects, at any tax rate, is reduced by the implicit tax break that high productivity workers receive via the before-tax employer provided medical benefit. Thus,

a higher tax rate is necessary in order to raise enough revenue for a given level of transfers. In regime b, high productivity workers receive no employer provided medical benefit/implicit tax break so the revenue collected from them increases which reduces the uniform tax rate. In regime f both types of agents' before-tax income is reduced by employer provided medical benefits however the implicit tax break they receive costs less than when one or more groups of agents receive Medicaid. High productivity workers receive an implicit tax break in regime d and still receive the same subsidization when old. Thus, it is low productivity workers that must make up the difference in tax revenue, so much so that they contribute a larger share of tax revenue than what they receive in benefits. Regime a has the lowest tax rate because it only provides Medicare subsidization and no one gets any medical subsidy when working.

Lifetime well-being of high productivity workers can be ranked, across all six model variations, from greatest to least in the above table. The largest medical benefit disparity between high and low productivity workers, in favor of high productivity workers, is that of regime d. This is because the tax burden of high productivity workers is at its minimum as they receive an implicit tax break via employer provided medical benefits. At the same time, low productivity workers do not receive any government or employer provided medical benefits when young. Regimes f and a are not quite as beneficial to high productivity workers because now both groups receive the same treatment (both receive employer provided medical benefits or no subsidy, when young) so that the tax burden weighs more equally on both groups. Again in regime c, both groups are treated equally however the Medicaid subsidy is paid for directly via the payroll tax on young workers along with Medicare which further increases the tax rate all

individuals face relative to the above regimes. With regime e, where high productivity workers receive an implicit tax break due to employer provided medical benefits and low productivity workers receive Medicaid, the tax rate is quite high and second only to the regime where both groups receive Medicaid. However, in certain cases, high productivity workers may still rank regime e second only to regime d. The employer provided medical benefit that high productivity workers receive is so beneficial, that if low productivity workers were to receive a small enough Medicaid subsidy, (smaller than the baseline) high productivity individuals would prefer employer provided medical benefits. Then, employer provided medical benefits are high productivity individuals' first choice, regardless of what subsidy the other group does or does not receive. Even though the tax rate is the highest in regimes c and e, the worst regime, in terms of high productivity well-being, is regime b. This is because the share of the tax burden on high productivity workers, without any implicit tax break, is greater due to low productivity workers receiving Medicaid.

Lifetime well-being of low productivity workers is ranked, across all six model variations, from greatest to least in the above table. The largest medical benefit disparity between high and low productivity agents, in favor of low productivity workers, is that of regime b. This is because the tax burden on high productivity workers is at its maximum, as they do not receive any implicit tax break from an employer or Medicaid subsidization while low productivity workers receive Medicaid. Regime e is not quite as good for low productivity workers because now high productivity workers get an implicit tax break from their employer so that the tax burden is shifted somewhat back to the low productivity workers although they still receive Medicaid. In regimes f and a, both groups

are treated equally (both receive employer provided medical benefits or no medical subsidy when young) so they face the same benefit and tax structure which means that they differ only in productivity/income. If the price of medical care that young workers face is the same as the price that firms face, these two regimes are equivalent in terms of low productivity workers' lifetime well-being. For the baseline economy, regime d is better than regime c for low productivity individuals' lifetime well-being. The tax burden of Medicaid for both groups of workers is so great that low productivity workers would prefer no subsidy while high productivity workers receive employer provided medical benefits/implicit tax break. The ranking of these last two regimes can reverse if the Medicaid subsidy given to both groups is sufficiently small.

Result 10: Economies in which high productivity workers receive sufficiently large employer provided medical benefits and low productivity workers receive no medical subsidy when young, yield a share of tax revenue contributed by high productivity workers less than the benefits they receive. Thus, the government medical subsidy program is redistributive to high productivity workers. In this variation, the government subsidy program includes only Medicare. See Table 21.

In all other models the disparity between productivity groups, in terms of health care benefits, is lessened either by both groups receiving equal treatment or by low productivity workers receiving Medicaid which works to close the medical care benefits gap. This then translates into the government programs, Medicare and Medicaid where applicable, being redistributive to low productivity workers instead of high productivity

workers. Whereas in this variation, high productivity workers receive employer provided medical benefits/implicit tax break which pushes up the tax rate. Further, due to the way in which employer provided benefits are taken out of their before-tax income, the amount of revenue that the government can collect from this group decreases, for any tax rate. Thus, it falls upon low productivity workers to make up the difference and a larger share of their income goes to the government; more in fact than what they receive from Medicare when old.

VI. Social Welfare Rankings

In the previous section lifetime well-being of each productivity group was examined separately however it may be of interest to also examine other measures of well-being. Analysis thus far has been done at the level of productivity group such that there is no single economy-wide measure and so a population weighted average (Benthamite social welfare function) will be formulated as follows.

$$(25) \qquad \sum_j N_j U^j(t) = \sum_j N_j [\ln h_t^j(t) + \beta \sum_i \pi_i \ln h_{it}^j(t+1)] \qquad j, i = 1,2$$

Also, up until this point the assumption of equally weighted well-being when young and when old has been employed. One of the results that comes out of this is that even if increases in Medicare subsidies benefit well-being when old, its cost in terms of greater taxes and lower medical and non-medical inputs when young is so great that the net effect on lifetime well-being is negative. At the same time, there does appear to be

great benefit to increasing subsidies to medical inputs when young via employer provided medical benefits or Medicaid, which results in greater well-being when young which carries through to greater lifetime well-being. Still, in reality, great pains are taken to protect Medicare; so much so that it may be the case that society values the protection of well-being of the old to such a degree that greater weight is placed on well-being when old than when young. This exercise tries to determine a possible social welfare function that a social planner might have in mind in order to generate what is observed in reality. Additional social welfare measures are constructed using equation (25) and adding weight λ_k, where k=1,2,3,4, to well-being when old where $\lambda_1 = 1$, $\lambda_2 = 5$, $\lambda_3 = 10$ and $\lambda_4 = 100$.[6]

$$(26) \qquad \sum_j N_j U^j(t) = \sum_j N_j [\ln h_t^j(t) + \lambda_k \beta \sum_i \pi_i \ln h_{it}^j(t+1)] \qquad j,i = 1,2 \quad k = 1,2,3,4$$

Result 11: When $\lambda_1 = 1$, (youth and retirement are equally weighted) the population weighted lifetime well-being measure is always decreasing for any increase in the Medicare subsidy rate. Thus, the Medicare subsidy rate that yields the greatest population weighted lifetime well-being is equal to zero. When $\lambda_2 = 5$, as the Medicare subsidy rate increases so too does the population weighted lifetime well-being measure until the Medicare subsidy rate = .25 at which point social welfare is at its peak. When $\lambda_3 = 10$, as the Medicare subsidy rate increases so too does the population weighted lifetime

[6]Thus variations on the Benthamite social welfare function will be examined. The standard one is a population weighted function in which both periods of life are equally weighted. Variations on this include greater weights on the second period which may be designed by a social planner. The Rawlsian welfare function will not be included in the discussion as it is a measure of the worst off individual in the economy (in this case the low productivity agent) and will always be last in the rankings.

well-being measure until the Medicare subsidy rate = .35 at which point social welfare is at its peak. When λ_4 =100, as the Medicare subsidy rate increases so too does the population weighted lifetime well-being measure until the Medicare subsidy rate = .45 at which point social welfare is at its peak.[7]

Even with the increased weight on old age, not all increases in the Medicare subsidy rate unequivocally increase population weighted lifetime well-being as the maximum population weighted lifetime well-being varies according to the weight on old age as well as the size of the Medicare subsidy. If old age well-being is valued 100 times more than well-being when young, still the welfare maximizing Medicare subsidy is less than 50% while in practice, current estimates of Medicare subsidization are on the order of 60-70%. A welfare maximizing Medicare subsidy of 60% cannot be generated in this model with the baseline parameters even with weight on the well-being of the old as high as 1 million times the weight on the young.

Result 12: In model variation e (high productivity workers receive employer provided medical benefits and low productivity workers receive Medicaid)[8], when λ_1 =1, (youth and retirement are equally weighted) as the Medicaid subsidy rate increases so too

[7] This result holds generally for all model variations. Although the exact peak of the social welfare measure may be at a Medicare subsidy rate that is 5% higher or lower, the general pattern is the same.
[8] The same pattern holds for the other model variations (b and c) where Medicaid is present. However, in regime c, where both groups of workers receive Medicaid, the tax burden of Medicaid and Medicare is too extreme. No matter if there are equal or differential weights on well-being when young and old, population weighted lifetime well-being is always decreasing for any increase in the Medicaid subsidy rate.

does the population weighted lifetime well-being measure until the Medicaid subsidy rate=.55. When λ_2 =5, as the Medicaid subsidy rate increases so too does the population weighted lifetime well-being measure until the Medicaid subsidy rate = .25 at which point social welfare is at its peak. When λ_3 =10, as the Medicaid subsidy rate increases so too does the population weighted lifetime well-being measure until the Medicaid subsidy rate = .20 at which point social welfare is at its peak. When λ_4 =100, as the Medicaid subsidy rate increases so too does the population weighted lifetime well-being measure until the Medicaid subsidy rate = .05 at which point social welfare is at its peak.

Result 13: In the model variations where only high productivity workers receive employer provided medical benefits[9], for all λ, the population weighted lifetime well-being measure is always decreasing for any increase in employer provided medical benefits. Employer provided medical benefits benefit high productivity workers in these variations so that that group's lifetime well-being is increased. However, the negative effect on low productivity workers when only high productivity workers receive employer provided medical benefits is so great that it overwhelms the positive effect on high productivity agents when a population weighted measure of lifetime well-being is used.

As can be seen from Results 12 and 13, if well-being when old is valued more than well-being when young any increase in the weight of old well-being will certainly decrease

[9] In the model variation in which both groups of workers receive employer provided medical benefits an increase in employer provided medical benefits has no effect on population weighted lifetime well-being because the price of medical care for the young that firms and individuals face is the same. This holds for regardless of the relative weights on well-being in youth or retirement.

the effectiveness of the medical subsidies when young. Thus, when examining population weighted lifetime well-being, employer provided medical benefits or Medicaid are more favorable when $\lambda_1 = 1$.

VII. Other Policy Experiments

In this section further analysis of the government health care policies will be conducted. In general, these results hold across all model variations and exceptions will be noted accordingly. Policy experiments that will be examined include the means-testing of Medicare subsidies to the old such that high productivity agents face a lower Medicare subsidy rate than low productivity agents. Instead of a single Medicare subsidy rate, σ, Medicare subsidy rates are differentiated according to productivity group where σ^1 is the Medicare subsidy rate that high productivity agents face and σ^2 is the subsidy rate that low productivity workers face where $\sigma^1 \leq \sigma^2$.

Result 14: For all $\sigma^1 \in [0, \sigma^1 = \sigma^2]$, economies with less generous Medicare subsidies for high productivity agents have greater saving for both types, thus greater capital accumulation, greater well-being of the young of both types, lower well-being of high productivity old, greater well-being of low productivity old and greater well-being of all agents over their lifetimes. See Table 22.

A decrease in the Medicare subsidy rate for high productivity agents decreases the tax rate and increases the after-tax income of all types of agents. This increase in income

causes agents to save more and increase the amount of current medical and non-medical inputs which increases their well-being when young. Agents enter old age with greater well-being and greater old age income. High productivity old spend less on medical care because of the decrease in their Medicare subsidy and, although they spend more on non-medical inputs, the net effect on their well-being when old is negative. Low productivity old spend more on current medical and non-medical inputs which yields increased well-being when old. Despite the decreased Medicare subsidy for the high productivity old, their lifetime well-being is greater along with that of low productivity agents. The positive effect on lifetime well-being when young is the dominant effect and this holds even if the link between well-being when young and old is weakened or eliminated.

Another policy change put into operation is a progressive payroll tax such that high productivity workers face a higher tax rate than low productivity workers. Instead of a single payroll tax rate, τ, tax rates are differentiated according to productivity group where τ^1 is the tax rate that high productivity agents face and τ^2 is the tax rate that low productivity workers face where $\tau^1 \geq \tau^2$.

Result 15: For all $\tau^2 \in [0, \tau^1 = \tau^2]$, economies with lower tax rates for low productivity workers, holding the size of the government programs fixed, have lower saving for high productivity workers, greater saving for low productivity workers with a negative net effect on capital accumulation. These economies have worse off high productivity agents when young, old, and throughout their lifetime while low productivity workers are better off when young, old and throughout their lifetime. See Table 23.

Holding the size of the government programs constant, a decrease in the tax rate that low productivity workers face, increases the tax rate that high productivity workers face, in order for the government budget to balance. Low productivity workers are able to save and spend more on medical and non-medical inputs when young. Thus they enter old age better off, as well as spend more on medical and non-medical inputs when old which yields greater well-being when old as well as over their lifetimes. The opposite is true for high productivity workers as they are able to save less and spend less on medical and non-medical inputs when young because of the increased tax burden. This effect carries through to old age and over their lifetimes such that they have lower well-being.

Thirdly, another way to examine the policies is to fix the tax rate that agents face, thus government revenue is fixed and then either the Medicare and or Medicaid subsidy must adjust in order to balance the government budget. The model variations that are examined are those where both Medicare and Medicaid are present. Thus for a given tax rate and Medicare subsidy rate what is the Medicaid subsidy for those type(s) that receive it and how does it affect all agents in the economy?

Result 16i: For all $\tau \in [0, .7]$,[10] economies with greater tax rates, holding Medicare benefits fixed, have greater subsidy rates for those types that receive Medicaid and lower saving for all types and thus lower capital accumulation. When only low productivity workers receive Medicaid they have greater well-being when young however high productivity workers have worse well-being when young as seen in Table 24.

[10] The greatest tax rate that the baseline economy can support is τ=.70.

When both types of workers receive Medicaid, they have worse well-being when young as seen in Table 25. In all model variations, all agents are worse off in all states of old age. The dominant effect on agents lifetime well-being is well-being when young. Thus in all instances, lifetime well-being of agents is worse with one exception: low productivity agents in the model variations where they are the only type to receive Medicaid when young.

Holding the Medicare subsidy rate constant, an increase in the payroll tax rate causes the Medicaid subsidy to increase until the government budget is balanced. The increased tax rate causes agents to save less and spend less on medical and non-medical inputs when young. In model variations where only low productivity workers receive Medicaid when young low productivity agents' well-being when young is increased despite the increased taxes because they also receive Medicaid. However, high productivity workers are worse off when young due to the increased tax burden. In the model variation where both types of agents receive Medicaid, the tax burden is too great despite the Medicaid subsidy they all receive such that well-being for all young agents is lower. In all model variations the well-being of all old agents is worse due to the decreased savings and well-being when young. Well-being when young is the dominant effect on lifetime well-being.

Result 16ii. For all $\sigma \in [0,.5]$, [11] economies with lower Medicare subsidy rates, holding the tax rate constant, have greater Medicaid subsidy rates for those types that receive Medicaid and greater savings for all types and thus greater capital accumulation. All agents have greater well-being when young and worse well-being when old. In all model variations low productivity agents have greater lifetime well-being. High productivity agents are worse off over their lifetime unless they also receive Medicaid when young. See Tables 26 and 27.

Holding the payroll tax rate constant, a decrease in the Medicare subsidy rate causes the Medicaid subsidy rate to increase until the government budget is balanced. Due to the decreased Medicare subsidy when old all types of agents save more, spend more on medical and non-medical inputs when young, and have greater well-being when young. All agents have lower well-being in old age as the Medicare subsidy is reduced. The type(s) of agents that receive Medicaid when young have greater lifetime well-being despite the decreased Medicare subsidy while those agents that only receive Medicare when old have lower lifetime well-being as they receive no additional benefits (Medicaid) when young.

VIII. Conclusion

In the real world, the well-being of the first generation of old to receive Medicare appears to have improved. However, the various health care programs are relatively new and it is not clear that the economy is at a steady-state. The findings in this paper, with

[11] The greatest Medicare subsidy rate that a tax rate of 20% can support in the baseline economy is σ=.5.

regard to Medicare, suggest that in the long-run steady-state equilibrium of some model variations the well-being of the old does improve, however, in all model variations individuals are less well-off over their lifetimes. The cost of the program, in terms of higher taxes when young and subsequently less expenditures on well-being when young, outweighs the benefit of the program they receive once they have retired. It may be much more beneficial, in steady-state, to subsidize medical care of the young, whether via Medicaid or beneficial tax treatment of employer provided medical care. Subsidizing the medical expenditures of young workers, through either of these programs, yields individuals increased well-being when young and old and thus over their lifetimes. But, just how these subsidies are financed must be carefully examined since the inadvertent subsidization of the relatively rich by the relatively poor is a possible outcome of health care policy made without careful thought to distributional effects.

These results suggest a closer review of the types of medical subsidies, how they are financed and to whom they are given, is needed. This is true of the medical subsidy programs that the government directly facilitates but also the one that it indirectly facilitates which implicitly gives workers a tax break. The effect of this implicit government program is too often ignored even though it may be adversely affecting other groups of workers, i.e., low income workers. Along with a review of the source of medical subsidies for the young, an evaluation of Medicare is also prudent. It may be that society values the protection of the well-being of the old so much that the cost in terms of higher taxes when young is not too high. Medicare was created in order to provide for the missing market for health insurance for the elderly population although that is not to say that it is a perfect replacement for a private insurance market as it has introduced program

restrictions and bureaucratic inefficiencies unique to such a government program. Even with greater weight on the well-being of the old, the welfare maximizing Medicare subsidy is found to be less than the subsidy rate that is estimated in the real world. Still, it is not clear that individuals are aware of the general equilibrium effects especially due to the fact that the program is relatively new, even if greater weight is placed on the well-being of the old. The lifetime effects of the types and timing of the various medical subsidies must be brought to the forefront in order to make informed policy decisions.

APPENDIX

APPENDIX

Table 1
Result 2.1

σ	**.35**	**.45**	**.50**	**.55**	**.65**	**.75**
s^1	.221537	.200917	.188484	.174101	.136888	.0816033
s^2	.12439	.112364	.105243	.0970993	.0763508	.0459439
τ	.110101	.164756	.199686	.24184	.359363	.559207
h^1	.215067	.196404	.184759	.171003	.134434	.788443
h^2	.100723	.0922494	.0868788	.0804771	.0632634	.036851
h_1^1	.181279	.18296	.182962	.181946	.174006	.145749
h_2^1	.166095	.168231	.16846	.167694	.160365	.133218
h_1^2	.0895814	.0904475	.0904572	.0899644	.0860377	.0720065
h_2^2	.074456	.075763	.0760047	.0757598	.0724422	.0595273
lifetime well-being^1	-2.41253	-2.4978	-2.55859	-2.63849	-2.90143	-3.52569
lifetime well-being^2	-3.54792	-3.62904	-3.6882	-3.76691	-4.02993	-4.66395

^{1} = high productivity workers $_1$ = state 1 of old age

^{2} = low productivity workers $_2$ = state 2 of old age

*All other simulations are available upon request.

Table 2
Result 2.2 – Regime B

η	**.35**	**.50**	**.65**
s^1	.12748	.120337	.108901
s^2	.0712798	.0674238	.0612394
τ	.392399	.417939	.459723
h^1	.124659	.117256	.105439
h^2	.0726108	.0777414	.0833091
h^1_1	.166931	.161401	.152231
h^1_2	.153512	.14816	.139292
h^2_1	.088648	.0895164	.0895602
h^2_2	.074284	.0747129	.0742149
lifetime well-being ^{1}	-2.99821	-3.07673	-3.213
lifetime well-being ^{2}	-3.87838	-3.80623	-3.73861

Table 3
Result 2.2 – Regime C

η	**.11**	**.15**	**.35**	**.50**	**.65**
s^1	.130008	.127257	.11098	.095133	.0747624
s^2	.0726433	.0711593	.0623649	.0537731	.0426747
τ	.383457	.393192	.452038	.511682	.592589
h^1	.134908	.134944	.133399	.129024	.119069
h^2	.0634056	.0633882	.0624371	.0601255	.0550643
h^1_1	.172158	.171327	.165358	.157771	.145145
h^1_2	.158414	.157547	.151397	.143698	.131019
h^2_1	.0851103	.0846941	.0817079	.0779198	.071625
h^2_2	.0714148	.0709622	.0678019	.0639085	.0575752
lifetime well-being ^{1}	-2.90363	-2.90595	-2.93629	-2.99442	-3.11866
lifetime well-being ^{2}	-4.03397	-4.03706	-4.02540	-4.13692	-4.272

Table 4
Result 2.3 – Regime E

m	**1/15 w**	**1/11 w**	**1/8 w**	**1/5 w**
s^1	.122663	.123559	.124869	.127973
s^2	.0659777	.0654209	.0646079	.0626839
τ	.435292	.441965	.451703	.474711
h^1	.119902	.120922	.122412	.125943
h^2	.0751957	.0742146	.0727807	.0693817
h_1^1	.164543	.165751	.167511	.171665
h_2^1	.151288	.152489	.154241	.158375
h_1^2	.0867193	.0856451	.0840789	.0803843
h_2^2	.0719048	.0708265	.0692545	.0655471
lifetime well-being ^{1}	-3.04437	-3.03209	-3.01435	-2.97318
lifetime well-being ^{2}	-3.85703	-3.87706	-3.90680	-3.97961

Table 5
Result 2.3 – Regime F

m	**1/15 w**	**1/11 w**	**1/8 w**	**1/5 w**
s^1	.136888	---------->		
s^2	.0763508	---------->		
τ	.385031	.395299	.4107	.449203
h^1	.134434	---------->		
h^2	.0632634	---------->		
h_1^1	.174006	---------->		
h_2^1	.160365	---------->		
h_1^2	.0860377	---------->		
h_2^2	.0724422	---------->		
lifetime well-being ^{1}	-2.90143	---------->		
lifetime well-being ^{2}	-4.02993	---------->		

Table 6
Result 2.4 – Regime A

ϕ_1	1	2	3
s^1	.0825035	.136888	.190333
s^2	"	.0763508	.0733639
τ	.342855	.359363	.368212
h^1	.0675589	.134434	.198243
h^2	"	.0632634	.0611214
h_1^1	.0860246	.174006	.261757
h_2^1	"	.160365	.248346
h_1^2	.0719532	.0860377	.085951
h_2^2	"	.0724422	.0725901
lifetime well-being ^{1}	-3.96597	-2.90143	-2.30158
lifetime well-being ^{2}	"	-4.02993	-4.06412

Table 7
Result 2.4 – Regime D

ϕ_1	1	2	3
s^1	.084476	.139994	.194237
s^2	.0805335	.0732898	.0695226
τ	.362941	.392035	.410129
h^1	.0698989	.138066	.202801
h^2	.0652185	.0596267	.0565596
h_1^1	.0887099	.178488	.267582
h_2^1	.0746343	.164846	.254169
h_1^2	.0833393	.0815565	.08041293
h_2^2	.0692725	.0679675	.0667766
lifetime well-being ^{1}	-3.91509	-2.86152	-2.26755
lifetime well-being ^{2}	-4.01865	-4.11845	-4.18009

Table 8
Result 2.4 – Regime B

ϕ_1	**1**	**2**	**3**
s^1	.0692046	.120337	.172116
s^2	"	.0674238	.0666439
τ	.427759	.417939	.412925
h^1	.0552828	.117256	.178581
h^2	.078141	.0777414	.0775873
h_1^1	.077026	.161401	.247229
h_2^1	.0635297	.14816	.234125
h_1^2	.0864338	.0895164	.0910576
h_2^2	.0712891	.0747129	.0764126
lifetime well-being ^{1}	-4.22526	-3.07673	-2.43505
lifetime well-being ^{2}	-3.82159	-3.80623	-3.79832

Table 9
Result 2.5 – Regime A

N_1	**.25**	**.50**	**.75**
s^1	.142093	.138018	.135158
s^2	.0817012	.0791486	.077366
τ	.372954	.376607	.379312
h^1	.132698	.129492	.127218
h^2	.0610216	.059676	.0587157
h_1^1	.147313	.148134	.148699
h_2^1	.11853	.119513	.120195
h_1^2	.073283	.0736923	.0739742
h_2^2	.0513784	.0519808	.0524
lifetime well-being^1	-3.03162	-3.05263	-3.06797
lifetime well-being^2	-4.19202	-4.21001	-4.22327

Table 10
Result 2.5 – Regime E

N_1	**.25**	**.50**	**.75**
s^1	.123124	.126777	.130073
s^2	.0654886	.0675304	.0693862
τ	.485764	.467026	.450688
h^1	.114714	.118731	.122315
h^2	.0651991	.0682778	.0710122
h_1^1	.13939	.143145	.146342
h_2^1	.112001	.115367	.118224
h_1^2	.0695739	.0719654	.0740159
h_2^2	.046947	.0490559	.0508564
lifetime well-being^1	-3.20524	-3.15678	-3.1154
lifetime well-being^2	-4.16133	-4.09576	-4.04046

Table 11
Result 2.6

π_1	**.25**	**.50**	**.75**
s^1	.143991	.138018	.131725
s^2	.0839216	.0791486	.0738454
τ	.375735	.376607	.37747
h^1	.129684	.129492	.129127
h^2	.0588789	.059676	.060572
h_1^1	.149168	.148134	.147075
h_2^1	.120499	.119513	.118513
h_1^2	.0748961	.0736923	.0721548
h_2^2	.0533256	.0519808	.0502701
lifetime well-being^1	-3.07403	-3.05263	-3.03236
lifetime well-being^2	-4.25548	-4.21001	-4.16357

Table 12
Result 2.7i – Regime D

p_m^j	.5	1.0	1.5
s^1	.124494	.139994	.155997
s^2	.0709524	.0732898	.0755835
τ	.390934	.392035	.393046
h^1	.171667	.138066	.126814
h^2	.0826539	.0596267	.0495947
h_1^1	.184053	.178488	.180129
h_2^1	.169055	.164846	.167127
h_1^2	.0931022	.0815565	.0750183
h_2^2	.0781552	.0679675	.062074
lifetime well-being^1	-2.62971	-2.86152	-2.94081
lifetime well-being^2	-3.72387	-4.11845	-4.34623

Table 13
Result 2.7i – Regime B

p_m^j	.5	1.0	1.5
s^1	.120337	-	-
s^2	.0674238	-	-
τ	.417939	-	-
h^1	.165738	.117256	.0957679
h^2	.109886	.0777414	.0634949
h_1^1	.181114	.161401	.150879
h_2^1	.166256	.14816	.138502
h_1^2	.10045	.0895164	.0836811
h_2^2	.0838382	.0747129	.0698426
lifetime well-being^1	-2.67306	-3.07673	-3.31287
lifetime well-being^2	-3.40255	-3.80623	-4.04236

Table 14
Result 2.7ii – Regime A

p_1^j	.5	1.0	1.5
s^1	.136958	.136888	.136836
s^2	.0761864	.0763508	.0765376
τ	.355931	.359363	.362795
h^1	.135458	.134434	.133411
h^2	.0638754	.0632634	.0626456
h_1^1	.222054	.174006	.150035
h_2^1	.160882	.160365	.159847
h_1^2	.110688	.0860377	.07357
h_2^2	.0725328	.0724422	.072359
lifetime well-being^1	-2.83207	-2.90143	-2.94693
lifetime well-being^2	-3.95701	-4.02993	-4.07917

Table 15
Result 2.7ii – Regime C

p_1^j	.5	1.0	1.5
s^1	.0950816	.095133	.0952037
s^2	.0536015	.0537731	.0539667
τ	.509184	.511682	.514168
h^1	.129976	.129024	.128079
h^2	.0607045	.0601255	.059541
h_1^1	.201542	.157771	.135897
h_2^1	.144113	.143698	.143284
h_1^2	.100465	.0779198	.0664758
h_2^2	.0639574	.0639085	.0638702
lifetime well-being^1	-2.92514	-2.99442	-3.03981
lifetime well-being^2	-4.06361	-4.13692	-4.18655

Table 16
Result 2.7iii

p_2^J	**.5**	**1.0**	**1.5**
s^1	.136444	.136888	.13745
s^2	.0752273	.0763508	.0776241
τ	.402756	.4107	.418622
h^1	.136404	.134434	.132474
h^2	.0646991	.0632634	.0617874
h_1^1	.1751	.174006	.172912
h_2^1	.207849	.160365	.136045
h_1^2	.0859996	.0860377	.0861029
h_2^2	.0956382	.0724422	.0602823
lifetime well-being^1	-2.82047	-2.90143	-2.9588
lifetime well-being^2	-3.93816	-4.02993	-4.09929

Table 17
Result 2.7iv

p_r^j	**.5**	**1.0**	**1.5**
s^1	.15433	.139994	.126218
s^2	.0772222	.0732898	.0692535
τ	.375955	.392035	.409552
h^1	.153319	.138066	.123467
h^2	.0626733	.0596267	.0564565
h_1^1	.190377	.178488	.166612
h_2^1	.17647	.164846	.153245
h_1^2	.082561	.0815565	.0803777
h_2^2	.0687101	.0679675	.0670613
lifetime well-being^1	-2.72357	-2.86152	-3.00873
lifetime well-being^2	-4.06284	-4.11845	-4.18008

Table 18
Result 2.8i

$p_m^j = p_f^j$	**Regime a**	**Regime f**
s^1	.136888	-
s^2	.0763508	-
τ	.359363	.4107
m^1	.134232	.0550617
m^2	.0631685	.0235834
lifetime well-being ^{1}	-2.90143	-
lifetime well-being ^{2}	-4.02993	-

Table 19
Result 2.8ii

	Regime f $(p_m^j = p_f^j)$	**Regime f** $(p_m^j > p_f^j$ *$)$
s^1	.136888	.138647
s^2	.0763508	.0772981
τ	.4107	.40795
m^1	.0550617	.0565895
m^2	.0235834	.0243135
lifetime well-being ^{1}	-2.90143	-2.88409
lifetime well-being ^{2}	-4.02993	-4.01215

* $p_f^j = .95$

Table 20
Ranking of tax rate and lifetime well-being of both productivity groups

	τ	**lifetime well-being**^{1}	**lifetime well-being**^{2}
Regime a	.359363	-2.90143	-4.02993
Regime b	.417939	-3.07673	-3.80623
Regime c	.511682	-2.99442	-4.13692
Regime d	.392035	-2.86152	-4.11845
Regime e	.451703	-3.01435	-3.90680
Regime f	.4107	-2.90143	-4.02993

Table 21
Tax-benefit ratio in regime D

m	**1/15 w**	**1/11 w**	**1/8 w**	**1/5 w**
tax/benefit ratio^{1}	.979015	.965407	.945692	.899765
tax/benefit ratio^{2}	1.04168	1.06969	1.11173	1.2169

Table 22
Means-testing of Medicare benefits

σ^1 (σ^2=.65)	.65	.55	.35	.25	.10	0
s^1	.136888	.161476	.19234	.203174	.216432	.223958
s^2	.0763508	.0889157	.103897	.108841	.114591	.117688
τ	.359363	.281573	.194275	.166944	.136299	.120387
h^1	.134434	.158005	.185435	.194138	.203876	.208889
h^2	.0632634	.0749136	.0888541	.0934422	.0987504	.10159
h_1^1	.174006	.174677	.168355	.164433	.158709	.155136
h_2^1	.160365	.160689	.153711	.149446	.143187	.139246
h_1^2	.0860377	.0940293	.102633	.105225	.10805	.109473
h_2^2	.0724422	.0799088	.0879422	.0903539	.0929712	.0942829
lifetime well-being^1	-2.90143	-2.7384	-2.59864	-2.5657	-2.53631	-2.52469
lifetime well-being^2	-4.02993	-3.81417	-3.59768	-3.53433	-3.46532	-3.43019

Table 23
Progressive tax system

τ^2	$\tau^2 = \tau^1$	.10	.05	.001
s^1	.136888	.112297	.107567	.102936
s^2	.0763508	.100769	.105493	.110126
τ^1	.359363	.48903	.51403	.53853
h^1	.134434	.105627	.100075	.0946345
h^2	.0632634	.092081	.0976391	.10308
h_1^1	.174006	.138393	.131525	.124794
h_2^1	.160365	.124762	.117897	.111169
h_1^2	.0860377	.121643	.128511	.135242
h_2^2	.0724422	.10802	.114885	.121613
lifetime well-being^1	-2.90143	-3.2626	-3.34346	-3.42718
lifetime well-being^2	-4.02993	-3.46804	-3.38037	-2.9916

Table 24
Medicaid subsidy holding the Medicare subsidy constant – Regime B

τ (σ=.65)	**.40**	**.417939 (baseline)**	**.50**	**.60**
η	.401697	.5	.738961	.860787
s^1	.125342	.120337	.0981833	.0729652
s^2	.0701263	.0674238	.0554295	.041692
h^1	.122442	.117256	.0944111	.0686754
h^2	.0743	.0777414	.0861042	.0849239
h_1^1	.16529	.161401	.143238	.120147
h_2^1	.151924	.14816	.130604	.108349
h_1^2	.0889901	.0895164	.0884496	.0822812
h_2^2	.0744842	.0747129	.0727237	.0659977
lifetime well-being^1	-3.02123	-3.07673	-3.3548	-3.76372
lifetime well-being^2	-3.85374	-3.80623	-3.7138	-3.76994

Table 25
Medicaid subsidy holding the Medicare subsidy constant – Regime C

τ (σ=.65)	**.40**	**.50**	**.511682 (baseline)**	**.60**
η	.176633	.4738	.5	.661493
s^1	.125342	.0981833	.095133	.0729652
s^2	.0701263	.0554295	.0537731	.041692
h^1	.134918	.130088	.129024	.117941
h^2	.0633514	.0606778	.0601255	.0544973
h_1^1	.170718	.159374	.157771	.143854
h_2^1	.156913	.145317	.143698	.129729
h_1^2	.0843893	.0787194	.0779198	.0709817
h_2^2	.0706334	.0647235	.0639085	.0569344
lifetime well-being^1	-2.90804	-2.98088	-2.99442	-3.13289
lifetime well-being^2	-4.0397	-4.12205	-4.13692	-4.2874

Table 26
Medicaid subsidy holding the tax rate constant – Regime B

σ (τ =.20)	.45	.30	.15	0
η	.300339	.579203	.670544	.717372
s^1	.189616	.193387	.197275	.201286
s^2	.106263	.109564	.112993	.116556
h^1	.184695	.184797	.184876	.184929
h^2	.103528	.132432	.148418	.158811
h_1^1	.176882	.162376	.151403	.142661
h_2^1	.162342	.147581	.136232	.127041
h_1^2	.0927717	.0925877	.0898343	.0867561
h_2^2	.0773983	.0755824	.0716915	.0676195
lifetime well-being^1	-2.57663	-2.6213	-2.65837	-2.69042
lifetime well-being^2	-3.50201	-3.26222	-3.16902	-3.12467

Table 27
Medicaid subsidy holding the tax rate constant – Regime C

σ (τ =.20)	.45	.30	.15	0
η	.120529	.304107	.391129	.44324
s^1	.189616	.193387	.197275	.201286
s^2	.106263	.109564	.112993	.116556
h^1	.196925	.221466	.23684	.247731
h^2	.0923561	.10302	.109225	.113207
h_1^1	.1807	.172464	.164421	.157249
h_2^1	.165845	.15675	.147945	.140031
h_1^2	.0893102	.0851595	.0811145	.0775081
h_2^2	.0745105	.0695185	.0647328	.0604114
lifetime well-being^1	-2.50183	-2.41016	-2.36943	-2.34937
lifetime well-being^2	-3.63522	-3.55518	-3.52669	-3.51952

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