Universal Health Care and the Maryland Economy

An Econometric Analysis Using the Maryland State Tax Analysis Modeling Program

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The Beacon Hill Institute at Suffolk University in Boston focuses on federal, state and local economic policies as they affect citizens and businesses. The institute conducts research and educational programs to provide timely, concise and readable analyses that help voters, policymakers and opinion leaders understand today's leading public policy issues.

Beacon Hill Institute for Public Policy Research • Suffolk University
8 Ashburton Place • Boston, Massachusetts 02108
Phone 617/573-8750, Fax 617/720-4272, e-mail BHI@beaconhill.org, www.beaconhill.org

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Prepared for

Maryland Foundation for Research and Economic Education
and
The Heritage Foundation

by the
Beacon Hill Institute

David G. Tuerck, PhD, *Project Director*

In-Mee Baek, PhD, *Project Manager*

Jonathan Haughton, PhD, *Project Consultant*

Rebecca L. Moryl, *Economist*

Sorin Codreanu, Tija Kurian and Corina Murg, *Research Assistants*

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About the Beacon Hill Institute

The Beacon Hill Institute is an independent, nonpartisan economic research organization located in the Department of Economics at Suffolk University in Boston, Massachusetts. Articles and references to BHI's work have appeared in leading publications, including the *Boston Globe, Wall Street Journal, Los Angeles Times Magazine, U.S. News & World Report* and *State Tax Notes*. For the last seven years, BHI has been a leader in the development of econometric models for the analysis of state tax policy changes. This is the 14th in a series of studies that the BHI has performed applying its STAMP℠ (State Tax Analysis Modeling Program) methodology to state and local policy issues.

About Maryland FREE

Maryland FREE (Maryland Foundation for Research and Economic Education) is a foundation established by Maryland Business for Responsive Government. It sponsors research that identifies problems facing Maryland's economic competitiveness and explores solutions to those problems. An important part of the foundation's mission is to educate the state's opinion leaders, policy makers, and the media about policy innovations employed successfully in other states and to suggest innovative solutions to Maryland's economic problems.

About The Heritage Foundation and The Center for Data Analysis

The Heritage Foundation, located in Washington D.C. is one of the world's foremost research and educational institutions, conducting research on a wide range of issues, including tax policy, regulation, welfare, international trade policy and defense. As part of The Heritage Foundation, the Center for Data Analysis provides timely and accurate analytical products intended to help advance public policy debates.

To carry out this work, the Center employs the highest quality databases and maintains a set of customized and peer-reviewed analytical models. Using its Heritage Matched Database, along with the WEFA econometric model and the BHI STAMP model, the Center analyzes the effects of global, national and state policy changes on a wide variety of economic indicators. The Center shares its analysis of proposed legislation and administrative actions with policymakers in and out of government, and provides members of Congress, officials within the executive branch, and the public-policy community with an independent assessment of policy options.

Center Director William Beach served from 1981 to 1985 as an economist for the state of Missouri, where he designed and managed the state's econometric model and advised the governor on revenue and economic issues. A graduate of Washburn University in Topeka, Kansas, Beach earned a master's degree in history and economics from the University of Missouri at Columbia.

About the Authors

David G. Tuerck is Executive Director of the Beacon Hill Institute for Public Policy Research at Suffolk University in Boston, MA, where he also serves as Chairman and Professor of Economics. He holds a doctorate in economics from the University of Virginia and has written extensively on issues of taxation and public economics. Dr. Tuerck has over 11 years experience developing econometric tax models, beginning with the Coopers & Lybrand Economic Forecasting Simulator, developed for the U.S. Treasury, and continuing today with STAMP. He has testified on tax and welfare policy before Congress and various state legislatures.

In-Mee Baek is Senior Economist at the Beacon Hill Institute and Associate Professor of Economics at Suffolk University. She holds a doctorate in economics from Indiana University, and is a specialist in international monetary economics.

Jonathan Haughton is Senior Economist at the Beacon Hill Institute and Assistant Professor of Economics at Suffolk University. He holds a doctorate in economics from Harvard University and has published widely in refereed journals on economic development and taxation.

Rebecca Moryl is Director of Operations and Economist at the Beacon Hill Institute. She is a Master of Science in Economic Policy degree candidate at Suffolk University. She holds a Bachelor of Arts (public policy) degree from Trinity College in Hartford, Connecticut.

Sorin Codreanu is a Research Assistant at the Beacon Hill Institute and a Master of Science in International Economics degree candidate at Suffolk University. He holds a Bachelor of Arts (economics) degree from the West University in Timisoara, Romania.

Tija Kurian is a Research Assistant at the Beacon Hill Institute and a Master of Science in International Economics degree candidate at Suffolk University. She holds a Bachelor of Arts (economics) degree from Mahatma Gandhi University in Kerala, India.

Corina Murg is a Research Assistant at the Beacon Hill Institute and a Master of Science in International Economics degree candidate at Suffolk University. She holds a Bachelor of Arts (economics) degree from the West University in Timisoara, Romania.

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Executive Summary

The year 2002 will find Maryland in the throes of a debate over the introduction and implementation of universal health care. Universal health care would consist of providing health care or health insurance coverage for some or all Maryland residents, depending on the details of the health care system finally adopted. That system might be expected to take the form of one of four alternative plans: (I) Medicaid Expansion, (II) Pooling the Uninsured, (III) a Multi-Payer System or (IV) a Single-Payer System.

Medicaid Expansion would increase the coverage of Maryland's existing Medicaid system by raising the eligibility threshold from the existing 44 percent of the poverty level to some higher threshold (say, 300 percent of the federal poverty level). Pooling the Uninsured would go beyond mere expansion of existing Medicaid programs to achieve full insurance coverage for all uninsured Marylanders. A Multi-Payer System would require employers to either offer insurance coverage directly to their employees or pay into a government created system. Finally, a Single-Payer System would be a wholly state financed and administered health care system that would cover all Marylanders.

Proponents of universal health care stress the "need" for health insurance and the cost savings that, they argue, certain plans would make possible. They do not ordinarily consider the economic costs that the implementation of universal health care might inflict. Yet, such costs are an inevitable, if unwanted, byproduct of the sweeping increases in tax rates or employer costs that its implementation would necessitate. Indeed, all of the above-described methods would have negative economic consequences for the state, including decreases in employment and payroll.

The Beacon Hill Institute (BHI) has developed a State Tax Analysis Modeling Program for Maryland (Maryland-STAMP) specifically to identify and measure these consequences. The Maryland-STAMP analysis shows how each method of implementing universal health care would affect employment, payroll, tax revenues and the capital stock, which is the stock of factories, office buildings, machine tools, computers and other forms of private fixed nonresidential capital.

The study assumes that universal health care is permanently implemented in 2002. Table 1 summarize the effects of its implementation for 2002.

Table 1. The Economic Effects of the Universal Health Care on the Maryland Economy in 2002

(dollar amounts in millions of 2002 dollars)

Economic Effect of Proposal	Medicaid Expansion	Pooling the Uninsured	Multi-Payer System	Single-Payer System
Change in Number of Jobs	-30,618	-61,488	-54,188	-117,531
Change in Capital Stock	$0	$0	$0	$14,958
Change in Payroll	-$1,274	-$2,558	-$2,255	-$4,890
Tax Effects				
Dynamic Tax Effect	$78	-$187	-$127	-$746
Required Increase in the Personal Income Tax	23%	46%	13%	233%
Net Tax Revenue Required to Fund the Program	$1,162	$2,319	$565	$11,885
Change in Employer Health Insurance Costs	$0	$0	$1,142	-$7,714

The loss in jobs and payroll depends on whether a particular system would be financed mainly from business payrolls or mainly from taxes and on how comprehensive the plan would aim to be. Implementation of Medicaid Expansion, the least comprehensive plan, would result in the loss of 30,618 jobs and of $1,274 million in payroll. Alternatively, a Single-Payer System, the most comprehensive plan, would result in the loss of 117,531 jobs and of $4,890 million in payroll. As shown, Medicaid Expansion would inflict the smallest job loss, causing the equivalent of a 1.2-percentage-point increase in the state unemployment rate. The Single-Payer System would inflict the largest job loss. It would cause the unemployment rate to increase by about 4.7 percentage points and, in so doing, bring about a severe economic contraction.

All four health care systems would require the state to raise additional tax revenues, ranging from $565 million for the Multi-Payer System to $11,885 million for the Single-Payer System in 2002. We assume that Maryland raises revenues through the state personal income tax in order to defray its portion of the costs of providing universal health care.

While the state might attempt to fund these costs in part or in total through other taxes, we believe that it would be driven to rely largely on the income tax for funding. This is owed to the unreliability – and to a degree, the unpopularity – of other revenue sources for funding a large program such as this. Whatever the combination of tax increases ultimately relied upon for funding, the economic effects would be of the same general magnitude as those identified here.

The required increase in the personal income tax rate would exert negative "dynamic" effects on the state economy. In order to raise the new revenue needed to fund a Single-Payer System, for example, the state would have to raise the average effective personal income tax rate by 233%, from the projected 2002 effective rate of 5.01 percent to 16.69 percent. The shrinkage in payroll brought about by this increase in the tax rate would in and of itself cause the state to incur a revenue loss of $746 million. The state would therefore have to raise tax rates enough to provide for a net increase in revenues of $11,885, after adjusting for this "dynamic" revenue loss.

Health insurance costs would change under the Multi-Payer System and the Single-Payer System. Under the former, employers would incur $1,142 million in additional health insurance costs as they extended coverage to currently uninsured employees.

Under the Single-Payer System employers would save $7,714 million in health insurance costs. This would, in turn, induce employers to engage in $14,958 million in new capital spending. The negative effects on jobs and payroll would, however, as shown above, be all the larger.

Table 2. The Economic Effects of the Universal Health Care on the Maryland Economy in 2005

(dollar amounts in millions of 2002 dollars)

Economic Effect of Proposal	Medicaid Expansion	Pooling the Uninsured	Multi-Payer System	Single-Payer System
Change in Number of Jobs	-30,444	-73,408	-63,517	-124,828
Change in Capital Stock	$0	$0	$0	$15,924
Change in Payroll	-$1,317	-$3,133	-$2,719	-$5,226
Tax Effects				
Dynamic Tax Effect	-$80	-$239	-$155	-$753
Required Increase in the Personal Income Tax	21%	52%	14%	234%
Net Tax Revenue Required to Fund the Program	$1,191	$2,851	$667	$13,046
Change in Employer Health Insurance Costs	$0	$0	$1,493	-$9,096

Table 2 summarizes the results for 2005. Here we find that, by the fourth year of implementation, there would be 30,444 fewer jobs under Medicaid Expansion than there would have been had there been no implementation of universal health care in 2002. Payroll would be reduced by

$1,317 million (in constant, 2002 dollars). In 2005, under the Single-Payer System, there would be 124,828 fewer jobs and $5,226 million less in payroll.

These numbers reflect the increase in premiums, in the population and in the labor force that will take place between 2002 and 2005. The actual job and payroll losses in any year would depend on the health care costs and on the economic conditions that happen to prevail in that year. Permanent losses are, however, inevitable. Once universal health care was implemented, the number of jobs and persons employed would continue to rise with the economy but would always be less than would have been possible in the absence of its implementation. Whatever its benefits, universal health care would inflict a permanent scar on the economic landscape.

The details behind these estimates are spelled out in our study. The estimates are naturally sensitive to our assumptions of how the Maryland economy responds to changes in tax rates and to employer costs. They are sensitive also to our interpretation of the lines along which universal health care might ultimately be adopted. To that degree, we might under or over-estimate the ultimate job and payroll losses. That such losses will occur and should be weighed against the alleged benefits of implementing universal health care cannot, however, be disputed.

I. Maryland and Universal Health Care

The state of Maryland is about to enter into a debate over the adoption of universal health care. The movement to adopt universal health care is headed by Maryland Citizens' Health Initiative (MCHI), a local arm of a national citizens group, Health Care for All. The goal of MCHI is to place a proposal for universal health care before the Maryland legislature in 2002. The details of the proposal are unclear. While MCHI was formed over 2 years ago, it has yet to reveal a specific method for implementing its ideas.

There appear to be four principal options for implementing universal health care:

1. Medicaid Expansion to cover a larger number of the uninsured,
2. Pooling the Uninsured in a group to be insured by the state government,
3. A Multi-Payer System, which would require businesses to cover the cost of insuring all employees and state government to insure the uninsured unemployed,
4. A state-funded Single-Payer System, which would insure all residents.

All four options would impose substantial economic losses on the state economy. Because the details of universal health care, as ultimately implemented, cannot be envisioned now, the costs could run a wide gamut – from some 31,000 to 118,000 lost jobs in 2002, by our estimation.

Job losses are inevitable and substantial. And these are conservative estimates, obtained by assessing as accurately as possible the costs of such a plan to taxpayers, employers and employees and by determining how employers and employees are likely to adjust their economic behavior to the imposition of these costs.

A survey of attempts by other states to implement universal health care can be used as a starting point in considering options available to – as well as the pitfalls arguably faced by – the state of Maryland in considering universal health care.

State-Run Health Care in Other States

Minnesota

Throughout the 1990s, a wave of health care reforms spread across the country as states attempted to address rising concerns about the escalation of health care costs. Minnesota adopted

Health Right in 1992, the precursor to *MinnesotaCare*, adopted in 1993. *MinnesotaCare* was an attempt to redesign health care delivery in the state along "supply-side" lines. The program was primarily a cost-containment program consisting of price control measures and mandated uniform premiums for insurers.

By 1997, *MinnesotaCare* was almost completely dismantled owing to patient dissatisfaction and the financial burdens the plan placed on the state. All that currently remains is a program for those who do not have access to employer based insurance and who fall under 175 percent of the federal poverty level.[1] The program is financed through a combination of sliding-scale premiums, a 1.5 percent tax on health care providers and some Medicaid funds.

Washington

Even as President Clinton's Health Security Act of 1993 was foundering in Washington D.C., Washington State was implementing its own variation, the Washington Health Services Act (HSA). HSA was a government subsidized Multi-Payer System that raised taxes, increased regulation, imposed price controls and limited patient choice of doctors and coverage plans. Employers were required to pay 50 percent of the lowest cost health plan in their area, leaving employees to make up the difference of the plan they selected. Self-employed and unemployed individuals were required to pay for the plans themselves.[2]

As a result of HSA, many private health insurers left the state. Those that remained were forced to raise rates, and still lost money.[3] Premium increases meant that more people became uninsured. In addition, the plan attracted very ill persons from outside the state, further driving up costs.[4] As a result of these effects, HSA was repealed only 18 months after its implementation. All that remains today is the *Basic Health Plan*, which complements existing Medicaid plans. The *Basic Health Plan* covers families with incomes below 200 percent of the federal poverty level that are not eligible for Medicaid. It is funded through tobacco settlement payments and taxes on hospital services, alcohol and tobacco.

[1] For families with children the threshold is 275 percent of the federal poverty level.
[2] Robert Cihak, Bob Williams and Peter Ferrara, *The Rise and Repeal of the Washington State Health Plan* (Washington, D.C.: The Heritage Foundation, June 11, 1997).
[3] *Ibid*.
[4] Representative Phil Dyer, "The Burdens of Health-Care Reform," *The Seattle Times*, August 23, 1996, sec. B7.

Tennessee

Tennessee's *TennCare* was established in 1994 to offer state-funded insurance to the uninsured and uninsurable. Using a managed-care model, *TennCare* increased existing Medicaid programs in Tennessee by 50 percent without proportionally increasing funding. By 1999 *TennCare* was $250 million in the red. The state, which faced a $416 million budget shortfall, owed $190 million of this amount. *TennCare* is undergoing reform, but it has cost the state millions of dollars in unanticipated costs.[5]

Other States

The 1990s saw similar programs implemented and then repealed or substantially modified in other states, including California, Kentucky, Vermont and New Jersey. The new decade finds the movement towards universal health care taking hold in several states, including some in which it suffered earlier failures.

Health Care in Maryland

Maryland is at the front of this latest movement. In May 2000, MCHI released a report by the Lewin Group of Northern Virginia, indicating that the state could provide health care for all its citizens and save money in the process.[6] The report considered two methods by which the state could provide health care coverage, a Single-Payer System and a Multi-Payer System.

Under the Single-Payer System, the state would administer and fund a uniform health plan to cover all individuals in the state. It would replace existing public insurance programs including Medicare, Medicaid, Civilian Health and Medical Programs for the Uniformed Services (CHAMPUS), Children's Health Insurance Program (CHIP), and the Federal Employees Health Benefits Plan, as well as all private insurance plans in the state. This Single-Payer System would be financed by redirecting funds from existing government programs and by imposing new taxes on employer payrolls, personal income, tobacco and alcohol.

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[5] Leigh Ann Roman, "TennCare: Health Care Providers and the Public Seek Solutions to Save the Program," *Memphis Business Journal*, May 21, 1999.

[6] John F. Sheils and Randall A. Haught, *Analysis of the Costs and Impacts of Universal Health Care Models for the State of Maryland: The Single-Payer and Multi-payer Models* (The Lewin Group: May 2, 2000) available from http://www.healthcareforall.com/Lewin.htm; Internet; accessed July 24, 2001.

The Multi-Payer System would also be funded by increased taxes and would be designed to cover all Marylanders. But unlike the Single-Payer System, this plan would allow employers to opt out of the program and provide benefits to their employees and their families as long as the benefits offered under the employer plan were at least as comprehensive as the state plan.

The Lewin report calculated that the Single-Payer System would cost approximately $345.8 million less than the existing health care system.[7] It estimated that the Multi-Payer System would cost $207 million more than the existing system. Critics have argued that either program would drive businesses from the state and draw the chronically ill to the state, causing the cost substantially to exceed that of the existing health care system.

Maryland-STAMP

The Beacon Hill Institute (BHI) has applied its State Tax Analysis Modeling Program, STAMP[SM], to the economy of Maryland to determine the cost of implementing universal health care in the state. First developed in 1994, STAMP is a computer representation of a state's economy founded on archetypal economic principals and employing state-of-the-art statistical and econometric methods.

The Maryland-STAMP analysis reveals the effects that implementing universal health care would have on state employment, the stock of capital, wage rates, payroll and tax revenue. We consider four methods that could be brought before the legislature: (I) Medicaid Expansion, (II) Pooling the Uninsured, (III) the Multi-Payer System and (IV) the Single-Payer System. We present the economic effects of each of these methods in Section V. In order to determine the economic effects of each method, we first consider what segments of the population would be covered by each of the four possible methods.

[7] The Lewin Group estimates 2001 Maryland health care costs at $20.8 billion.

II. Four Possible Methods for Expanding Health Care in Maryland

Government plays an essential role in any system for providing universal health care. The choice of system defines the nature and extent of government involvement. Under a Multi-Payer System, for example, the government relies largely on its regulatory powers, which it uses to require employers to provide health insurance for currently uninsured employees.
All proposals for universal health care require government to increase spending on health care, in most instances only for the currently uninsured, in other instances (notably, the Single-Payer System) for persons who already have insurance. In using its own funds to guarantee health care, government can proceed in one of two ways. First, it can provide health care directly from its own facilities and through its own providers. This approach would eliminate the role of insurance and provide for a completely centralized health care system. Alternatively, government can guarantee access to existing health care providers and insurers to residents who might otherwise not have access to (or refuse for some reason to purchase) their own health insurance. We assume that government takes the second of these approaches in our analysis of the four alternative plans.

In deciding which persons would be covered by a Maryland universal health care plan, it is useful to distinguish between three groups of Marylanders: (1) persons who live in the state and either work in the state or are unemployed – all presumably covered by any future Maryland universal health care plan; (2) persons who live in the state but work outside the state; and (3) persons who live outside the state but work in the state.

Because a substantial number of persons comprising group (2) work in Washington, D.C. and are employed by and receive health care benefits from the federal government, it seems unrealistic to consider many of the persons comprising this group as, in any sense, "needing" universal health care from the state of Maryland. The most likely outcome of an attempt to institute universal health care would be to permit such persons to continue receiving their existing insurance, which, we may presume, they would rather do than join the state system. On the other hand, it would be difficult, even if for some purposes desirable, to exclude persons falling into group (3) from participating in the system.

For the foregoing reasons, we assume that universal health care instituted by the state of Maryland would extend to persons in groups (1) and (3) but not persons in group (2).

Marylanders who live in the state but work out of state would continue to be insured (or not) by their out-of-state employer.

Method I. Medicaid Expansion

This method would expand Maryland's existing Medicaid and Child Health Plans by raising the income thresholds for these programs from their current levels to 300 percent of the federal poverty level (FPL). For the Child Health Plan the current income threshold is 200 percent of the FPL. But for adult Medicaid programs the threshold currently is 44 percent of the FPL.[8] Thus Medicaid Expansion would translate to a 256-percentage-point increase in the eligibility limit for adults. The result would be a vast increase in the number of persons eligible for assistance, which, in turn, would require the state to increase Medicaid spending.[9] In order to finance this spending, the state would have to increase taxes or cut spending on other programs.

We assume that here, and under the other systems to be considered, the state opts for higher taxes rather than reduced spending. We further assume that, under any system of implementing universal health care, the government defrays its portion of the incremental costs by raising personal income tax rates.

This is a reasonable assumption. While the state might initially attempt to fund expenses through alternative or additional revenue sources, it would, in our judgment, come to find these sources both unreliable and unpopular. Excise taxes alone would not yield the needed revenue. Sales taxes are regressive and both sales and excise tax revenues are vulnerable to rapid erosion from cross-border sales.

In any event, sweeping tax increases of the kind that any state system of universal health care would require have the same general effects: raising the cost of hiring labor and creating capital and, in the process, reducing the state's competitiveness. In the end, any increase in other tax rates sufficiently large to raise the required revenue would be roughly equivalent, in its economic

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[8] Vernon K. Smith and Eileen Ellis of Health Management Associates and Christina Change, *Eliminating the Medicaid Asset Test for Families: A Review of State Experiences* (Washington, D.C.: Kaiser Commission on Medicaid and the Uninsured, April 2001) available from http://www.kff.org/content/2001/2239/2239.pdf; Internet; accessed July 24, 2001.

[9] We assume that the state absorbs all the costs of raising the threshold, which is to say that the federal government does not reimburse the states for any of the costs thus incurred. It might therefore be more accurate to think of this as a "Medicaid-like" system.

effects, to the income tax increases considered here. The equivalence between certain broad-based tax changes for their effects on economic activity has been long established in the academic literature.[10]

Method II. Pooling the Uninsured in Government Programs

Pooling the Uninsured would extend health insurance to persons not covered by existing government or employer programs. This system could take two very different forms, (1) a state managed "safety net" program or (2) direct subsidies that uninsured Marylanders could use to purchase health care coverage. Absent reform of the tax treatment of health insurance, we assume that either system would be financed by an increase in the income tax (the former so that the state could raise the funds necessary to provide insurance, the latter so that the state could replace revenue lost as a result of uninsured persons' taking advantage of the tax credit).

A state managed safety-net plan would enroll all uninsured Maryland residents in a state sponsored plan. Individuals or families not covered by their employer or through Medicaid, Medicare, the Children's Health Insurance Program (CHIP), or by an approved plan would fall into this state "safety net." Premiums could be charged to enrollees of the state plan on a sliding-scale basis. In modeling the effects of Pooling the Uninsured, we assume that the state pays all health care costs for the uninsured.

Tax credits can be designed in many ways. This plan would make uninsured Maryland workers and unemployed Maryland residents and their families eligible for a tax credit that could be used to cover all of the cost of purchasing their health insurance. The credit would be *refundable* for those uninsured who have no tax liability, effectively making it a state subsidy for those individuals. With refundable tax credits, the state provides subsidies to the uninsured for their health care coverage rather than automatically enrolling them in a state-sponsored health insurance plan.

Method III. Multi-Payer System

The Multi-Payer System would require employers to contribute to the cost of coverage for their employees. In this case we assume that employers have two possible options under the Multi-Payer System, sometimes referred to as "play or pay". Employers could either (1) "play" by offering direct coverage to employees through benefits at the workplace, or (2) "pay" a fee to the

[10] See, for example, Richard A. Musgrave, *The Theory of Public Finance* (New York: McGraw-Hill, 1959),

government through payroll taxes so the state can provide coverage for their workers. The state would create a coverage safety net for those not insured by their Maryland employer as well as for unemployed uninsured residents.

With a Multi-Payer System, the government would impose a substantial portion of the cost of the program on employers. Whether by offering insurance to their employees or by paying a fee to the government, employers would contribute to the cost of the Multi-Payer System. Mandating health insurance for all employees increases the cost of hiring labor and results in a loss in jobs and wages.

Method IV. Single-Payer System

Under a Single-Payer System, the state provides health care for all residents. Proponents of this program claim that it would impose lower "administrative costs" than private programs. A single state-run plan would not have the paperwork and varying claim forms, benefit packages and processing systems inherent in administering current private HMOs. Additionally, proponents claim, a single state-run plan would not have to spend on advertising and public relations, as does a private competitive HMO.

There is the possibility that implementation of a Single-Payer System would conflict with the existing Federal Employee Retirement Income Security Act (ERISA). ERISA was implemented in 1974 to establish uniform federal standards for employee benefit plans offered by private employers and unions, including health plans. ERISA supersedes any state administered insurance program by preventing the state from regulating employer-provided insurance plans where employers "self-insure," that is, provide health care directly to their employees rather than purchasing coverage through an existing outside insurer.

In order to include those residents currently covered by ERISA, Maryland could apply to the federal government for a waiver from the law. Alternatively, Maryland could design its Single-Payer System to exempt persons covered by ERISA. We assume that Maryland obtains a Federal waiver from ERISA, so that the Single-Payer System can cover all persons.

350-355.

III. The Economics of Healthcare Reform

Any proposal to reform health care is aimed in part at addressing the problem of rising health care costs. Unfortunately, reform proposals seldom address the root cause of this problem, which is the breakdown in individual incentives to guard against rising health care costs.

Most individuals are risk-averse, meaning that they prefer to insure against catastrophic health costs, rather than bet that they will not become sick. Risk-averse individuals would rather pay a small but certain cost than risk the high costs of unforeseen illness. This is similar to the reasons individuals choose to insure their homes and cars against damage or accidents. However, once purchased, health insurance reduces the price that consumers pay for medical care when they do become sick. It has been estimated that consumers pay on average only one-fifth of the market price of the health goods and services they consume.[11]

The discrepancy between the costs paid by individuals and those covered by insurance gives rise to excess demand for health care. This is a manifestation of moral hazard, with the individual lacking an incentive to reduce costs that arise out of his own behavior. By lowering the price of health care without simultaneously imposing any significant penalty (such as a co-payment or deductible) for overuse of the health care system, insurance encourages the individual to consume more than he would if he had to pay the full price. This is represented in Figure 1. Studies have found this to be the case empirically: people consume less health care when enrolled in insurance plans with high levels of cost sharing, compared to consumption of health care in plans with lower levels of cost sharing.[12]

Consumers choose the "efficient" amount of health care coverage, given their demand, when they pay the market price (P^*). They consume the efficient quantity of health care (Q^*). In this case, consumers bear the full cost of health care. When consumers have health insurance, they face a lower, distorted price for health care (P_1). Because demand for health care is downward sloping, this causes them to consume the quantity (Q_1).[13]

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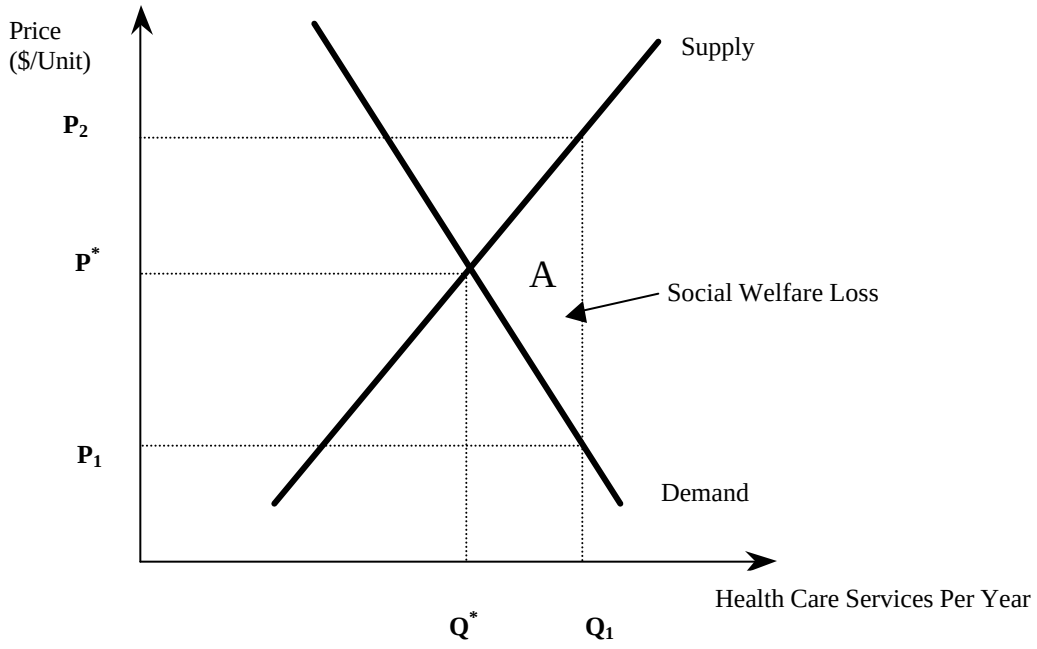
[11] David N. Hyman, *Public Finance: A Contemporary Application of Theory to Practice* (New York: Dryden Press, 1999), 298-299.
[12] Joseph P. Newhouse and the Insurance Experiment Group, *Free for All? Lessons from the Rand Health Insurance Experiment* (Cambridge, MA: Harvard University Press, 1993).
[13] Willard G. Manning, et al., "Health Insurance and the Demand for Medical Care: Evidence From a Randomized Experiment," *American Economic Review* 77 (June 1987): 251-277.

This quantity represents an excess or "inefficient" demand for health care. Whereas consumers are required to pay only P_1 for this quantity, producers would have to receive a higher amount (P_2) in order to cover their costs. The resulting inefficiency or social welfare loss can be measured as area *A*, the value of the resources wasted accommodating the excess demand for health care.

As Nancy Turnbull, a lecturer at Harvard's School of Public Health states, "the problem is neither patients nor their doctors are the ones paying the bills. Without any financial constraints, there would be no limits on the care demanded…in this country we want it all, but we don't want to pay for it."[14]

Figure 1



The result of the artificially low price of health care faced by insured individuals is overconsumption and an inevitable rise in the cost of health care and health insurance. Joseph Gerstein, medical director and doctor at Tufts Health Plan, states,

> If everyone says, "I paid my health insurance premium, I don't care what anything costs," the result is the inevitable and inexorable rise in the premium…and if you raise the premium, people will drop out at the bottom because they can't afford the insurance. We have a social obligation not to squander resources.[15]

[14] Charles Stein, "When Money and Medicine Meet," *Boston Globe Magazine*, October 11, 1998, 38.
[15] Ibid, 25.

Whether Maryland adopts a Multi-Payer System, Single-Payer System or some other method, moral hazard will continue to pose a problem. Without rationing or very high co-pays, no mechanism exists to reduce rising health care costs. Universal health care will simply exacerbate the current stress on health resources by increasing the number of individuals who face deceptively low health care costs.[16]

Currently, Health Maintenance Organizations (HMOs) and managed care insurance companies trim costs by negotiating discounts with doctors and hospitals and by eliminating unnecessary medical care. To encourage firms and individuals to move to managed care plans from traditional indemnity plans (those that cover all costs), HMOs expanded the offerings to include plans that offered higher quality care. Combined with "point-of-service" plans, consumers have seen nearly a decade of expanded consumer choice in health care coverage.[17] It is unlikely that consumers would willingly switch to a restrictive Single-Payer System.

Single-Payer Systems also create excess demand for health resources. Because individuals pay for their health care through taxation, they do not internalize the direct costs of health care when they visit the doctor or demand a medical procedure. Effectively, they view health care as free, bringing about excess demand and waiting lists, such as we observe in Canada and the United Kingdom.

The explanations as to why there are so many uninsured are complex and multifaceted. There is an identifiable segment of the population that simply refuses to accept health insurance, either employer-provided or offered through government programs.[18] However, one of the most important factors explaining the growth of uninsured individuals has been the rising cost of health care. Studies have determined that the single largest reason for the decline in health coverage from 1979 to 1995 is explained by the fact that per capita health spending rose much more rapidly than personal income during this period.[19]

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[16] Jerome H. Grossman, *An Economic History of Healthcare in Massachusetts 1990 – 2000* (Boston: Pioneer Institute for Public Policy Research, 2000) 6.
[17] Ibid, 19.
[18] Michael Chernew, Kevin Frick, and Catherine McLaughlin, "The Demand for Health Insurance Coverage by Low Income Workers: Can Reduced Premiums Achieve Full Coverage?" *Health Services Research* 32 (October 1997).

Modeling Healthcare Reform: the STAMP Approach

The problem of determining the economic effects of health care reform requires some method of "modeling" the responses of firms and individuals to changes in costs and in tax rates that implementation of reform would bring about. As shown above, we need to understand how the existing insurance system affects individual behavior in order to assess the consequences of that system for health care economics. Likewise, we need to understand how any health care reform proposal would affect individual behavior in order to assess the economic consequences of its implementation.

This gives rise to the question of how best to estimate individual responses to the policy changes that universal health care would bring about. Many attempts to model policy changes, including tax-law changes, proceed directly from "reduced-form" estimates that test for the effects of such changes on various economic indicators. These estimates can provide useful information about the effects of tax-law changes on jobs, wages and other economic indicators.[20]

However, these estimates do not ground their results in any formal representation of the choice calculus of the individual consumer, worker or firm. A "structural" model, on the other hand, begins with a theory of individual behavior and then determines, through estimation, whether and by how much policy changes affect economic activity in a manner consistent with that theory. Maryland-STAMP is a structural model, in that it is rooted in the optimizing behavior of households and firms.

Maryland-STAMP begins with the assumption that households (or the individuals comprising them) want to maximize their well-being or "utility." Households derive utility from the goods and services they consume, as well as the leisure time they enjoy. There is a tradeoff between the two, because by working more, the household earns the wherewithal to buy more goods and services, but now has less leisure time. The structure of taxes affects this tradeoff.

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[19] Richard Kronick and Todd Gilmer, "Explaining the Decline of Health Insurance Coverage, 1979-1995," *Health Affairs* 18 (March/April 1999).
[20] Timothy J. Bartik, *Who Benefits from State and Local Economic Development Policies?* (Kalamazoo, Michigan: W.E. Upjohn Institute for Employment Research, 1991).

Business firms provide the goods and services that households buy. These firms need inputs of capital and labor, which they employ in such a way as to maximize their profits. The two sectors, households/consumers and firms/producers, interact to determine equilibrium employment, wage rates and the stock of capital.

The amount of capital and labor hired will depend, to a degree, on the level and structure of taxes faced by firms and their owners. Consider the example of a higher state tax on labor income. As some households work less, employers will now face a lower supply of labor, and, as a result, the pre-tax wage rate will increase somewhat. This will result in a decrease in the amount of labor employed, in equilibrium, in the market. This is an example of the outcome that we expect from the adoption of a universal health care system when the system is financed by tax increases.

One strength of STAMP tax models is that they measure tax rates in a theoretically appropriate way. We may think of households and firms as making decisions at the margin: The individual worker asks, "Should I work an extra hour?" The employer asks, "Should I hire the services of an extra worker if I have to provide him with health insurance?" STAMP captures this decision making at the margin by taking into account the effects of policy changes on marginal tax rates.

Modeling Universal Health Care

The cost of hiring labor includes not only the wage of the employee, but also certain nonwage costs that may be treated as an ad-valorem tax on the use of labor services. These nonwage costs include the cost of providing health care benefits to employees. In our model, nonwage labor costs are divided into two categories: (1) certain payroll taxes paid by the employer and (2) the costs of certain employer-provided "insurance benefits," which include health insurance. We measure this "employment benefit cost" as the total insurance cost expressed as a percentage of wages and salaries.

Employer Costs for Employee Compensation data published by the U.S. Bureau of Labor Statistics (BLS) provide the costs of employer-provided health insurance.[21] The BLS provides

[21] There are two surveys done by BLS that provide information regarding employee benefits: the Current Population Survey and the Employee Benefits Survey. The Employee Benefits Survey, which collects data from establishments, rather than individuals, is more useful inasmuch as we seek information on the details of plans and the costs to employers. See Dianne Herz, et al., "Health and Retirement Benefits: Data from Two BLS Surveys," *Monthly Labor Review* (March 2000).

data on the costs of health insurance benefits per hour and as a percentage of total compensation. In addition, it provides data on the distribution of compensation between wages and benefits. Using this information, along with the data gathered on wages and payroll, we estimate employer health insurance costs as a fraction of wages and salaries. The total wage and salary cost to Maryland employers in 2000 was $93.12 billion.[22] According to the Employee Benefit Survey's data on the South region, of which Maryland is a part, 7.33 percent of this total, or $6.83 billion, was spent on health insurance costs.[23]

In STAMP, a health plan for insuring the uninsured has economic effects through the following channels: If the proposed plan requires employers to provide health insurance, it will increase the cost of hiring labor. And thus, employers will hire fewer workers. With a lower demand for workers, the wage rate will decrease. If labor and capital are complementary in production, the resulting decrease in the amount of labor employed will lead to a reduction in the demand for capital stock.

Under a Single-Payer System, the employer cost for health insurance will be eliminated but at the same time the government will have to pay for health care for every individual in the state. Assuming that the government increases the personal income tax rate to pay for the Single-Payer System, the consequences of implementation of that plan in the context of STAMP are: (1) the decrease in the employer benefit cost would have a positive effect on the state economy inasmuch as firms can now afford to hire more workers and capital, but (2) the resulting higher state income tax rate would discourage workers from working in Maryland by reducing their post-tax reward (or take-home pay) for working there.

The Single-Payer System would discourage workers from working in Maryland for three reasons: First, workers residing in Maryland may leave the labor force or refuse to take jobs for which there are openings. The household may find that it is no longer worth having the second wage earner in the work force. Workers holding part-time or temporary jobs may find such jobs less attractive. Workers holding full-time jobs may elect to work part-time, instead. Older workers

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[22] Maryland Board of Revenue Estimates, *Report of the Maryland Board of Revenue Estimates on Estimated Maryland Revenues Fiscal Years ending June 30, 2001 and June 30, 2002*, (Annapolis, MD: Maryland Board of Revenue Estimates, December 14, 2001) available from http://www.marylandtaxes.com/initiatives/localgov/bre2000.pdf; Internet; accessed July 24, 2001.

[23] Data are from the Employee Benefit Survey of the Bureau of Labor Statistics. Although state-level data are not available, regional data are. Maryland is classified as a South region state in the Survey. Thus, we use the data for the South. Total insurance includes life, sickness and accident insurance as well as health insurance. Bureau of Labor Statistics, *Employer Costs for Employee Compensation* (Washington, D.C.: 2001) available from http://www.bls.gov/ecthome.htm; Internet; accessed June 20, 2001.

may retire earlier. Younger workers may put off entering the labor force for school or other options. Unemployed workers may be slower to take new jobs.

Second, out-of-state workers considering a move to Maryland may find working there less attractive. This would apply particularly to out-of-state workers who have insurance through their existing jobs, who would not find the availability of universal health care an incentive to move to Maryland and who would find the reduction in post-tax income a disincentive.

Third, those individuals who currently work mainly to gain health benefits for their households could leave the work force without sacrificing their health care. The other three methods of implementing universal health care would have similar effects.

These are some of the general principles that underlie Maryland-STAMP. Readers interested in the theoretical structure and econometric estimation of the model will find a detailed discussion in the chapter that follows and in Appendix 1. Readers not interested in this detail may proceed to Section V for the discussion of the estimation of health care costs under the four different universal health care proposals and an analysis of the economic impacts of each plan.

IV. STAMP Estimation

How STAMP Works

In this section we explain, at a relatively intuitive level, how STAMP works, summarizing the components of the model and deriving the reduced-form equations. Further details are provided in the Appendices.

STAMP takes the optimizing behavior of households and firms as its starting point. This is the sense in which it is a "structural" model. From this foundation it derives "reduced form" equations, which are estimated using data for seven main sectors of the economy over the period 1975-1998.

We start with a typical adult who has to allocate his time ($\bar{L}$) between work (L) and leisure ($l = \bar{L} - L$). If he works more, then he will be able to earn more and buy more goods to consume (C), but on the other hand this will leave him with less leisure. This tradeoff is captured in the form of a utility function, which the individual maximizes, subject to his budget constraint. The budget constraint shows that consumption must be paid for out of post-tax earnings and transfer payments received from the government. This maximization problem may be solved to generate the supply of labor of a typical individual.

We multiply the individual's supply of labor by the working-age population (PW) in order to get the total labor supply in the state. We specify that PW is simultaneously determined by the condition of the state's labor market as well as by the state policy variables (such as the state income tax and the residential property tax) that attract or deter people from moving into or out of the state.

After some manipulation we may derive the labor supply function, given by

$$\ln L^s = q_0 - q_1 \ln G_{tr} + q_2 \ln w - q_3 t_{fl} - q_4 t_{sl} - q_5 t_{pr}, \quad (1)$$

where

q_0 = constant;

G_{tr} = government transfer payment;

w = wage rate;

t_{fl} = the marginal federal personal tax rate on labor income and the employees' contribution to social security as a fraction of payroll;

t_{sl} = the marginal state personal tax rate on labor income; and

t_{pr} = the residential property tax rate.

The structural model suggests that the relationship between wages and labor supply is a positive one, while the relationship between the other variables and labor supply is a negative one. For instance, we expect that an increase in wages will attract more people into the labor force, thus increasing labor supply. Note that henceforth *all coefficients are positive, unless otherwise noted*.

Meanwhile producers are striving to maximize their profits by demanding labor (L) and capital (K) in order to produce output (Q). The additional expenses they incur when hiring labor (such as payroll taxes imposed by state and federal governments and the costs of other employee benefits) will affect their profits. We may think of firms as renting the capital they use, where the rental cost of capital (r) is affected by the taxes that are borne by capital, including corporation income taxes, taxes on dividends and capital gains. By solving the producers' maximization problem it is possible to derive demand curves for labor and for capital, which may be written as:

(2) $$\ln L^d = l_0 + l_1 \ln q - l_2 \ln r - l_3 t_{pc} - l_4 \ln w - l_5 v_s - l_6 v_f - l_7 v_b$$

and

(3) $$\ln K = k_0 + k_1 \ln q - k_2 \ln r - k_3 t_{pc} - k_4 \ln w - k_5 v_s - k_6 v_f - k_7 v_b ,$$

where

k_0 = constant

q = U.S. production index;

t_{pc} = the tax rate on corporate property;[24]

n_s = the state payroll tax rate, measured by the unemployment insurance tax rate;

n_f = the federal payroll tax rate, measured by employers' contribution to social security as a fraction of payroll; and

n_b = the employment benefit cost to employer, measured by the cost of providing employees with benefits in the form of health insurance and other kinds of insurance as a fraction of payroll.

Our interest is not in these equations per se, but in what happens to the wage rate (w), employment (L) and the capital stock (K) when there are changes in taxes or employment benefit costs. It is thus more useful to solve the structural equations simultaneously to arrive at a set of

[24] In Maryland t_{pc} is equal to t_{pr} the tax rate on residential property; they are interchangeable in the model.

reduced form equations, which may then be estimated econometrically. In deriving the reduced form equations, we combine the marginal federal tax rate on labor income (t_{fl}) with the federal payroll tax rate (v_f) and generate the new variable, t_{payf} (= t_{fl} + v_f), which we may interpret as the federal labor tax rate. We may think of t_{payf} as the total of federal taxes that employers and employees pay for each additional dollar of payroll.

Similarly, we combined the marginal state tax rate on labor income with the state payroll tax to generate t_{pays} (= t_{sl} + v_s), the state labor tax rate. This is the sum of the relevant state taxes that employers and employees pay for an additional dollar of payroll.

These give:

the wage equation:

$$\ln w = p_0 + p_1 \ln q - p_2 \ln r + p_3 t_{pr} - p_4 v_b + p_5 \ln G_{tr} + p_6 t_{payf} + p_7 t_{pays}, \quad (4)$$

where the signs of π_3, π_6 and π_7 are ambiguous,

the labor equation:

$$\ln L = b_0 + b_1 \ln q - b_2 \ln r - b_3 t_{pc} - b_4 v_b - b_5 \ln G_{tr} t_s - b_f t_{payf} - b_s t_{pays}, \quad (5)$$

and *the capital equation:*

$$\ln K = d_0 + d_1 \ln q - d_2 \ln r - d_3 t_{pc} - d_4 v_b - d_5 \ln G_{tr} - d_f t_{payf} - d_s t_{pays}. \quad (6)$$

To understand the intuition behind these equations, consider an increase in the state labor tax t_{pays}. This could take place through an increase in either the state income tax or the state payroll tax. In the event of a rise in the income tax, the higher tax borne by workers discourages individuals from working, thus reducing the supply of labor. Pre-tax wages (wages before personal income taxes) rise, in turn inducing employers to hire a smaller amount of labor. Despite the rise in pre-tax wages, workers will not be better off, because they will face a reduction in their post-tax wage (the wage rate after personal income taxes are deducted). The higher personal income tax makes hiring labor more expensive and causes the post-tax wage and employment to fall.

If the rise in t_{pays} results from a rise in the state payroll tax, then the demand for labor falls as employers discover that it is more expensive to hire labor than before. While the higher payroll tax causes the post-tax wage rate to rise, the pre-tax wage received by workers goes down causing

a fall in the quantity of labor that they are willing to supply. As with a rise in the income tax, employment falls.

The Data Used to Estimate STAMP

It is useful to list all the variables used in the Maryland-STAMP, with some notes on their construction and sources. This information is summarized in Table 3.

Table 3. Description of Variables and Their Sources

	Description	Measurement	Source
L	Private sector employment by major industry	Total number of jobs, in thousands	BEA[25]
W	Wage rate by sector	Total payroll divided by number of jobs	BEA
K	Capital stock by sector	See Appendix 3	US Census and other sources
q	Index of U.S. economic activity by sector	U.S. Real GDP index by sector	BEA and BLS
r	Cost of capital by sector	See Appendix 4	BEA, IRS and other sources
t_{pr}	Local tax rate on property[26]	Statewide effective tax rate on property.	Maryland Comptroller of Treasury
n_b	Employment benefit cost to employers	Total insurance cost as a percent of wages and salaries. See Appendix 5 for detailed estimation procedures	BLS
G_{tr}	Government Transfer Payments.	Income maintenance benefits plus unemployment insurance benefits per non-employed person in working age population	Census BEA
t_{payf}	Federal labor tax rate	Average marginal federal tax rate on labor income applied to MD residents and employer's and employee's social security tax rates. For the calculation of the average marginal tax rate on labor income, see Appendix 2	IRS and OSSA
t_{pays}	State labor tax rate	Average marginal state tax rate on labor income and unemployment insurance tax rate	Maryland Comptroller of Treasury and OWS

[25] BEA: Bureau of Economic Analysis, U.S. Department of Commerce, BLS: Bureau of Labor Statistics, U.S. Department of Labor, IRS: Internal Revenue Service, OSSA: Office of Social Security Administration, OWS: Office of Workforce Security, U.S. Department of Labor.

[26] Recall the tax rate on property in Maryland is the same for residential, commercial and industrial property, i.e. $t_{pr} = t_{pc}$.

A value for each variable was constructed for each year from 1975 through 1998. All of the dependent variables (labor, capital, wages) as well as some of the independent variables (cost of capital, insurance cost to firms, economic activity elsewhere in the U.S.) are constructed for each of the seven major sectors of the economy, namely:

- Agriculture, forestry, and fisheries (AFF)
- Construction
- Finance, insurance and real estate (FIRE)
- Manufacturing
- Services
- Transportation and public utilities (TPU)
- Wholesale and retail trade.

Some of the variables, including the measures of employment and wages, are relatively straightforward. However several of them are difficult to construct. Here we provide a succinct discussion of the data transformations that were needed, relegating the full details to the appendices.

Average Marginal Tax Rates

The federal and state personal income tax rates (t_{fl}) and (t_{sl}) and the tax rates that are included in the cost of capital – the federal taxes on capital income (dividends, capital gains) and the federal taxes on corporate income – are *effective average marginal tax rates*. That is, they aim to measure the average of the marginal tax rates actually faced by taxpayers. Although it has long been recognized that this is the correct measure to use when assessing the incentive effects of most tax changes, it is only over the past decade or so that such measures have been calculated and put to use.[27]

For the personal income tax, information is available for a number of income brackets on the number of taxpayers, their adjusted gross incomes, and their actual tax liabilities. From this information it is possible to determine the extra tax liability that would be incurred as a taxpayer

[27] An early example is Leslie Papke, "Taxes and Other Determinants of Gross State Product in Manufacturing: A First Look," *Proceedings of the Eighty-Second Annual Conference 1989*, ed. Frederick Stocker (Columbus, Ohio: National Tax Association /Tax Institute of America, 1990).

moves from one income class to the next, i.e. the marginal tax rate. The average marginal tax rate is then calculated as a weighted average of these marginal rates:

- for the average marginal tax rate on *labor* income, the weights are the proportion of wages and salaries falling within each income class and
- for the average marginal tax rate on *capital* income, the weights are the proportion of dividend and capital gains income falling within each income class.

We followed a similar procedure for the federal corporation income tax. This is possible because for each of the seven main sectors of the economy, information on the number of returns, net income, taxable income, and tax liability is available for each of several size classes of business receipts. From this it is possible to determine the marginal tax rates faced by corporations as they expand their net income. Full details of these procedures are described in Appendix 2.

The Stock of Private Capital

It was necessary to construct a measure of the net stock of fixed nonresidential private capital, by industry, for the state for each year from 1975 through 1998. The Bureau of Economic Analysis publishes national, but not state-level, estimates of private capital, broken down into a number of categories such as fixed capital for construction, for manufacturing, trucks, gas pipelines, and so on. In order to estimate the state's share of national capital, in each category, we applied a series of proxies. For instance, for capital used in the retail and wholesale trades, we took the state share to be in proportion to the state's share of sales in these categories. The complete details are given in Appendix 3.

The Cost of Capital

Businesses make decisions about investment based, in large part at least, on the rental cost of capital (r), which is the total rental charge for capital (including tax costs and a provision for depreciation) divided by the value of capital. It can be shown (Appendix 4, equation (A4.17)) that:

(7) $$r = \frac{(r + d)(1 - t_{ck} C)}{(1 - t_{ck})},$$

where $C = \sum_{t=1}^{DL} \frac{a_t}{(1+r)^t}$, and C < 1.

This equation shows that the rental cost of capital depends on the discount rate (r), the capital consumption rate (d), the average marginal tax rate on capital (t_{ck}), the recovery allowance percentage that is allowed under the tax laws (a_t), and the depreciable life of the asset (DL). The systems of depreciation permitted for tax purposes have changed over time, with the sum of the years' digits system in place from 1954 through 1980, an accelerated cost recovery system from 1981 through 1985, and a modified accelerated cost recovery system since then. The average marginal tax on capital is derived from state and federal taxes on corporate income and on dividends and capital gains. A detailed description of how these tax rates were constructed is given in Appendix 2.

Estimation Results

The results of estimating the employment, wage rate and capital stock equations for Maryland are described in Table 4. We apply a pooled time-series cross-section data estimation method, for the time period of 1975-1998 and for seven sectors of the economy.

We report the coefficients and associated p-values. The p-values measure the statistical significance of the coefficients. We follow the convention whereby a coefficient is deemed statistically significant if its p-value is less than 0.10, which indicates that there is less than a 10 percent chance that the true value of the coefficient is zero.

Table 4. Estimates of the Jobs, Wage Rate, and Capital Stock Equations

		Jobs Equation		Wage Equation		Capital Equation	
		Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Dependent variable:		Ln(Jobs)		Ln(Wage Rate)		Ln(Capital Stock)	
Independent variables:							
Ln(US production index)	Ln(q)	**0.1452**	**0.0207**	-0.0709	0.3235	**0.0965**	**0.0323**
State labor tax rate	t_{pays}	**-0.0106**	**0.0067**	0.0068	0.6092	0.0022	0.6755
Federal labor tax rate	t_{payf}	-0.0009	0.6371	**0.0138**	**0.0007**	0.0009	0.6701
Ln (Gov't transfer payments)	Ln(G_{tr})	**-0.1119**	**0.0000**	-0.0579	0.2826	**-0.0507**	**0.0028**
Employment benefit cost	v_b	**-0.0064**	**0.0238**	-0.0061	0.5069	**-0.0122**	**0.0077**
Ln (Cost of Capital)	Ln(r)	**-0.0595**	**0.0015**	**-0.3471**	**0.0000**	**-0.0372**	**0.0945**
Property tax rate	t_{pr}	**-0.7972**	**0.0000**	-1.0500	0.1533	**-0.5038**	**0.0473**

Note: The estimated intercept terms and Auto Regressive terms are not reported in this table.
Statistically significant coefficients are in bold type.

Number of Jobs

The dependent variable in the first equation is the total number of jobs; this is slightly larger than total employment, because some individuals hold more than one job.[28] Consider the independent variable "state labor tax rate." Higher state taxes on labor are associated with significantly lower employment, since employers and employees both respond negatively to this higher tax. An increase in the state labor tax (for example, unemployment insurance tax rate) raises the cost of labor, prompting employers to cut back on hiring. At the same time, workers will respond to a rise in the state personal income tax by moving out of the state or leaving the state labor force. The empirical evidence shown in Table 4 suggests that this effect is large. Specifically, the coefficient implies that a one-percentage-point increase in the state labor tax rate decreases employment by 1.06 percent, everything else remaining constant.

As our model indicates, the state labor tax is not the only variable that negatively influences employment in Maryland. Employment benefit cost, government transfer payments, the cost of capital and the property tax rate also have significant negative effects on employment.

With an increase in employment benefit cost, such as health insurance cost, it becomes more expensive for firms to hire workers resulting in a decrease in employment. The estimated coefficient of -0.0064 indicates that a one-percentage-point increase in the benefit cost as fraction of wages and salaries would decrease the number of jobs by 0.64 percent.

The cost of capital measures how much employers have to pay to "hire" the capital they use. It is a complex measure that reflects the size of depreciation, the cost of borrowing (i.e., the interest rate), and the numerous taxes that bear on capital (including the state and the federal corporate income tax, and state and federal taxes on dividend income and capital gains). The coefficient for the cost of capital implies that a one percent increase in the cost of capital decreases employment by 0.06 percent. The negative relationship between the cost of capital and employment indicates that capital and labor are complements.

An increase in the government transfer payment also has a significant negative effect on job creation. The result suggests that a one percent increase in government transfer payments would cut the number of jobs by 0.11 percent.

[28] Although there is the indicated difference between "number of jobs" and "employment," the terms are used interchangeably throughout the text.

The result also indicates that a one-basis-point increase in property tax rate would decrease employment by 0.80 percent.[29] In addition, as expected, a stronger U.S. economy would have a significant positive effect on employment. The estimated coefficient implies that a one percent increase in the U.S. production increases employment by 0.14 percent.

Wages and Capital

In the wage equation, only two variables – the federal labor tax and the cost of capital – are statistically significant. A one-percentage-point rise in the federal labor tax rate is associated with 1.38 percent increase in wages. An explanation of this result is that workers require higher wage rates when faced with higher federal labor tax rates. The estimation result for wages implies a complementary relationship between labor and capital, consistent with the estimation result for the employment equation. As the cost of capital rises, firms employ less capital, which in turn leads them to hire fewer workers and to push down the wage rate.

The cost of capital has a significant impact on the capital stock in Maryland. As predicted, a higher cost of capital decreases capital spending and thus leads to shrinkage in the capital stock. Other variables that have a significant effect on capital stock are the strength of the national economy, government transfer payments, the employment benefit cost, and the property tax rate. Not surprisingly, a stronger U.S. economy increases the capital stock. An increase in the employment benefit cost raises the cost of hiring workers, which results in less employment of workers and a smaller capital stock. Again, this result implies a complementary relationship between labor and capital. An increase in government transfer payments reduces the capital stock in the state, as does a higher property tax rate.

We now turn to consider the economic effects of the implementation of universal health care in Maryland. We trace the effects each of the four possible methods would have on economic activity in the state.

[29] Note that the property tax rate is measured in percentage points in the regression. In 1997, the average effective property tax rate was 8 basis points (i.e., 80 cents per $1,000 of market value of property).

V. Economic Effects of Health Care Reform

We wish to determine how the resulting changes in tax rates and payroll costs would affect the number of workers (*L*), the wage rate (*w*), and the capital stock (*K*) for the state of Maryland.

Two steps are needed in order to simulate the effects of tax changes on the variables of interest. First, we must establish baseline values for the variables, projecting them out through 2005. Then we have to use our estimated reduced form equations to determine how the tax and payroll cost changes necessitated by universal health care would affect the economic indicators of interest under each of the four alternative methods by which such care might be implemented.

Constructing the Baseline Projections

The baseline projections are summarized in Table 5. They show employment, nominal wages, the capital stock and tax revenue for 2000 through 2005, on a calendar year basis. With the exception of the capital stock (which we assume will grow in proportion with payroll), the projections are derived from the forecasts reported by the State of Maryland Board of Revenue Estimates in its *Estimated Maryland Revenues* (December 14, 2000), adjusted to a calendar year basis where necessary.[30] We should mention that our simulation results are not particularly sensitive to the particular baseline projections adopted.

Table 5. Baseline Projections for 2000 – 2005 (in nominal dollars)

	Number of private sector jobs, in thousands $L_{baseline}$	Average wage, $ $w_{baseline}$	Capital Stock, $m $K_{baseline}$	Total Tax Revenue, $m $TR_{baseline}$
2000	2,442	38,139	141,637	9,434
2001	2,482	40,005	151,001	9,789
2002	2,528	41,610	160,001	10,144
2003	2,576	43,284	167,728	10,595
2004	2,625	45,025	179,728	11,089
2005	2,675	46,837	190,564	11,618

Source: Derived from the State of Maryland Board of Revenue Estimates, *Estimated Maryland Revenues*.

[30] The fiscal year for Maryland runs from July 1 through June 30. Thus FY2000 refers to July 1999-June 2000. By averaging data from FY2000 and FY2001 we arrive at an estimate for calendar year (CY) 2000.

Method I. Medicaid Expansion

The Medicaid Expansion program would increase the income threshold that enrollees must not exceed from the current 44 percent to 300 percent of the federal poverty level. Medicaid in Maryland currently covers several categories of beneficiaries, including: seniors over 65 years of age, blind individuals, medically disabled individuals, as well as parents and children in families whose annual income falls below this 44 percent threshold.

According to the Maryland Health Care Commission, the 1999 average expenditure per Medicaid enrollee was $5,617. Applying an annual average growth rate of 2.56 percent calculated over the period 1996-1999, we estimate the average expenditure per enrollee in 2002 to be $6,059.[31]

In order to estimate the costs of expanding this program, we first calculate the cost of insuring all uninsured families (parent(s) with children) that fall under the new 300 percent threshold.[32] We do not take into consideration the elderly and the disabled since we assume that almost all of them already have some type of government provided health insurance.

Since the Maryland Health Care Commission does not break out the average Medicaid cost per enrollee based on eligibility status, we use data from the Health Care Financing Administration (HCFA), the federal agency that administers Medicaid, to determine the average Medicaid cost for a member of an eligible family in Maryland. Thus, we calculate the ratio of average expenditure on an eligible family member to average expenditure on any Medicaid enrollee to be 38 percent.[33] We apply this ratio to our 2002 estimated average cost for any Medicaid enrollee of $6,059, to obtain the average cost for individuals in eligible families $2,303.

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[31] Maryland Health Care Commission, *State Health Care Expenditures, 1997, 1998, 1999*, (Baltimore, MD: Maryland Health Care Commission, Analysis & Data Systems, 1997, 1998, 1999) available from http://www.mchc.state.md.us/database/_database.htm; Internet; accessed August 2, 2001.

[32] In estimating the cost of this and the following three possible methods, we consider persons currently covered by Medicaid or Medicare to be insured.

[33] We calculate an average expenditure on adults and children in poverty in 1997 and 1998 by taking the sum of the total expenditures on those persons in the two years ($211,454,990 in 1997 and $211,297,403 in 1998) and dividing by the sum of the number of enrollees in the two years (96,582 in 1997 and 131,964 in 1998) to get $1,850. We then do the same for the average expenditure on *all* enrollees in the Medicaid program (for which total expenditures for 1997 and 1998 were $2,200,668,586 and $2,489,280,148, respectively and the number of enrollees 402,002 and 561,085, respectively), to get $4,870. We then divide $1,850 by $4,870 to get 0.38. U.S. Health Care Financing Administration, *Report No. 2082: Medicaid Program Statistics: 1997 and 1998* (Washington, D.C.: 1998, 1999) available from http://www.hcfa.gov/medicaid/msis/mstats.htm; Internet; accessed July 24, 2001.

The estimated number of uninsured families in Maryland in 1998, as shown in Table 6, was 214,812. We assume this number will be the same in 2002 and multiply it by 3.13, the average size of a family in Maryland, to obtain the number of individuals in families that will be uninsured in 2002, which is 672,362.[34]

Table 6. Distribution of Single Adults and Families in Maryland's Uninsured Population

	Individuals	Single Adults	Families
Number of uninsured	837,000[35]	164,638 (= 837,000 * 19.67%[36])	214,812 [= (837,000 * 80.33%)/3.13]
Number of uninsured employed	694,710 (= 837,000 * 83%)	136,650 (= 164,638 * 83%)	178,294 (= 214,812 * 83%)
Number of uninsured unemployed	142,290 (= 837,000 * 17%)	27,988 (= 164,638 * 17%)	36,518 (= 214,812 * 17%)

According to the Maryland Health Care Commission's Report, 31 percent of uninsured persons in Maryland have an annual income above 300 percent of the federal poverty level.[37] Under this proposal the remaining 69 percent of the 672,362 – or 463,929 – uninsured individuals in eligible families, would now become eligible for Medicaid. See Table 7.

[34] U.S. Census Bureau, *Maryland 2000 Census for Population and Housing: Profile of General Demographic Characteristics*, (Washington, D.C.: 2000) p. 3 of 416; available from http://www.census.gov/prod/cen2000/dp1/2kh24.pdf; Internet; accessed July 24, 2001.

[35] U.S. Census Bureau; "Health Insurance Coverage: 1998 - Table 8" (Washington, D.C.: October 4, 1999) available from http://www.census.gov/hhes/hlthins/hlthin98/hi98t8.html; Internet; accessed July 24, 2001. We assume that the number will remain constant from 1998, the most recent estimate, until 2002.

[36] Since data on Maryland's employed and unemployed population by family status are not available, we assume that the distribution of families and single adults, both in the uninsured employed and uninsured unemployed population is the same as the distribution of families and single adults in the total Maryland population. Maryland total population = 5,296,486. Number of persons in families in Maryland = 4,254,665 (= number of families in Maryland * average family size = 1,359,318 * 3.13) or 80.33 percent of total population. Number of single adults in Maryland = 1,041,821 (= total Maryland population – number of persons in families in Maryland = 5,296,486 – 4,254,665) or 19.67 percent of total population. U.S. Census Bureau, *Maryland 2000 Census for Population and Housing: Profile of General Demographic Characteristics*, (Washington, D.C.: 2000) p. 3 of 416; available from http://www.census.gov/prod/cen2000/dp1/2kh24.pdf; Internet; accessed July 24, 2001.

[37] Maryland Health Care Commission, *Maryland Health Care Coverage Through 1999: A Graphic Profile* (Baltimore, MD: Maryland Health Care Commission, 1999) available from http://www.mhcc.state.md.us/database/insurance00/ins2001.pdf; Internet; accessed July 24, 2001.

Table 7. Costs of Medicaid Expansion

State Costs
Eligibility Level: up to 300% of the federal poverty level. Number of uninsured families = 214,812 Number of uninsured individuals in families = 672,362 (= 214,812 * 3.13) Number of uninsured individuals in families that will be eligible = 463,929 (= 672,362 * 69%)[38] Average cost of insuring an individual eligible for Medicaid due to poverty status in 2002 = $2,303
Initial State Costs: 463,929 * $2,303 = **$1,068.21 million**[39]
Additional State Costs: 40,633 * $2,303 = **$93.56 million**[40]
Total State Costs: **$1,161.77 million**
Total required increase in the state income tax rate: **1.147 percentage points**.

Applying the estimated average cost of $2,303 per individual in a family to the 463,929 individuals in eligible families, we estimate the initial state cost of Medicaid Expansion to be $1,068 million in 2002.

In order to finance this program, we assume the state would increase income taxes. One economic effect of an income tax increase, as noted in previous sections, is an increase in unemployment. As workers are thus left unemployed, they will become eligible for this Medicaid Expansion program. This will increase the number of uninsured that the state must cover, thus increasing the price tag for the Medicaid Expansion program. According to our estimates, the additional cost to the state to provide health insurance for these newly unemployed is $94 million. Thus, the total cost to the state of implementing this program is estimated at $1,162 million. The

[38] Sixty-nine percent of the uninsured individuals in Maryland fall below 300 percent of the federal poverty level. Maryland Health Care Commission, *Maryland Health Care Coverage Through 1999: A Graphic Profile*, p. 8 of 21.

[39] Here and elsewhere the reported results may differ slightly from those obtained from the formula because of rounding.

[40] The additional state cost accounts for the cost of insuring those who become unemployed and thus uninsured as a result of implementing the program. In order to determine this cost we first divide the newly uninsured between those who are single and those who are members of a family. We calculate the percentage of single individuals in the total adult population (see footnote above) as 26.44. That leaves 73.56 percent of individuals living in families. We then determine the numbers of the newly uninsured who were the sole providers of insurance to their families through the job they lost. We first calculate the percentage of all families that are single parent families to be 15 percent. This leaves 85 percent of the individuals as members of families that include a married couple. We assume that among no married couples do both adults lose their jobs. We further assume that of this 85 percent, 50 percent were the sole providers of insurance for their families. We then apply the appropriate health insurance premiums to determine the additional costs. See U.S. Bureau of the Census, *Profiles of General Demographic Characteristics, 2000* (Washington D.C.) available from http://www.census.gov/prod/cen2000/dp1/2kh24.pdf; Internet; accessed August 27, 2001.

tax rate increase necessary to fund implementation of such a program would be 1.147 percentage points, as shown in Table 7.

Tax Effects of Medicaid Expansion

In assessing the change in tax revenues shown in Table 7, we distinguish the static from the dynamic revenue effect. The static revenue effect measures the change in tax revenue resulting from a tax-law change, under the assumption that the tax-law change does not affect the behavior of economic agents. The dynamic revenue effect results from the change in the tax base due to both (1) diminished payroll as a result of the decrease in employment and (2) diminished corporate income as a result of the decrease in capital stock.

Calculating the Static and Dynamic Effects

Given our estimate of the total cost for implementing a given plan, we calculate the initial change in the income tax rate that would be required to raise that amount of revenue by dividing the amount necessary to finance the given plan by the income tax base. As shown in our regression results, there is a negative association between an increased state tax rate on labor income and employment. As noted, a one-percentage-point increase in the income tax rate will result in 1.06 percentage decrease in total employment (See Table 4). Thus, this increase in the income tax rate results in a certain number of individuals becoming unemployed. As a result, the number of unemployed individuals in Maryland who will become eligible for the given plan increases. Inasmuch as there are fewer employed, the income tax base will shrink. Total revenues raised at the current income tax rate will no longer be sufficient to finance the given plan.

Additionally, more uninsured individuals mean an increase in the estimate of the total cost for implementation of the plan (number of unemployed now eligible for the given plan multiplied by the cost to insure). Thus, it is necessary to raise the income tax rate further to meet this higher cost of implementation. However, increasing the income tax rate once again results in more lost jobs, which leads to a higher cost for implementing the plan and an additional increase in the income tax rate required to finance implementation. This process will iterate, at each round the number of jobs lost becoming fewer and the necessary income tax rate increase required to cover those additional unemployed smaller, until the cycle results in no more job losses. This final round of our iteration gives us the total income tax rate increase required to fund the program, given the number of unemployed that implementation of that program will itself create.

Static Revenue Effect

We use the above process to calculate the static revenue effects from the Medicaid Expansion plan. We use the income tax increase calculated in the final round of our above iteration to calculate the total static revenue effect resulting from implementation of Medicaid Expansion. First, we must project the tax baseline. The Maryland Board of Revenue Estimates reports the revenue expected to be raised from the personal income tax through 2005.[41] The projected personal income tax revenue for calendar year 2002 is $5,412 million. By dividing the 2002 projected tax revenue by the current effective tax rate on income (5.01 percent), we calculate the 2002 income tax base (*TB*) to be $108,023 million. We calculate the revenue expected to be raised from the income tax rate increase of 1.147. The expected revenue (ΔTR^S) is calculated as:

$$\Delta TR^S = TB * D\, t_{pays}$$
$$= \$108{,}023 \text{ million} * 1.147\%$$
$$= \$1{,}240 \text{ million.}$$

Thus, the static revenue gain from increasing the state income tax is projected to be $1,240 million in 2002.

Dynamic Revenue Effect

In order to estimate the net revenue effect (static plus dynamic effect) of the Medicaid Expansion system, we first calculate the change in employment in 2002 (DL_{2002}) resulting from the change in the income tax using the estimated coefficient for the state labor tax rate in employment, the baseline employment and the change in the tax rate:

$$DL_{2002} = L_{baseline} * (e^{-.0106 * Dt_{pays}} - 1)$$
$$= 2{,}528{,}000 * (e^{-.0106 * 1.147} - 1)$$
$$= -30{,}618.$$

This change in employment results in the following change in the income tax base, or payroll:

$$\Delta\text{payroll} = \Delta L * w_{baseline}$$
$$= -30{,}618 * \$41{,}610$$
$$= -\$1{,}274 \text{ million.}$$

[41] Maryland Board of Revenue Estimates, *Report of the Maryland Board of Revenue Estimates on Estimated Maryland Revenues Fiscal Years ending June 30, 2001 and June 30, 2002*.

The dynamic change in labor income tax revenue (ΔTR^D) is calculated by multiplying this change in payroll by the new income tax rate of 6.15 percent, which is the sum of the existing effective income tax rate, 5.01 percent, and 1.147 percent:

$$\Delta TR^D = Dpayroll * t_{pays}$$
$$= \text{-\$1,274 million} * 6.15\%$$
$$= \text{-\$78 million.}$$

In the case of Medicaid Expansion, there is no effect on capital stock. Therefore, there is no effect on corporate income.

A summary of the static and dynamic tax revenue effects is presented in Table 8. The net tax effects of Medicaid Expansion is net tax revenue of $1,162 million resulting from a static tax revenue change of $1,240 million and a dynamic revenue change of -$78 million. This net tax revenue is the total cost to the state to fund Medicaid Expansion.

Table 8. Summary of the Economic Effects of Medicaid Expansion

(Dollar amounts expressed in millions)

	Number of Jobs	Payroll	Static Tax Revenue	Dynamic Tax Revenue	Net Tax Revenue
Medicaid Expansion	-30,618	-$1,274	$1,240	-$78	$1,162

Method II. Pooling the Uninsured in a Government Program

We estimate the cost of Pooling the Uninsured by calculating the cost of purchasing insurance for all 837,000 of the currently uninsured in Maryland. We do this by assuming the state would create a group health insurance plan similar to that of a large corporation. The state would subsidize the purchase of insurance by these individuals at 100 percent, providing "free" health insurance to those without health insurance. We do this on the assumption that the state would consider a100-percent subsidy to be a more effective incentive for uninsured individuals to purchase insurance than, for example, a 50-percent subsidy.[42] We estimate the cost per individual

[42] Some research has found that individuals are often not responsive to changes in health insurance prices or subsidies unless the changes are very large. See Chernew, Frick, and McLaughlin.

based on whether the individual is single or part of a family. This is because rates differ based on demographic characteristics, as well as health characteristics.

Of the currently uninsured individuals in Maryland, 164,638 are single individuals, leaving 672,362 individuals living in 214,812 families with an average 3.13 members per family.[43] In Table 9 below, we apply the respective premiums for individuals and families, $3,077 and $7,315, to each of these groups to get the costs of insuring single individuals and families.[44] These costs are $507 million and $1,571 million, respectively. Combining these, we get $2,078 million as the cost for the state to insure all the uninsured in Maryland.

In order to finance this program, we assume the state will raise the income tax rate. We calculate the percentage point increase required to raise the necessary revenues using the same iterative process discussed under Method I. We calculate the required increase in the state income tax rate at 2.318 percentage points, as shown in Table 9. This tax rate increase results in more unemployed uninsured individuals. We apportion these newly uninsured into single individuals and family members, as above, and apply the appropriate premiums given in Table 9 to estimate the additional cost to the state to insure these newly uninsured at $187 million. The total cost to the state to finance Pooling the Uninsured will be $2,318 million.

[43] See Table 6.

[44] The data on annual premiums come from the *Employer Health Benefits Annual Survey* (Washington, D.C.: The Kaiser Family Foundation and Health Research and Educational Trust, 1999 & 2000). The values reported in the table below are for health insurance in the Southeast. In order to estimate the 2002 number we apply the 1999-2000-growth rate of 13.3 percent for individual premiums and 8.7 percent for family premiums. (See table below.) We selected the growth rate from that year based on the findings of the Kaiser Family Foundation that premiums across the country increased from 1999-2000 at nearly double the rate of the previous year. According to the Foundation, "this suggests higher premium increases in the coming years." Additionally, a survey of company health plans by the firm William Mercer projected premiums across the country to increase between 11 and 22 percent in 2001 (Source: John Martin, "Health Care Hike," *abcNEWS.com*, July 25, 2001; available from http://abcnews.go.com/sections/wnt/WorldNewsTonight/healthcarecosts_wnt010725.html; Internet; accessed July 25, 2001.) Thus, use of a growth rate from a period extending prior to 1999 would not accurately reflect the expectations of the health care industry for the cost of health care premiums in 2002.

Year	Individual premium ($)	Growth rate 1999 - 2000	Family premium ($)	Growth rate 1999 - 2000
1999	2,113		5,694	
2000	2,395	0.133	6,190	0.087
2001	2,715	0.133	6,729	0.087
2002	**3,077**	0.133	**7,315**	0.087

Table 9. Cost of Pooling the Uninsured

State Costs	
Total uninsured: 837,000	
Of these:	
Single adults: 164,638	Cost of insuring individuals: $506.58 million
Families: 214,812	(= $3,077 * 164,638 adults)
Individual premium: $3,077	Cost of insuring families: $1,571.35 million
Family premium: $7,315	(= $7,315 * 214,812 families)
Initial State Costs: **$2,077.93 million**	
Additional State Costs: **$240.73 million**[45]	
Total State Costs: **$2,318.66 million**	
Total required increase in the state income tax rate: **2.318 percentage points**	

Static Revenue Effect

As in the previous section, we calculate the revenue expected to be raised through the income tax rate increase, as:

$$DTR^S = TB * Dt_{pays}$$
$$= \$108{,}023 \text{ million} * 2.318\%$$
$$= \$2{,}506 \text{ million.}$$

Thus, the static revenue gain from increasing the state income tax is projected to be $2,506 million in 2002.

Dynamic Revenue Effect

In order to estimate the net revenue effect of Pooling the Uninsured, we first calculate the change in employment resulting from the change in the income tax:

$$DL_{2002} = L_{baseline} * (e^{-.0106 * Dt_{pays}} - 1)$$
$$= 2{,}528{,}000 * (e^{-.0106 * 2.318} - 1)$$
$$= -61{,}488.$$

This change in employment results in the following change in the payroll:

$$\Delta\text{payroll} = \Delta L * w_{baseline}$$
$$= -61{,}488 * \$41{,}610$$
$$= -\$2{,}558 \text{ million.}$$

[45] Cost of insuring those who become uninsured as a result of implementing the program.

The dynamic change in labor income tax revenue is calculated by multiplying this change in payroll by the new income tax rate of 7.32 percent:

$$\Delta TR^D = \Delta payroll * t_{pays}$$
$$= -\$2,558 \text{ million} * 7.32\%$$
$$= -\$187 \text{ million.}$$

Again, there is no effect on capital stock.

A summary of the static and dynamic tax revenue effects is presented in Table 10. The net tax revenue presented in this table, which is equal to the total state cost of Pooling the Uninsured, is the sum of the static tax revenue gain of $2,506 million and the dynamic change of -$187 million.

Table 10. Summary of the Economic Effects of Pooling the Uninsured

(Dollar amounts expressed in millions)

	Number of Jobs	Payroll	Static Tax Revenue	Dynamic Tax Revenue	Net Tax Revenue
Pooling the Uninsured	-61,488	-$2,558	$2,506	-$187	$2,319

Our estimates suggest that providing insurance for those currently uninsured by the State of Maryland will have a significant impact on the Maryland economy, causing a loss of 61,488 jobs and a reduction in payroll of $2,558 million.

Method III. Multi-Payer System

To determine the additional cost imposed on employers under a Multi-Payer System, we assume that all uninsured persons who are employed will receive insurance coverage from their employers, while the state will cover the uninsured who are unemployed. We calculate the cost of insuring those who are currently employed but uninsured assuming that employers would pay the standard 83 percent of the annual individual premium and 73 percent of the annual family premium, employees bearing the remainder of the premium in each case.[46] Out of the 837,000 residents that do not have health insurance in Maryland, 83 percent are either working adults or

[46] Maryland Health Care Commission, *Maryland Health Care Coverage Through 1999: A Graphic Profile*, p. 3 of 21.

dependents of working adults, indicating that 694,710 Maryland residents are currently employed (or dependents of employed adults) but uninsured.

We determine the cost to employees by applying the same distribution of singles and families as above to the employed uninsured, resulting in 136,650 single adults and 178,294 families with at least one employed adult. Inasmuch as health insurance is now *mandated* by the state under the Multi-Payer System, employees are expected to pay their percentage of insurance costs.

This cost to employees acts effectively as a tax on their income. Currently insured employees do not respond to their health insurance premiums as if they were paying a tax. For these employees, the payment of such premiums is essentially a voluntary act. They choose both to work for their employers and to accept the employer-provided health care plan because doing so is preferable to the next best option. For hitherto uninsured employees, on the other hand, the requirement to pay a health insurance premium, even given the health benefits thus provided, may not be preferable to escaping the premium and going without health insurance.

The fact that an uninsured worker accepted a job not offering health insurance may mean that the worker considered that option to be better than accepting a job that does offer health insurance or better than holding the same job but at lower pay. Some workers may feel better off under mandatory health insurance, but others may not. Thus, for uninsured workers, a Multi-Payer System has much the same effect as any increase in the personal income tax from which he may or may not derive a benefit.

To calculate the cost of this tax increase, we again apply the respective single and family insurance premiums. We assume that single employees pay 17 percent of the total cost for insurance, while families pay 27 percent of the total cost. We thus calculate an initial employee cost of $424 million. Here as a result of implementation of the Multi-Payer System, there will be 54,188 individuals that become unemployed. These newly unemployed individuals will no longer contribute their portion to the employer provided health insurance. This requires an employee cost adjustment of $53 million, resulting in a new employee cost of $371 million, as shown in Table 11.[47]

[47] Again in calculating the cost savings we apply the ratio of single individuals and families to the newly unemployed and calculate the cost savings using the respective premiums.

Since a Multi-Payer System requires employers either to provide insurance or to pay the state to insure their employees, this new additional cost acts like a payroll tax. This cost falls only on those who do not currently provide insurance to their employees.

Health insurance costs do not have the effect of a tax in the instance of employers that currently offer health insurance. Those employers offer health insurance voluntarily because they are able to hire workers at lower cost than they could hire the same workers without offering health insurance. The reason is that workers accept lower wages in return for the cost and tax advantages of choosing employer-provided over individual health insurance.

Employers who do not currently offer health insurance will ordinarily, on the other hand, find that their labor costs are higher once a Multi-Payer System is implemented. While they may find workers willing to accept lower pay because health insurance is now offered as part of the benefits package, they also may not. The effect is much like any payroll tax, such as the unemployment insurance tax, from which the employer may or may not derive a benefit.

We calculate the cost to employers as with the cost to employees, by separating single individuals from families and applying the respective premium. We then assume that employers will bear 83 percent of the total cost for single individuals and 73 percent of the cost for families. Here the initial employer cost is calculated at $1,301 million, but again there is a cost adjustment as employers have fewer employees due to the unemployment that implementation of the plan creates. This employer cost adjustment is estimated at $159 million. As shown in Table 11, above, the resulting net cost to employers is $1,142 million, which is equivalent to implementation of a new 1.06 percent payroll tax.

The cost of insuring the currently unemployed uninsured shifts to the state, that is, to taxpayers. We first apply the same distribution of single individuals and individuals in families as found in the state as a whole to the 17 percent of current uninsured that are unemployed, 142,290. We then calculate the cost to the state of insuring these uninsured by applying the respective single and family premiums. The result is an estimated $86 million to insure individuals combined with an estimated $267 million to insure families, resulting in an initial cost to the state of $353 million.

Table 11. Costs of Multi-Payer System

Employee Costs Total uninsured and employed: 694,710 (= 83% * 837,000) Of these: Single adults: 136,650 Families with a working adult: 178,294 Individual premium: $3,077 Family premium: $7,315	Cost to individuals: $71.48 million (= 17% * $3,077 * 136,650 adults) Cost to families: $352.14 million (= 27% * $7,315 * 178,294 families)
Initial Employee Costs: **$423.62 million**	
Additional Employee Costs: **-$52.87 million**[48]	
Total Employee costs: **$370.75 million**	
As equivalent to a required increase in the state income tax rate of **0.34 percentage points**	
Employer Costs Total uninsured and employed: 694,710 (= 83% * 837,000) Of these: Single adults: 136,650 Families with a working adult: 178,294 Individual premium: $3,077 Family premium: $7,315	Costs to insure individuals: $348.98 million (= 83% * $3,077 * 136,650 adults) Cost to insure families: $952.08 million (= 73% * $7,315 * 178,294 families)
Initial Employer Costs: **$1,301.06 million**[49]	
Additional Employer Costs: **-$159.28 million**[50]	
Total Employer costs: **$1,141.79 million**	
As equivalent to a required increase in the state labor tax rate of **1.06 percentage points**	
State Costs Total uninsured and unemployed: 142,290 (= 17% * 837,000). Of these: Single adults: 27,988 Families without a working adult: 36,518 Individual premium: $3,077 Family premium: $7,315	Cost to insure individuals: $86.12 million (= $3,077 * 27,988 adults) Cost to insure families: $267.13 million (= $7,315 * 36,518 families)
Initial State Costs: **$353.25 million**	
Additional State Costs: **$212.15 million**	
Total State Costs: **$565.40 million**	
Total required increase in the state income tax rate: **0.64 percentage points**	

In addition to these uninsured unemployed, the state will be burdened with the cost of insuring the newly unemployed uninsured, resulting from implementation of the Multi-Payer System. The state must now insure these individuals at an estimated cost of $212 million. Thus, the total cost

[48] This represents the employee part of the premium for those who will become unemployed and uninsured during the process.

[49] The extra cost to the employers will be considered as a payroll tax, since it is mandatory for them to provide insurance or pay a tax to the state.

to the state of insuring all the uninsured unemployed will be $565 million annually. This would require an increase in the state income tax rate of 0.64 percentage points. Again, see Table 11.

Static Revenue Effect

As above, we calculate the revenue expected to be raised through the income tax rate increase as:

$$\Delta TR^{s} = TB * Dt_{pays}$$
$$= \$108{,}023 \text{ million} * 0.641\%$$
$$= \$693 \text{ million.}$$

The static revenue gain from increasing the state income tax from labor income is projected to be $693 million in 2002.

Dynamic Revenue Effect

In order to estimate the dynamic revenue effect from the implementation of a Multi-Payer System, we first calculate the change in employment that results from the increase in the income tax:

$$\Delta L_{2002} = L_{baseline} * (e^{-.0106 * Dt_{pays}} - 1)$$
$$= 2{,}528{,}000 * (e^{-.0106 * 2.04} - 1)^{51}$$
$$= -54{,}188.$$

This change in employment results in the following change in payroll:

$$\Delta \text{payroll} = \Delta L * w_{baseline}$$
$$= -54{,}188 * \$41{,}610$$
$$= -\$2{,}255 \text{ million.}$$

The dynamic effect on tax revenue is calculated by multiplying this change in payroll by the new income tax rate of 5.65 percent:[52]

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[50] This represents the employers' part of the premium for those who will become unemployed and uninsured during this process.

[51] In this equation, 2.04 percent is the sum of the actual increase in the income tax rate required to finance the costs to the state, 0.64 percentage points, plus the *equivalent* payroll tax rate of 1.06 percent that would have to be imposed to finance the costs to the employer and the *equivalent* additional income tax rate increase of 0.34 percentage points that would have to be imposed to finance the additional out of pocket expenses borne by the employees.

[52] The new personal income tax rate, as the sum of the old tax rate of 5.01 percent and the increase of 0.64 percentage points needed to implement this program.

$$\Delta TR^{D} = \Delta payroll * t_{pays}$$
$$= -\$2{,}255 \text{ million} * 5.65\%$$
$$= -\$127 \text{ million.}$$

A summary of the static and dynamic tax revenue effects is presented in Table 12. The net tax effects of a Multi-Payer System are a static tax revenue gain of $693 million and a total dynamic revenue loss of $127 million.

Table 12. Summary of the Economic Effects of a Multi-Payer System

(Dollar amounts expressed in millions)

	Number of Jobs	Payroll	Static Tax Revenue	Dynamic Tax Revenue	Net Tax Revenue
Multi-Payer System	-54,188	-$2,255	$693	-$127	$565

Although popular because it does not involve large increases in state taxes, a Multi-Payer System has significant economic costs, largely because of the increase in the cost of hiring labor. An unfortunate consequence of a Multi-Payer System is that those most likely to become unemployed and thus uninsured are young adults between the ages of 19 and 24 years of age working in entry-level or low-wage jobs. These jobs are defined as those that an individual can learn in a few days or weeks and include office administration, retail sales, food services, facilities maintenance and repair, and delivery and transportation.

Historically, entry-level workers have borne the brunt of mandated reforms. Analysis of the minimum wage has generally concluded that the minimum wage decreases entry-level employment and the ability of such workers to gain the necessary experience to compete in the labor force.[53] The full costs cannot be shifted onto these entry-level workers who are without health insurance and earning close to the minimum wage. Thus, employers choose to reduce the number of these types of jobs.[54]

[53] David Neumark and William Wascher, "Minimum-Wage Effects on School and Work Transitions of Teenagers," *American Economic Review* 85 (May 1995): 244-249.
[54] Jacob A. Klerman and Dana P. Goldman, "Job Loss due to Health Insurance Markets," *Journal of the American Medical Association* 272 (1994): 552.

Entry-level workers have few skills and limited education. These workers gain the most from jobs that are flexible and permit them to work for low wages in return for experience and job training. The loss of such opportunities can have a pernicious effect on the ability of these individuals to ever succeed in the labor market. Although not measured directly in this model, the nonpecuniary implications of policy changes should be kept in mind.

Method IV. Single-Payer System

Under the Single-Payer System, every individual would receive state-provided health insurance. A single state financed and administered program would eliminate the need for employer-provided or individually-purchased health insurance. We assume that co-payments and deductibles would be maintained and that persons currently insured though government programs such as Medicaid or Medicare would continue to be insured under such programs.

We calculate the cost of a Single-Payer System by first estimating the cost in 2002 of insuring those covered through their place of employment under the current system. The Bureau of Labor Statistics reports employer health care costs as a percentage of total wages and salaries. In 2000, this ratio is 7.33 percent and we assume it will be the same in 2002. We apply this ratio to our 2002 wage baseline number (see Table 5) and estimate the 2002 employer health care costs at $7,714 million.

To calculate total employee health care costs, we separate the costs paid by employers into the amounts paid for single individuals and the amounts paid for families. We then apply the percentages of total costs that single individuals and families pay, 17 percent and 27 percent respectively, and determine the total health care cost for all employees of $2,512 million.

Under the Single-Payer System, the state would cover the cost of insuring all workers and unemployed residents. To calculate these costs we combine the costs previously borne by the employers and employees, a total of $10,226 million, with the cost of insuring the uninsured. The cost of insuring the uninsured, $2,078 million, is the same as the cost of Pooling the Uninsured and is calculated as discussed in Method II (see Table 9). Thus, the initial cost to the state of a Single-Payer System would be $12,304 million, as shown in Table 13.

It should be noted that our estimates do not encompass supplemental health costs that are currently borne by the persons having employer-provided insurance and that the state would have to pick up under a Single Payer System. To that extent, we underestimate the economic losses that implementation of that system would bring about.[55]

Table 13. The Cost of a Single-Payer System to the State

State Costs 100% of all health expenditures in Maryland, less co-payments and deductibles[56] • Current employer costs estimated at $7,714.40 million, assuming employers pay 83% of individual premium and 73% of the family premium for employees • Current employee costs are 17% of the premium for singles and 27% for families, or $2,511.75 million • Cost of purchasing individual insurance plans for the uninsured estimated at $2,077.93 million[57]
Initial State Costs = **$12,304.07 million**
Additional State Costs: **-$419.53 million** (Estimated Savings from decreased administrative paperwork)
Total State Costs: **$11,884.55 million**
Total required change in the state income tax rate: **11.68 percentage points**
Cost Savings to Employees Total Employee Costs: **-2,511.75 million**
Equivalent change in the state income tax rate: **-2.32 percentage points**
Cost Savings to Employers Total Employer Costs: **-$7,714.40 million**;
Total change in employment benefit cost: **-7.33 percentage points**

Since the state bears all the insurance costs under a Single-Payer System, employees no longer have to contribute their portion of insurance costs. As these costs are shifted onto the state, there is a resulting cost saving to employees of $2,512 million, as shown in Table 13. Dividing this employee cost savings by the 2002 payroll baseline, we find that this cost saving is equivalent to an income tax rate decrease of 2.32 percentage points.

[55] It might be thought that we overestimate these losses insofar as the Single-Payer System might require individuals and families to continue paying part or all of their current premiums. That is not the case, however, insofar as we treat the elimination of those premiums under our version of the System as a personal income tax cut (cost saving to employees), with its own expansive effect on the economy. Making people pay these premiums would have the effect of a tax increase, neutralizing this tax cut.

[56] We assume that all the residents of Maryland that work out of state will remain insured by their out-of-state employers.

[57] See Table 9.

The net cost to the state of implementing a Single-Payer System is calculated by subtracting an administrative cost savings of $420 million from the cost to the state of $12,304 million. Thus, the net cost to the state is $11,885 million.

In *Maryland State Health Care Expenditures Account for 1998,* the Maryland Health Care Commission estimated that 7.60 percent total health care expenditures in 1998 were spent on administration. Proponents of a Single-Payer System claim that its implementation would result in a reduction in these administrative costs.

We can estimate this reduction by comparing the above-noted percentage with the percentage associated with government health care programs. Using data available from the U.S. Health Care Financing Administration, we estimate that administrative costs were 4.44 percent of health care expenditures for all state and local governments in 1998.[58] We assume that implementing the Single-Payer System in Maryland would reduce administrative costs, as a percentage of total health care expenditures, from 7.60 percent to 4.44 percent.[59]

On this basis, the cost of administering health care in Maryland would decrease from $1,295 million to an estimated $756 million, given that the state would extend coverage only to the currently insured. However, because the Single-Payer System would extend coverage to the 837,000 people who are currently uninsured in Maryland, administrative costs would ultimately total $875 million. We thus estimate that administrative cost savings for implementing the Maryland Single-Payer System in 2002 would be $420 million.

Under a Single-Payer System, employers would no longer bear the cost of providing employees with health insurance. Thus, the cost of hiring labor would be diminished, as the cost of insurance is shifted fully onto the laboring population in the form of taxes. The employment benefit cost, as estimated for 2002, would drop dramatically, by 7.33 percent. While the lower employment benefit cost would have positive effect on hiring labor, this effect is swamped by the negative consequences of tripling the state's income tax rate.

[58] The total state health care expenditure for whole U.S. is $139,960 million, out of which $6,210 million represent administrative costs.
[59] We consider the percentages will remain the same for 2002, in absence of important changes in the cost structure.

A Single-Payer System calls for an increase in the state income tax rate from the current 5.01 percent to 16.69 percent. In our estimation,

$$\Delta t_{pays} = 11.68 \text{ percentage points.}$$

The employment benefit cost as a fraction of payroll (v_b) would diminish by:[60]

$$\Delta v_b = -7.33 \text{ percentage points.}$$

Static Revenue Effect

As above, we calculate the revenue expected to be raised through the income tax rate increase as:

$$\begin{aligned} \Delta TR^S &= TB * \Delta t_{pays} \\ &= \$108{,}023 \text{ million} * 11.68\% \\ &= \$12{,}631 \text{ million.} \end{aligned}$$

We find the static effect is an increase of $12,631 million in revenues.

Dynamic Revenue Effect

The dynamic revenue effect comes through two channels – changes in payroll due to change in employment and changes in revenue from corporate income as a result of a change in capital stock.

Our job equation estimates (see Table 4) show that employment is significantly affected by t_{pays} and the coefficient, -0.0106, indicates that a increase in t_{pays} by one percentage point would decrease the number of workers by 1.06 percent. In the Single-Payer Plan, the change in t_{pays}, 9.36 percentage points, reflects both (1) the increase in the income tax of 11.68 percentage points required to finance the plan and (2) savings due to elimination of employee's premium, which is *equivalent* to a decrease in their tax rate of -2.32 percentage points. Combining these two effects there would be a net increase in the state labor tax of 9.36 percentage points. Also, reducing the

[60] It is not realistic to assume that the cost of hiring labor would diminish by the entire predicted cost of providing health care in 2002. Economic inertias and the necessity of employers to shift to other tax-preferred employee compensation mechanisms (higher pension funding, rather than employer-provided

cost of hiring labor by 7.33 percentage points will have positive effects on the state economy as employers in Maryland can now afford to hire more workers. In our estimation, we find that a one-percentage-point decrease in the employment benefit cost (v_b) would increase the number of workers by 0.64 percent. The decrease in the cost of hiring labor also leads to increases in capital stock. Comparatively, however, these effects are much smaller than the negative impact the increase in the state income tax has on the central economic variables.

We calculate the change in employment, L, as follows:

$$\Delta L_{2002} = L_{\text{baseline}} * (e^{-.0106 * Dt_{pays}} + e^{-.0064 * Dv_b} - 2)$$
$$= 2{,}528{,}000 * (e^{-.0106 * 9.36} + e^{-.0064 * -7.33} - 2)$$
$$= -117{,}531.$$

The change in capital is calculated as:

$$\Delta K = K_{\text{baseline}} * (e^{-.0122 * Dv_b} - 1)$$
$$= \$160{,}001 \text{ million} * (e^{-.0122 * -7.33} - 1)$$
$$= \$14{,}958 \text{ million.}$$

The distortions caused by the dramatic changes in the state income tax rate and the costs of hiring labor from a Single-Payer System are significant. Those individuals who currently work to gain health benefits for their family could exit the work force without concern for health care access. In two-wage families, the high tax rate would force the marginal worker from the work force because the additional income they take home to the family is significantly reduced by the increased income tax. Out-of-state workers contemplating relocation to Maryland would be deterred by the increase in the state personal income tax rate.

Of most concern is the impact that a Single-Payer System would have on future state tax revenues. Due to the decline in labor income, state tax revenues drop by a magnitude that cannot be recouped through the increase in revenue collected through corporate income tax. The resulting decrease in the number of workers in the state would also diminish the state's payroll:

$$Dpayroll = DL * w_{baseline}$$
$$= 117{,}531 * \$41{,}610$$
$$= -\$4{,}890 \text{ million.}$$

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health insurance) will mean that the cost of hiring labor will decrease by the majority of the elimination of

The dynamic change in tax revenue under a Single-Payer System is due to a combined effect of the change in payroll and the change in the capital stock. We calculate the portion of this dynamic change that is due to the change in payroll by multiplying the change in payroll by the new tax rate on labor income of 16.69 percent:

$$\Delta TR_L^D = Dpayroll * t_{pays}$$
$$= \text{-\$4,890 million} * 16.69\%$$
$$= \text{-\$816 million.}$$

A Single-Payer System increases capital stock held by firms in the state, which in turn increases the tax revenue from corporate income. The corporate income is estimated to be 14.2 percent of the capital stock in Maryland. The dynamic change in tax revenue that is due to the change in the capital stock is calculated below. We apply the effective average corporate income tax rate of 3.26 percent to find:

$$\Delta TR^D = DK * 0.1420 * t_{sc}$$
$$= \text{\$14,958 million} * 0.1420 * 3.26\%.$$
$$= \text{\$69 million.}$$

Thus, the total dynamic tax revenue change is -$746 million, as seen in Table 14 below.

Table 14. Summary of Tax Revenue Effects of a Single-Payer System

(Dollar amounts expressed in millions)

	Number of Jobs	Payroll	Capital Stock	Static Tax Revenue	Dynamic Tax Revenue	Net Tax Revenue
Single-Payer System	-117,531	-$4,890	$14,958	$12,631	-$746	$11,885

Summary

Whatever form it finally takes, implementation of universal health care in Maryland would bring about substantial losses in jobs and wages. The job and wage losses would be least for the least extensive system, namely Medicaid Expansion, and greatest for the most extensive system,

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the health care cost, but not by the entirety.

namely the Single-Payer System. Table 15 summarizes the economic effects of each of the four possible methods for implementing universal health care in Maryland for 2002.

Table 15. Comparison of Four Methods for 2002

(Dollar amounts expressed in millions of 2002 dollars)

Economic Variable	Medicaid Expansion	Pooling the Uninsured	Multi-Payer System	Single-Payer System
Change in Number of Jobs	-30,618	-61,488	-54,188	-117,531
Change in Capital Stock	$0	$0	$0	$14,958
Change in Payroll	-$1,274	-$2,558	-$2,255	-$4,890
Tax Revenue Effects				
Static Revenue Effects	$1,240	$2,506	$693	$12,631
Dynamic Revenue Effects				
Labor Income Tax	-$78	-$187	-$127	-$816
Capital Income Tax	$0	$0	$0	$69
Total Dynamic Tax Effect	-$78	-$187	-$127	-$746
Required Increase in Personal Income Tax	23%	46%	13%	233%
Net Tax Revenue Required to Fund the Program	$1,162	$2,319	$565	$11,885

All four methods would require an increase in taxes. The increase in personal income tax rates would have to be large enough to raise the "net tax revenue" required to fund each program, given the "dynamic" effects that would be created. These effects arise from changes in the tax base that occur as firms adjust their hiring and capital spending decisions to the changes in the cost of labor and capital that any sweeping new government program could be expected to bring about.

For example, the state would have to raise existing personal income tax rates by 233% in order to fund a Single-Payer System. This increase in tax rates would bring about a $12,631 million "static" revenue gain. In addition, it would bring about a $746 million "dynamic" loss in tax revenue, as employment and payroll shrank in response to the higher tax rate. It would furthermore bring about a $69 million gain in tax revenue as capital spending rose in response to the reduction in employer costs. The net result would be the $11,885 million increase in revenue needed to fund the system.

Table 16. Comparison of Four Methods in 2005

(Dollar amounts expressed in millions of 2002 dollars)

Economic Variable	Medicaid Expansion	Pooling the Uninsured	Multi-Payer System	Single-Payer System
Change in Number of Jobs	-30,444	-73,408	-63,517	-124,828
Change in Capital Stock	$0	$0	$0	$15,924
Change in Payroll	-$1,317	-$3,133	-$2,719	-$5,226
Tax Revenue Effects				
Static Revenue Effects	$1,271	$3,089	$822	$13,046
Dynamic Revenue Effects				
Labor Income Tax	-$80	-$239	-$155	-$873
Capital Income Tax	$0	$0	$0	$120
Total Dynamic Tax Effect	-$80	-$239	-$155	-$753
Required Increase in Personal Income Tax	21%	52%	14%	234%
Net Tax Revenue Required to Fund the Program	$1,191	$2,851	$667	$13,046

Table 16 expands the methodology to provide comparable results for 2005. We find that the economic effects grow modestly over time. Implementation of a Single-Payer System in 2002 would leave the state with 117,531 fewer jobs in 2002 than it would otherwise have had and with 124,828 fewer such jobs in 2005.

As mentioned at the start of this study, these estimates are sensitive to the assumptions made in reaching them, to our estimation methods and to our choice of a theoretical model. That universal health care would inflict substantial job losses and would require a substantial increase in tax rates is, however, beyond dispute. While that, in and of itself, may not represent a decisive argument against implementing some form of universal health care, it is a consideration to be weighed against the benefits that its supporters claim in its behalf.

Appendix 1. Deriving the Reduced-Form Equations

a. Introduction

This section provides a detailed derivation of the reduced form equations that are estimated in Section IV: STAMP Estimation.

b. Labor Supply by Households

Households with a fixed labor endowment of ($\bar{L}$) choose how to divide it between work (L) and leisure $\left(l = \bar{L} - L\right)$ based on the maximization of a utility function subject to a budget constraint. The household budget is the sum of the value of labor endowments (whether sold or retained as leisure) and unearned income. The household consumes goods and leisure, where the price of leisure is the post-tax wage rate. Assuming a Cobb-Douglas utility function, the household choice problem is then specified as:

(A1.1) $\quad \text{Max} U = AC^{q} l^{1-q}$

subject to

(A1.2) $\quad C + l\, w(1-t_{fl})(1-t_{sl}) = w\bar{L}(1-t_{fl})(1-t_{sl}) + G_{tr}$,

where

C = the consumption of goods and services;

w = the wage rate;

t_{fl} = the federal personal tax rate on labor income and employee's social security tax rate;

t_{sl} = the state personal tax rate on labor income;

G_{tr} = government transfer payments; and

λ = the consumption of leisure;

The problem in (A1.1) may be rewritten as:

(A1.3) $\quad \text{Max} Y = AC^{q} l^{(1-q)} - l\left[C + l\, w(1-t_{fl})(1-t_{sl}) - w\bar{L}(1-t_{fl})(1-t_{sl}) - G_{tr}\right]$.

Differentiating Y with respect to C, λ and l yields:

(A1.4) $\quad \dfrac{\partial Y}{\partial C} = \dfrac{qU}{C} - l = 0$,

(A1.5) $$\frac{\partial Y}{\partial \mathrm{l}} = \frac{(1-q)U}{\mathrm{l}} - l\, w(1-t_{fl})(1-t_{sl}) = 0\,,$$

(A1.6) $$\frac{\partial Y}{\partial l} = C + \mathrm{l}\, w(1-t_{fl})(1-t_{sl}) - w\bar{L}(1-t_{fl})(1-t_{sl}) - G_{tr} = 0\,.$$

By solving (A1.5) and (A1.6) simultaneously for λ one obtains:

(A1.7) $$\mathrm{l} = \frac{(1-q)C}{q\, w(1-t_{fl})(1-t_{sl})}\,.$$

Substituting (A1.7) into (A1.6) yields:

(A1.8) $$C = q\left[\, w\bar{L}(1-t_{fl})(1-t_{sl}) + G_{tr}\,\right].$$

Substituting (A1.8) into (A1.7) yields the demand for leisure:

(A1.9) $$\mathrm{l} = (1-q)\left[\,\bar{L} + \frac{G_{tr}}{w(1-t_{fl})(1-t_{sl})}\,\right].$$

Then, an individual's total supply of labor, L_i, is $\bar{L} - \lambda$ and is written as:

(A1.10) $$L_i = q\,\bar{L} - \frac{(1-q)G_{tr}}{w(1-t_{fl})(1-t_{sl})}\,.$$

Here L_i refers to the labor supply of a single individual. Total labor supply, L^s, is found by multiplying by the working-age population (*PW*), so $L^s = PW * L_i$, and so $\ln L^s = \ln PW + \ln L_i$. With appropriate substitution from equation (A1.10) and log-linear approximation we obtain

(A1.11) $$\ln L^s = f_0 - f_1 \ln G_{tr} + f_2 \ln w - f_3 t_{fl} - f_4 t_{sl} + f_5 \ln PW$$

(*Henceforth, all the coefficients are positive, unless otherwise noted.*)

Here we postulate that migration into a state, and thus its working-age population, is determined by job market conditions as well as the attractiveness of its living and working environment. In our study, the employment level (*L*) reflects current job market conditions. We also consider the state tax rate on income (t_{sl}) and the residential property tax rate (t_{pr}) to be policy variables that attract or deter people from moving into or out of the state. Then, the variable of working-age population is specified as:

(A1.12) $$\ln PW = q_0 + q_L \ln L - q_{sl} t_{sl} - q_{pr} t_{pr}$$

Then, by substituting (A1.12) into (A1.11) and solving the equation for L^s (equivalently *L*), the labor supply equation is expressed as:

(A1.13) $$\ln L^s = q_0 - q_1 \ln G_{tr} + q_2 \ln w - q_3 t_{fl} - q_4 t_{sl} - q_5 t_{pr}$$

c. Labor and Capital Demand by Producers

Producers use two primary production factors – labor (*L)* and capital (*K)*. They are assumed to maximize profit, given a production function and factor costs. The gross factor cost of labor is the pre-tax wage rate (*w*) plus non-wage costs such as employer payroll taxes, including unemployment insurance and social security tax, and employment benefit cost n_b. The employer's payroll tax is separated into the state payroll tax (v_s) measured by the unemployment insurance tax rate, and the federal payroll tax (n_f) measured by the employer's contributions to Social Security, expressed as a percentage of total payroll.

Employment benefit cost (n_b) represents the employer's insurance cost (including health insurance) as a fraction of wages and salaries. We treat non-wage costs ($v_f + v_s + v_b = v$) as an ad valorem tax on the use of labor services.

The rental cost of capital to producers (*r*) is derived from the equilibrium condition whereby the present value of the future income stream to the owners of capital (i.e., households) is equal to the current value of capital.[61] As explained below, *r* increases with the total tax rate on capital (t_{ck}).

The labor market in a state is influenced by national economic trends. To capture this, the model assumes that producers reflect nationwide economic conditions in their production decisions, i.e., other things being equal; they increase production when the national economy is strong. Let the U.S. production index (*q*) be a national economic indicator. We assume a generalized Cobb-Douglas production function of the following form:

(A1.14) $$Q = HqL^{\alpha}K^{\beta},$$

where $0 < \alpha, \beta < 1$ and H is a parameter. The profit-maximizing problem of producers may be written as:

(A1.15) $$Max\pi = Hq L^{a} K^{b} - w(1+v)L - r(1+t_{pc})K,$$

[61] A detailed derivation of cost of capital appears in Appendix 4.

where $\nu = \nu_s + \nu_f + \nu_b$ and t_{pc} is the tax rate on commercial property and p is the price of output, here normalized to 1.

The first-order conditions for a profit maximum are:

(A1.16) $$\frac{\partial p}{\partial L} = a\,Hq\frac{L^a}{L}K^b - w(1+\nu) = 0 \text{ and}$$

(A1.17) $$\frac{\partial p}{\partial K} = b\,HqL^a\frac{K^b}{K} - r(1+t_{pc}) = 0.$$

From (A1.16) and (A1.17) we obtain:

(A.1.18) $$\frac{a\,K}{b\,L} = \frac{w(1+\nu)}{r(1+t_{pc})} \text{ so } K = \frac{w(1+\nu)L}{r(1+t_{pc})}\frac{b}{a} \text{ and } L = \frac{r(1+t_{pc})}{w(1+\nu)}\frac{a\,K}{b}.$$

Then, substituting K in (A.1.18) into (A.1.16) we get:

(A.1.19) $$L^{1-a-b} = a^{1-b}\,b^{\,b}\,Hqw^{b-1}(1+\nu)^{b-1}r^{-b}(1+t_{pc})^{-b}.$$

Using the approximation that $\ln(1+x) \approx x$, we get

(A1.20) $$\ln L^d = l_0 + l_1 \ln q - l_2 \ln r - l_3 t_{pc} - l_4 \ln w - l_5 \nu_s - l_6 \nu_f - l_7 \nu_b.$$

where $l_1 = (1-a-b)^{-1}$, $l_2 = (1-a-b)^{-1}b$,
$l_3 = (1-a-b)^{-1}b$, $l_4 = (1-a-b)^{-1}(1-b)$,
and $l_5 = l_6 = l_7 = (1-a-b)^{-1}(1-b)$,

assuming $a + b < 1$.

Similarly, substituting L in (A.1.18) into (A.1.17) we obtain

(A.1.21) $$K^{1-a-b} = b^{1-a}\,a^{a}\,Hqr^{a-1}(1+t_{pc})^{a-1}w^{-a}(1+\nu)^{-a}.$$

This gives:

(A1.22) $$\ln K = k_0 + k_1 \ln q - k_2 \ln r - k_3 t_{pc} - k_4 \ln w - k_5 \nu_s - k_6 \nu_f - k_7 \nu_b,$$

where $k_1 = (1-a-b)^{-1}$, $k_2 = (1-a)(1-a-b)^{-1}$, $k_3 = (1-a)(1-a-b)^{-1}$,
$k_4 = a(1-a-b)^{-1}$, and $k_5 = k_6 = k_7 = a(1-a-b)^{-1}$.

d. Deriving the Reduced Form Equations

Setting labor supply (A1.13) equal to labor demand (A1.20) gives

(A1.23) $$q_0 - q_1 \ln G_{tr} + q_2 \ln w - q_3 t_{fl} - q_4 t_{sl} - q_5 t_{pr}$$
$$= l_0 + l_1 \ln q - l_2 \ln r - l_3 t_{pc} - l_4 \ln w - l_5 v_s - l_6 v_f - l_7 v_b .$$

Solving for ln$w$ yields the following:[62]

(A1.24) $$\ln w = (q_2 + l_4)^{-1}[(l_0 - q_0) + l_1 \ln q - l_2 \ln r + (q_5 - l_3) t_{pr} - l_7 n_b + q_3 t_{fl} - l_6 n_f + q_4 t_{sl} - l_5 n_s].$$

Here we generate the new variables, the total state labor tax rate, t_{pays} (= t_{sl} +n_s), and the total federal labor tax rate, t_{payf} (= t_{fl} +n_f). Then, (A1.24) is rewritten as:

(A1.25)

$$\ln w = (q_2 + l_4)^{-1}\left[(l_0 - q_0) + l_1 \ln q - l_2 \ln r + (q_5 - l_3) t_{pr} - l_7 n_b + q_1 \ln G_{tr} + g_f t_{payf} + g_s t_{pays}\right],$$

where $g_f = q_3\left(t_{fl}/(t_{fl}+n_f)\right)$-$\lambda_6\left(v_f/(t_{fl}+n_f)\right)$ and $g_s = q_4\left(t_{sl}/(t_{sl}+n_s)\right)$-$\lambda_5\left(v_s/(t_{sl}+n_s)\right)$, and the signs of g_f and g_s are ambiguous.

Now the equilibrium wage rate in (A1.25) is simplified as:

(A1.26) $$\ln w = p_0 + p_1 \ln q - p_2 \ln r + p_3 t_{pr} - p_4 v_b + p_5 \ln G_{tr} + p_6 t_{payf} + p_7 t_{tpays}$$

where $p_1 = l_1(q_2 + l_4)^{-1}$, $p_2 = l_2(q_2 + l_4)^{-1}$, $p_3 = (q_5 - l_3)(q_2 + l_4)^{-1} \gtreqless 0$, $p_4 = l_7(q_2 + l_4)^{-1}$, $p_5 = q_1(q_2 + l_4)^{-1}$, $p_6 = g_f(q_2 + l_4)^{-1} \gtreqless 0$, *and* $p_7 = g_s(q_2 + l_4)^{-1} \gtreqless 0$.

Substituting (A1.24) into equation (A1.20) and solving for ln$L$ gives:

(A1.27) $$\ln L = l_0 + l_1 \ln q - l_2 \ln r - l_3 t_{pc} - l_5 v_s - l_6 v_f - l_7 v_b - l_4(q_2 + l_4)^{-1}[(l_0 - q_0) + l_1 \ln q - l_2 \ln r + (q_5 - l_3) t_{pr} - l_7 n_b + q_1 \ln G_{tr} + q_3 t_{fl} - l_6 n_f + q_4 t_{sl} - l_5 n_s]$$

Simplifying (A1.27) one obtains:

(A1.28) $$\ln L = b_0 + b_1 \ln q - b_2 \ln r - b_3 t_{pc} - b_4 v_b - b_5 \ln G_{tr} t_s - b_6 t_{fl} - b_7 n_f - b_8 t_{sl} - b_9 n_s$$

[62] In Maryland, the tax rates on residential property and on commercial property are the same, i.e., $t_{pr} = t_{pc}$.

where $b_1 = \frac{l_1 q_2}{q_2 + l_4}$, $b_2 = \frac{l_2 q_2}{q_2 + l_4}$, $b_3 = \frac{l_3 q_2 + l_4 q_5}{q_2 + l_4}$, $b_4 = \frac{l_7 q_2}{q_2 + l_4}$,

$b_5 = \frac{l_4 q_1}{q_2 + l_4}$, $b_6 = \frac{l_4 q_3}{q_2 + l_4}$, $b_7 = \frac{l_6 q_2}{q_2 + l_4}$, $b_8 = \frac{l_4 q_4}{q_2 + l_4}$, *and* $b_9 = \frac{l_5 q_2}{q_2 + l_4}$.

Again using the variables, t_{payf} and t_{pays}, the equilibrium employment equation in (A1.28) is written as:

(A1.29) $$\ln L = b_0 + b_1 \ln q - b_2 \ln r - b_3 t_{pc} - b_4 v_b - b_5 \ln G_{tr} t_s - b_f t_{payf} - b_s t_{pays},$$

where $b_f = b_6[t_{fl}/(t_{fl}+n_f)]+b_7[v_f/(t_{fl}+n_f)]$ and $b_s = b_8[t_{sl}/(t_{sl}+n_s)]+b_9[v_s/(t_{sl}+n_s)]$.

Next, to get the equation for capital stock we substitute (A1.24) into equation (A1.22) as:

(A1.30) $$\begin{aligned}\ln K = {} & k_0 + k_1 \ln q - k_2 \ln r - k_3 t_{pc} - k_5 v_s - k_6 v_f - k_7 v_b \\ & - k_4 (q_2 + l_4)^{-1}[(l_0 - q_0) + l_1 \ln q - l_2 \ln r + (q_5 - l_3) t_{pr} - l_7 n_b + q_1 \ln G_{tr} \\ & + q_3 t_{fl} - l_6 n_f + q_4 t_{sl} - l_5 n_s]\end{aligned}$$

Or, more concisely,

(A1.31) $$\ln K = d_0 + d_1 \ln q - d_2 \ln r - d_3 t_{pc} - d_4 v_b - d_5 \ln G_{tr} - d_6 t_{fl} - d_7 n_f - d_8 t_{sl} - d_9 n_s$$

where $d_1 = Aq_2/B$, $d_2 = A[(1-a)q_2 + (1-a-b)A]/B$, $d_3 = A[(1-a)q_2 + (1-a-b)A + a q_5]/B$,

$d_4 = Aa\, q_1/B$, $d_5 = k_4 q_1/(q_2 + l_4)$, $d_6 = k_4 q_3/(q_2 + l_4)$, $d_7 = Aa\, q_2/B$,

$d_8 = k_4 q_4/(q_2 + l_4)$, $d_9 = Aa\, q_1/B$, $A = (1-a-b)^{-1}$ and $B = q_2 + (1-b)A$.

Finally using the variables, t_{payf} and t_{pays}, the equilibrium capital stock equation is rewritten as:

(A1.32) $$\ln K = d_0 + d_1 \ln q - d_2 \ln r - d_3 t_{pc} - d_4 v_b - d_5 \ln G_{tr} - d_f t_{payf} - d_s t_{pays}$$

where $d_f = d_6[t_{fl}/(t_{fl} + n_f)] + d_7[v_f/(t_{fl} + n_f)]$ and $d_s = d_8[t_{sl}/(t_{sl} + n_s)]+d_9[v_s/(t_{sl} + n_s)]$.

Appendix 2. Calculation of Tax Rates

The STAMP model includes a number of tax rates, either as independent variables in the reduced-form estimating equations, or as components of the cost of capital (see Appendix 4 for more details about the latter). Among the tax rates used in generating regressors in the estimation equations, the following tax rates are not readily available and are thus constructed by BHI:

(a) the federal tax rate on labor income applied to state residents,
(b) the state tax rate on labor income, and
(c) the local tax rates on commercial/industrial property and residential property.

The tax rates that we include as the components of the cost of capital are

(d) the state corporate income tax rate for corporations,
(e) the federal tax rate on corporate income by sector, and
(f) the federal tax rate on capital income applied to all U.S. residents.

In the following sections we explain how these tax rates were computed for the purposes of STAMP.

As a rule we use *average marginal tax rates* wherever the data needed to calculate them are available. These are calculated, in general, as the average of the marginal tax rates facing individuals (or businesses). A recognized weakness in other state-level tax models is that they typically use measures of average (rather than average marginal) tax rates, with the drawback that these do not summarize the tax rates that face an individual who is trying, at the margin, to decide whether to work more, or a firm wondering whether it should invest more.[63]

The calculation of average marginal tax rates is somewhat complicated, so the procedures followed are described in this Appendix. Our methodology is based on the approach taken by John Seater.[64]

[63] Bartik surveys the relevant literature.
[64] John Seater, "Marginal Federal Personal and Corporate Income Tax Rates in the US, 1909-1975," *Journal of Monetary Economics* 10 (November 1982): 361-382.

a. Average Marginal Federal Tax Rate on Labor Income for State Residents

We use data obtained from the IRS' *Statistics of Income* publication, which reports, for each Adjusted Gross Income (AGI) group, the number of returns, total AGI, total wages and salaries, and total tax liability. Given these data, we compute the marginal federal tax rate for AGI group i, $t_{fpy,i}$, as the change in tax liability per change in gross income. The marginal federal tax rate for income group i is then written as:

$$t_{fpy,i} = \frac{T_{fpy,i} - T_{fpy,i-1}}{Y_{fy,i} - Y_{fy,i-1}}, \qquad \text{(A2.1)}$$

where

$T_{fpy,i}$ = average federal tax liability for AGI group i, calculated by dividing the total tax liability by the number of returns for AGI group i, and

$Y_{fy,i}$ = average gross income for AGI group i, calculated by dividing the total gross income by the number of returns for AGI group i.

Then, the average marginal federal tax rate on labor income for the state, t_{fl}, is calculated by multiplying wages and salaries in each AGI class by the marginal tax rate for that class, then dividing by the total wages and salaries.

$$t_{fl} = \frac{\sum_i (Y_{fl,i}) * (t_{fpy,i})}{\sum_i (Y_{fl,i})}, \qquad \text{(A2.2)}$$

where $Y_{fl,i}$ = total wages and salaries for income group i.

b. Average Marginal Federal Tax Rate on Corporate Income

In order to calculate the average marginal federal tax rate on corporate income we use data for firms of all states, as published by the IRS in *Corporation Returns*. This publication reports, for each of the sectors of the economy (AFF, construction, FIRE, manufacturing, mining, services, TPU, and trade) and for each different size of business (as measured by receipts), the number of returns, net income, income subject to tax, and income tax. Given these data, we calculate the

marginal federal tax rate for business receipts group i, ($t_{fc,i}$) as the change in corporate tax liability per change in corporate taxable income.[65] Hence, $t_{fc,i}$ is written as:

$$t_{fc,i} = \frac{T_{fc,i} - T_{fc,i-1}}{TY_{fc,i} - TY_{fc,i-1}}, \quad \text{(A2.3)}$$

where

$T_{fc,i}$ = average corporate tax liability for group i, calculated by dividing the total corporate tax liability by the number of returns for business receipts group i, and

$TY_{fc,i}$ = average taxable corporate net income (less deficits) for business receipts group i, calculated by dividing the total corporate taxable income by the number of returns for business receipts group i.

Then we calculate the average marginal tax rate on corporate income (t_{fc}) by multiplying corporate net income in each business receipt group by the marginal tax rate for that class, and dividing by the total corporate net income, to give

$$t_{fc} = \frac{\sum_i (TY_{fc,i}) * (t_{fc,i})}{\sum_i TY_{fc,i}}. \quad \text{(A2.4)}$$

We follow a similar approach in order to compute the average marginal state tax rate on corporate income.

c. Average Marginal Federal Tax Rate on Capital Income Applied to All U.S. Residents

To compute this tax we use data from federal tax returns for all U.S. residents published in the *Statistics of Income Bulletin*.[66] This publication reports, for each AGI class, the number of returns, total AGI less deficit, tax liability, taxable income, dividends, and net capital gains. First, we defined the marginal federal tax rate for AGI group i ($t_{fy,i}$) as the change in tax liability per change in taxable income. Then, $t_{fy,i}$ is written as:

[65] The average tax rate on corporate income was used for the first business receipts income group. The marginal tax rate on corporate income was used on the remaining income groups, with the exception of negative or erroneous results, in which case the average tax rate on corporate income was used.

[66] See section on "Selected Historical and Other Data, Individual Income and Tax Data by State and Size of Adjusted Gross Income for the U.S."

(A2.5) $$t_{fy\,i} = \frac{T_{fy,i} - T_{fy,i-1}}{TY_i - TY_{i-1}},$$

where

$T_{fy,i}$ = average federal tax liability for AGI group i, calculated by dividing the total tax liability by the number of returns for AGI group i, and

TY_i = average taxable income for AGI group i, calculated by dividing the taxable income by the number of returns for AGI group i.

(a) *Average Marginal Federal Tax Rate on Dividend Income*. The average marginal tax rate on dividend income for all states (t^d_{fk}) is then calculated by multiplying dividend income in each AGI class, D_i, by the marginal tax rate for that class, and dividing by total dividend income. Thus

(A2.6) $$t^d_{fk} = \frac{\sum_i (t_{fy,i}) * (D_i)}{\sum_i D_i},$$

where D_i = the total dividend income for income group i.

As shown, t^d_{fk} is the weighted average of the individual AGI group marginal federal tax rates, the weight being the fraction of total dividends that fall within each income class.

(b) *Average Marginal Federal Tax Rate on Capital Gains*. The average marginal tax rate on capital gains income for all states (t^q_{fk}) is calculated by multiplying *actually realized* capital gains income in each AGI class (G_i) by the marginal tax rate for that class, then dividing by total capital gains income. The *SOI* reports only those capital gains included in the AGI, G^A_i. Since some of the capital gains were tax-deductible at the federal level until the year 1986, realized capital gains are greater than the reported capital gains for that period. We calculate G_i by multiplying G^A_i by the ratio of the total realized capital gains to the total reported capital gains for each year. The Office of Tax Analysis of the Internal Revenue Service reports this ratio. Then t^q_{fk} is calculated as:

(A2.7) $$t^g_{fk} = \frac{\sum_i (t_{fy,i}) * (G_i)}{\sum_i G_i}.$$

Here again, t_{fk}^{q} is the weighted average of the individual AGI group marginal federal tax rates, with the weight being the fraction of total capital gains that fall within each income class.

d. Average Marginal State Tax Rate on Labor Income

We employ a methodology similar to that used to compute t_{fl} in computing the average state marginal tax rate on labor income t_{sl}. The only difference is that we use taxable income instead of AGI.

e. State Corporate Income Tax Rate

We generated the corporate excise tax rate (t_{sc}) by applying the following formula:

t_{sc} = corporate income tax collections/state's corporate income taxable base.

To obtain the state corporate income taxable base, we first calculated the taxable base for each of seven primary sectors: agriculture, forestry and fishery (AFF), construction; manufactures; trade (wholesale and retail); transportation and public utilities (TPU); finance, insurance and real state (FIRE); and services, by multiplying the U.S. corporate net income for each sector reported in the *Corporation Income Tax Returns,* an IRS publication, by the apportionment ratio as:

(A2.8) $$TB_i = ar_i * Y_i$$

where TB_i, ar_i, and Y_i are taxable base, apportionment ratio and U.S. corporation net income for sector i, respectively. The apportionment of each of the ratios of sales, asset and payroll differ according to each state's tax legislature. In Maryland the apportionment formula in effect since 1993 is the three-factor:

(A2.9) $$ar_i = \left[0.5*\left\{\frac{\text{MD sales}}{\text{US sales}}\right\}_i + 0.25*\left\{\frac{\text{MD assets}}{\text{US assets}}\right\}_i + 0.25*\left\{\frac{\text{MD payroll}}{\text{US payroll}}\right\}_i \right].$$

The payroll ratios were computed using data on payroll for the state and for the United States, which were obtained from the Bureau of Economic Analysis (BEA). We calculated the asset ratios using data on U.S. nonresidential capital stock published by BEA and the state capital stock

data estimated by BHI.[67] Since sales data are not available on an annual basis for the United States or the states, we estimated the sales data for the seven primary sectors using census data published every fifth year.

The estimation method for the sales ratio for construction, trade, manufactures and service sectors is described below. We first estimated each state's and the U.S. sales for non-base years using the *census* year (or base year) [68] data on sales and the annual growth rates of the sector-specific U.S. GDP and the state's GSP as follows:

$$S_t = S_{t-1} * \exp\left[\left(\ln S_b - \ln S_a \right) * \left(\frac{g_t}{\sum_{t=a+1}^{b} g_t} \right) \right], a < t < b \qquad \text{(A2.10)}$$

where S_t = U.S. or state sales for year t,
S_a = U.S. or state sales for the preceding base year,
S_b = U.S. or state sales for the following base year, and
g_t = growth rate of U.S. GDP or state GSP for year t.[69]

Using the U.S. and state estimated sales for non-census years; we calculated the ratios of state sales to U.S. sales for the analysis period (1970-1997).

Census data for the FIRE sector are only available after 1992.[70] We estimated U.S. and each state's sales by applying the FIRE, GDP and GSP growth rates to the actual 1992 data for the period of our analysis.

The TPU sector consists of three subsectors: transportation, public utilities, and communications. Census data are available only for the transportation subsector. We used the ratio of state GSP to U.S. GDP in the TPU sector to estimate the sales ratio for TPU.

Once all the ratios (sales, asset and payroll ratios) in the apportionment formula were estimated or calculated, we multiplied the apportionment ratio by the U.S. corporate net income to get the taxable base for each sector. Then the total state taxable base was obtained by adding the taxable

[67] See Appendix 3 for a detailed description of the state capital stock estimation.
[68] Henceforth, the census year or the year for which sales was available is called the *base* year.
[69] The state GSP data are not available prior to 1977. For the years prior to 1977, we used the growth rate of personal income of U.S. and the state.
[70] FIRE census was first published in 1992.

base for all sectors: $TB_{state} = \Sigma_i \, TB_i$. The last step in the calculation of t_{sc} was to divide state collection of corporate income taxes by the total state taxable base.

f. Property Tax Rate

We divide the total property tax levies by an estimate of the actual market value of total property in the state. Data on the property tax levies and the actual value are obtained from the Maryland Comptroller of Treasury.

Appendix 3. Estimation of Maryland State Stock of Private Capital

a. The Basic Approach

Since no state-by-state data are available on the stock of private capital, it was necessary to develop a method for allocating capital stock between states from the national totals published by the Bureau of Economic Analysis (BEA). The capital stock series selected were the constant-cost net stock of fixed private capital, nonresidential, by industry, for the years 1970-1998. Net stock is calculated as the cumulative value of past gross investment less the cumulative value of past depreciation.[71] The approach taken was to apportion for each year, from 1970 to 1998, the BEA national total for private capital on the basis of various measures of a state's economic activity in the following sectors: agriculture, forestry, and fishery (AFF); construction; manufacturing; transportation and public utilities (TPU); wholesale and retail trade (trade); finance, insurance, and real estate (FIRE); and services. Adopting a procedure similar to the one outlined by Munnell, we apportioned BEA national stock estimates of these sectors using various proxies. The calculation of these proxies is described below.[72]

We obtained much of the data used as proxies from the economic censuses, which take place every fifth year. The most recent census was carried out in 1997. Where possible we have updated each proxy to include the 1997 data, otherwise we have used the 1992 census as the latest base year. We apportioned several sectors using data from sources other than the economic censuses. The state's share of the proxy in the census year and other years for which the state's share of the proxy was available was used to distribute the BEA national capital stock for that year. (Henceforth, the census year or the year for which the proxy was available is called the *base year*.) Thus, the state capital stock for a base year, for each sector, K_τ, is:

(A3.1) $$K_t = r_t * K_{US,t},$$

where

r_t = the apportionment rate for base year τ, and

$K_{US,t}$ = U.S. capital stock for base year τ.

[71] In 1997 the BEA revised the U.S. capital stock data based on a new methodology for calculating depreciation charges. For a given year, the depreciation charges are obtained by multiplying the prior year's charge by one minus the annual depreciation rate. Net stocks are estimated by subtracting cumulative depreciation from cumulative gross investment.

Then, we estimated the state's capital stock for non-base years using the base year apportionment ratios and the annual growth rates of the U.S. capital stock.[73] Using the state capital stock for two base years as reference points, the estimates for the years between the two base years are generated in accordance with the growth rate of the national capital stock as follows:

(A3.2) $$K_t = K_{t-1} * \exp\left[(\ln K_b - \ln K_a) * \left(g_t / \sum_{t=a+1}^{b} g_t \right) \right], \qquad a < t \leq b$$

where K_t = state capital stock for year *t*,
K_a = state capital stock for the preceding base year,
K_b = state capital stock for the following base year, and
g_t = growth rate of U.S. capital stock for year t.

In the few instances in which the formula above generated implausible state capital figures, for instance due to negative growth rates in U.S. capital while the state economy was booming, other proxies were used.

b. Methodology for Nonresidential Assets

We apportioned the BEA estimate of assets in construction according to the state's share of the gross book value of depreciable assets taken from the *Census of Construction* for 1972, 1977, 1982, 1987, 1992 and 1997. We estimated assets for 1970 and 1971 by applying the 1972 ratio; assets for 1973-76 with data from the 1972 and 1977 *Censuses*; assets for 1983-86 with data from the 1982 and 1987 *Censuses*; assets for 1988-91 with data from 1987 and 1992 *Censuses*; assets for 1993-96 with data from 1992 and 1997 *Censuses*.

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[72] Alicia M. Munnell, with Leah Cook, "How Does Public Infrastructure Affect Regional Economic Performance?" *New England Economic Review* (fall 1990): 11-32.

[73] Munnell used the base year apportionment ratios to distribute the BEA national capital stock for preceding years and following years. Thus, she used data from the 1972 *Census* to estimate the capital stock apportionment ratios for each state for 1969 to 1974; 1977 *Census* data to estimate shares for 1975 to 1979; 1982 *Census* data to estimate shares for 1980 to 1984; and 1987 *Census* data to estimate shares for 1985 to 1989. The resulting series, however, sometimes show significant divergence of annual growth rates from the growth rates of the U.S. capital stock. To avoid this problem we used the smoothing method described below.

Maryland's Share of U.S. Gross Book Value of Depreciable Assets for Construction (%)[74]

1972	1977	1982	1987	1992	1997
1.91%	1.79%	2.54%	3.01%	2.56%	2.24%

We apportioned the BEA estimate of assets in manufacturing according to the state's share of the gross book value of depreciable assets at the end of year taken from the *Annual Survey of Manufactures* for the years 1970 and 1971 and the *Census of Manufactures* for 1977, 1982, 1987, 1992 and 1997. "Gross book value of total assets at the beginning of the year" was used to approximate the gross book value of total assets at the end of the previous year for years 1976, 1981, 1986, 1991 and 1996. The data from the 1971 and the 1976 *Annual Survey* were used to estimate capital stock for 1972-75.

Maryland's Share of U.S. Gross Book Value of Depreciable Assets for Manufacturing (%)[75]

1970	1971	1976	1977	1981	1982	1986	1987	1991	1992	1996	1997
1.61%	1.60%	1.43%	1.38%	1.20%	1.18%	1.22%	1.20%	1.20%	1.16%	0.92%	0.92%

We used several procedures to distribute assets in the transportation and public utilities sector. This sector was divided into three sub-sectors: transportation; communications; and electric, gas, and sanitary services. We began with the transportation sector for which three sub-sectors were considered; railroad, trucking and warehousing, and air transportation. We distributed the BEA estimate for railroad transportation according to the state's share of rail mileage in 1980, 1981, 1982, and the years 1984 through 1997. We obtained these data from *Railroad Facts*. We estimated assets from 1970 to 1979 by applying the 1980 ratio, and assets for 1983 with data from 1982 and 1984.[76]

[74] U.S. Bureau of the Census, *Census of Construction* (Washington D.C.: 1972, 1977, 1982, 1987, 1992 and 1997).
[75] U.S. Bureau of the Census, *Annual Survey of Manufactures* (Washington D.C.: 1970, 1971); U.S. Bureau of the Census, *Census of Manufactures* (Washington D.C.: 1977, 1982, 1987, 1992 and 1997).
[76] We were unable to find the state's share of U.S. road mileage for early years, so we assume that the apportionment ratio remained constant before 1980 at that year's ratio. This assumption seems reasonable since the ratio after 1980 did not change significantly.

Maryland's Share of U. S. Railroad Mileage (%)[77]

1980	1981	1982	1984	1985	1986	1987	1988	1989	1990
0.68	0.65	0.66	0.55	0.57	0.55	0.64	0.60	0.61	0.60

1991	1992	1993	1994	1995	1996	1997
0.62	0.63	0.64	0.65	0.63	0.61	0.63

We estimated the state's assets in trucking and warehousing according to the state's share of trucks. We collected these data for 1971, 1972, 1977, 1981, 1982, 1987, 1992 and 1997 from the *Census of Transportation*.

Maryland's Share of U.S. Trucks (%)[78]

1971	1972	1977	1981	1982	1987	1992	1997
1.33	1.36	1.21	1.32	1.31	1.48	1.59	1.62

We apportioned the state's assets in air transportation by estimating the state's share of registered aircraft. We obtained these data from the *Census of U.S. Civil Aircraft,* a publication of the Federal Aviation Administration.

Maryland's Share of U.S. Aircraft (%)[79]

1972	1977	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1992	1994
1.36	1.09	1.04	1.02	1.02	1.03	1.07	1.10	1.15	1.18	1.21	1.23	1.23	1.19	1.17

[77] Association of American Railroads, *Railroad Facts* (Washington, D.C.: Association of American Railroads, 1983, 1985, 1988, 1993, 1995, 1996 and 1997).
[78] U.S. Bureau of the Census, *Census of Transportation* (Washington D.C.: 1972, 1977, 1982, 1987, 1992 and 1997).
[79] U.S. Federal Aviation Administration, *Census of U.S. Civil Aircraft* (Washington, D.C.: 1972, 1977, 1982, 1987, 1992 and 1994).

We were unable to obtain sufficient proxies for other sub-sectors of transportation so we apportioned then using the weighted average of the shares of railroad, trucking and warehousing, and air transportation to total transportation. These three sectors accounted for 79 percent of 1995 total transportation of U.S. capital stock.

The next sub-sector is the communication sector. We apportioned the national estimate of this sub-sector according to the state's share of miles of wire in cable. From 1991, "total industry-lines" is substituted for "miles of wire in cable" since it was no longer published. We collected this set of data from the *Statistics of Communications Common Carriers*, a publication of the Federal Communication Commission, for 1972, 1977, 1980, 1981, 1984, 1986, 1987, 1988, 1991,1992, 1993, 1994, 1996 and 1997. We estimated the 1995 ratio according to the state's share of total pre-subscribed lines since miles of wire and cable are no longer published (and are increasingly less relevant anyhow).

Maryland's Share of U.S. Miles of Wire in Cable (%)[80]

1972	1977	1980	1981	1984	1986	1987	1988	1990	1991	1992	1993	1994	1996	1997
2.47	2.28	2.19	2.19	2.21	2.11	2.10	2.11	2.18	2.08	2.03	2.02	2.00	1.94	2.03

The final sub-sector is electric, gas, and sanitary services. We distributed assets in the electric service sector based on the state's share of installed capacity of electric energy (for 1970 to 1989) and net summer capability (for 1990 to 1997).[81] These data were obtained from the *Statistical Abstract of the United States*, 1975, 1985, 1990, 1993, 1995, 1996 and 1997. We estimated 1972 assets with data from 1971 and 1973; assets for 1989 with data from 1988 and 1990, and so on.

[80] U.S. Federal Communications Commission, *Statistics of Communications Common Carriers* (Washington, D.C.: 1972, 1977, 1980, 1986, 1987, 1993, 1994, 1995, 1996 and 1997).
[81] Data for installed capacity are not available after 1989. They are replaced with net summer capability.

Maryland's Share of U.S. Installed Capacity of Electric Energy (%)[82]

1970	1971	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1.47	1.57	1.51	1.40	1.48	1.53	1.61	1.57	1.53	1.50	1.54	1.50	1.49	1.55	1.49	1.47

1987	1988	1990	1991	1992	1993	1994	1995	1996	1997
1.46	1.44	1.42	1.54	1.57	1.27	1.28	1.39	1.55	1.54

We estimated assets in the gas service sector based on the state's share of miles of pipeline and gas mains. We collected these data from *Gas Facts*, a publication of the American Gas Association, for 1970, 1975, 1980, 1985, 1990, 1992, 1993, 1994, 1995, 1996 and 1997. We estimated assets for 1971 to 1974 with data for 1970 and 1975, assets for 1976 and 1977 with data for 1975 and 1978, and so on. Once again, we could not find a good proxy for the sanitary service sector, so we apportioned a weighted average of the shares of electricity and gas to the total of electric, gas, and sanitary services.[83]

Maryland's Share of U.S. Miles of Pipeline and Gas Main (%)[84]

1970	1975	1978	1979	1980	1981	1982	1983	1985	1986	1987	1988	1989	1990
0.87	0.87	0.85	0.84	0.83	0.82	0.81	0.81	0.79	0.79	0.79	0.80	0.79	0.80

1991	1992	1993	1994	1995	1996	1997
0.80	0.79	0.83	0.83	0.86	0.90	1.00

We distributed assets in finance, insurance, and real estate (FIRE) according to the state's share of gross production in the U.S. for each year.[85] We obtained the annual data on gross product for

[82] U.S. Bureau of the Census, *Statistical Abstract of the United States* (Washington, D.C.: 1970, 1975, 1978, 1979, 1985, 1990, 1993, 1995 and 1997).
[83] The sanitary service sector is small, e.g., its share of the total 1993 U.S. capital stock in electric, gas, and sanitary services was 8.9 percent.
[84] American Gas Association, *Gas Facts* (Arlington, Virginia: American Gas Association, 1975,1980, 1985, 1980, 1992, 1993, 1994, 1995, 1996 and 1997).
[85] Munnell used the state's share of commercial bank deposits in the U.S. However, the fraction of banks' capital stock in FIRE is relatively small (e.g., it was 20 percent in 1993) and thus the deposit share may not

each subsector, for the U.S. and for Maryland State, from the Bureau of Economic Analysis (BEA).

Maryland's Ratio of U.S. GSP in FIRE (%)

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1.99	1.95	1.9	1.89	1.92	1.92	1.96	2.01	2.04	2.09	2.14	2.25	2.28

1990	1991	1992	1993	1994	1995	1996	1997	1998
2.31	2.27	2.22	2.23	2.29	2.18	2.1	2.08	2.07

We apportioned BEA estimates of retail and wholesale trade and service sector according to the state's share of sales in each category. We obtained sales data from the *Census of Retail Trade*, 1972, 1977, 1982, 1987, 1992 and 1997; the *Census of Wholesale Trade*, 1972, 1977, 1982, 1987, 1992 and 1997; and the *Census of Service Industries*, 1972, 1977, 1982, 1987, 1992 and 1997.

Maryland's Share of U.S. Sales in Retail Trade (%)[86]

1972	1977	1982	1987	1992	1997
2.07	1.99	1.97	2.12	2.02	1.82

Maryland's Share of U.S. Sales in Wholesale Trade (%)[87]

1972	1977	1982	1987	1992	1997
1.47	1.34	1.29	1.63	1.63	1.37

be a good measure for the whole FIRE sector. For this reason, we used the state share of gross production for which data are available for each year.

[86] U.S. Bureau of the Census, *Census of Retail Trade* (Washington, D.C.: 1972, 1977, 1982, 1987, 1992 and 1997).

[87] U.S. Bureau of the Census, *Census of Wholesale Trade* (Washington, D.C.: 1972, 1977, 1982, 1987, 1992 and 1997).

Maryland's Share of U.S. Sales in Service Industries (%)[88]

1972	1977	1982	1987	1992	1997
2.00	1.87	2.01	2.26	2.24	2.17

[88] U.S. Bureau of the Census, *Census of Service Industries* (Washington, D.C.: 1972, 1977, 1982, 1987, 1992 and 1997).

Appendix 4. Derivation of the Cost of Capital

The rental cost of capital that producers are required to pay (r) is determined by the equilibrium condition where the present value of the future income stream to the owner of capital (i.e., household, HH) is equal to the price of capital. In other words, HH investors would be willing to give up one dollar of current consumption in order to hold one dollar of capital only if the present value of the income stream (i.e., net of taxes and net of depreciation return of capital) is at least one dollar. Let:

K = price of capital (e.g., cost of new machine or equipment);
R = rental charge for capital including tax costs, i.e., rental cost to firms; and
R_n = net of tax rental income to capital owner.

Then, in equilibrium, the following must hold:[89]

(A4.1) $$K = \int_0^{SL} R_n e^{-(r+d)t} dt ,$$

where
SL = service life of capital asset,
r = real discount rate, and
d = capital consumption rate or replacement rate.

Investors who own corporate shares deduct corporation income tax liability from their portion of the corporation's net income before taxes; the investors then pay personal income taxes on capital gains and on any dividends paid out to them by the corporation. Then, R_n is obtained as:

(A4.2) $$R_n = R-(T_c + T_k),$$

where

$T_c = T_{fc}+T_{sc}$ is the sum of federal and state corporate income tax, and

$T_k = T_{fk}+T_{sk}$ is the sum of federal and state personal income taxes on capital income.

Also, T_{fc} and T_{sc} are calculated as:

(A4.3) $$T_{sc} = t_{sc}(R - D),$$

[89] Robert E. Hall and Dale W. Jorgenson, "Tax Policy and Investment Behavior," *American Economic Review* 57 (June 1967): 391-414.

(A4.4) $T_{fc} = t_{fc}(R\text{-}D\text{-}T_{sc})$,

where:

t_{sc} = state tax rate on corporate income;

t_{fc} = federal tax rate on corporate income; and

D = depreciation allowed for tax purposes.[90]

Then T_c is obtained from (A4.3) and (A4.4) as:

(A4.5) $T_c = (t_{fc}+t_{sc})(R\text{-}D)\text{-}t_{fc} * t_{sc}(R\text{ -}D) = \tau_c(R\text{ -}D)$,

where:

(A4.6) $\tau_c = t_{fc}+t_{sc}\text{-}t_{fc} * t_{sc}$.

Post-tax corporate profits are distributed to the investors who own corporate shares in the form of dividend income and/or capital gains. They then pay personal income taxes on dividends and capital gains. Now T_k is calculated as follows:

(A4.7) $T_k = T_{fk} + T_{sk} - T_{fk} * T_{sk}$.

Here T_{fk} is given by

(A4.8) $T_{fk} = t_{fk}(R\text{-}D\text{-}T_c) = t_{fk}(R\text{-}D\text{-}T_c)$,

where t_{fk} = federal tax rate on individual capital income.[91] Hence

(A4.9) $T_k = t_{fk}(R\text{ -}D\text{-}T_c)$.

Assuming that individual capital income takes the form of dividends and capital gains, t_{fk} is calculated as:

(A4.10) $t_{fk} = t^{d}_{fk}\ d_r + t^{q}_{fk}\ (1\text{-}d_r)$,

where

t^{d}_{fk} = federal tax rate on dividend income;

t^{q}_{fk} = federal tax rates on capital gains; and

[90] We assume that the depreciation allowed for federal tax purposes is the same for state tax purposes.
[91] Since we assume that the supply of capital is perfectly elastic due to perfect capital mobility in the U.S., t_{fk} is the tax rate on capital income applied to all U.S. residents.

d_r = the ratio of dividend income to the total of dividend income and capital gains.

Now substitute (A4.5) and (A4.9) into (A4.2) to rewrite R_n as:

(A4.11) $R_n = R - (T_c + T_k)$

$= R - [(R-D)t_{fk} - T_c t_{fk} + T_c]$

$= R - [t_{fk}(R-D) + (1-t_{fk}) t_c (R - T_p - D)]$

$= R - T_p - (R-D)(t_{fk} + (1-t_{fk}) t_c)$

$= (1-t_{ck})(R) + t_{ck} D$,

where :

(A4.12) $t_{ck} = \tau_c + t_{fk} - t_{fk} * \tau_c$.

Now substitute (A4.11) into (A4.1) to get:

(A4.13) $K = \int_0^{SL} [(R)(1-t_{ck})]\, e^{-(\rho+d)t} dt + \int_0^{SL} t_{ck} D e^{-(\rho+d)t} dt$

$$= \frac{-(R)(1-t_{ck})(e^{-(r+d)SL} - 1)}{(r+d)} + t_{ck} \int_0^{SL} (D e^{-(\rho+d)t}) dt$$

$$= \frac{R(1-t_{ck})}{(r+d)} + t_{ck} \int_0^{SL} (D e^{-(\rho+d)t}) dt ,$$

for $e^{-(r+d)SL} \approx 0$, which will be true for $SL \to \infty$.

The implicit rental *rate* of capital (or the cost of capital to producers), r, is then defined as the ratio of R to K,

(A4.14) $r \equiv R/K$.

As shown in (A4.13) and (A4.14), the structure of federal and state taxes and the depreciation method affect r. To get the closed form solution for r, the depreciation that is a function of K and t needs to be specified.

The second term on the right hand side of (A4.13) is the present value of the tax benefits of depreciation allowances (TBD), expressed in continuous time. It may be rewritten as

$$TBD = t_{ck} \int_0^{SL} (De^{-dt}) e^{-rt} dt \equiv t_{ck} \int_0^{SL} A e^{-rt} ,$$

where De^{-dt} measures the depreciation allowed in any given time period and $e^{-\rho t}$ discounts this allowance to the present. In discrete form this gives

$$TBD = t_{ck} \sum_{0}^{DL} \frac{A_t}{(1+r)^t},$$

where A_t is the depreciation allowed for tax purposes by the federal government for recovery year *t*. Note that the depreciation allowance is summed up over *DL* years, reflecting the tax depreciation life of the asset.

Federal tax law stipulates the depreciable life for various types of capital and the recovery allowance percentages for each recovery year. Assuming that the depreciable basis is equal to the value of capital, the depreciation allowed for year *t*, A_t, is:

(A4.15) $A_t = \alpha_t K$, for $1 \leq t \leq DL$; otherwise, 0,

where α_t is the recovery allowance percentage for recovery year *t*. With these changes, equation (A4.13) is modified to give

(A4.16) $$K = \frac{R(1-t_{ck})}{(r+d)} + t_{ck} \sum_{t=1}^{DL} \frac{a_t K}{(1+r)^t}.$$

Solving for *r* (=*R/K*) yields

(A4.17) $$r = \frac{R}{K} = \frac{(r+d)(1-t_{ck}C)}{(1-t_{ck})},$$

where

$C = \sum_{t=1}^{DL} \frac{a_t}{(1+r)^t}$ and $C < 1$.

a. Numerical Example of Calculation of C

The depreciation for federal tax purposes is currently based on the Modified Accelerated Cost Recovery System (MACRS). Under MACRS, the depreciable life is seven years for most industrial equipment, office furniture and fixtures, and the recovery allowance percentages, α, are as follows:

Recovery Allowance Percentages under MACRS

Recovery Year	1	2	3	4	5	6	7	8
Recovery allowance percentages, α, in %	14	25	17	13	9	9	9	4

Suppose that the discount rate (r) is 10 percent, and the depreciation method is based on MACRS with a depreciable life of seven years. Then, we get:

$$(A4.18) \qquad C = \sum_{t=1}^{DL} \frac{a_t}{(1+r)^t} = \frac{.14}{(1+.1)} + \frac{.25}{(1+.1)^2} + \frac{.17}{(1+.1)^3} + \frac{.13}{(1+.1)^4} + \ldots + \frac{.04}{(1+.1)^8} = 0.722.$$

b. Data on a

The recovery allowance percentage, a, varies depending on the depreciation method specified in the tax laws, as follows.

Depreciation Methods for Federal Tax Purposes

Years	Method
1986-present	Modified Accelerated Cost Recovery System (MACRS)
1981-1985	Accelerated Cost Recovery System (ACRS)
1954-1980	Accelerated method (sum-of-years'-digits, SYD)

c. Modified Accelerated Cost Recovery System (MACRS)

Under MACRS, a sample of the depreciation life allowed for tax purposes is:

DL = 3 years for certain special manufacturing tools,

DL = 5 years for automobiles, computers, certain manufacturing equipment,

DL = 7 years for most industrial equipment, office furniture and fixtures,

DL = 10 years for certain longer-lived types of equipment.

The Recovery Allowance Percentages are:

	Class of investment		
Recovery year	3-year, %	5-year, %	7-year, %
1	33	20	14
2	45	32	25
3	15	19	17
4	7	12	13
5		11	9
6		6	9
7			9
8			4

d. Accelerated Cost Recovery System (ACRS)

Under ACRS, a sample of the depreciation life allowed for tax purposes is:

DL = 3 years for autos, research and experimental equipment and certain special tools,

DL = 5 years for all other machinery and equipment,

DL = 10 years for certain public utility property, residential manufactured homes.

The Recovery Allowance Percentages are shown here.

	Class of investment		
Recovery year	3-year, %	5-year, %	10-year, %
1	25	15	8
2	38	22	14
3	37	21	12
4		21	10
5		21	10
6			10
7-10			9

e. Sum of the Years' Digits (SYD) Method

The Internal Revenue Code of 1954, which authorized taxpayers to use the SYD method, does not specify the depreciation life allowed for tax purposes for different property classes; the SYD method does not provide any guidelines regarding different recovery periods. The depreciation percentages by ownership years under SYD are shown here.

	Class of investment			
Ownership Year	3-yr, %	5-yr, %	7-yr, %	10-yr, %
1	50.00	33.33	25.00	18.18
2	33.33	26.67	21.43	16.36
3	16.67	20.00	17.86	14.55
4		13.33	14.29	12.73
5		6.67	10.71	10.91
6			7.14	9.09
7			3.57	7.27
8				5.45
9				3.64
10				1.82

Appendix 5. Estimation of the Employer's Benefit Cost

We measure the employment benefit cost to the employer using employer's insurance cost as a percent of wages and salaries (v_b). Insurance cost includes the cost of life, health, sickness and accident, and long-term disability insurance.[92] Since the data on insurance cost are available only after 1986, we estimate the cost for 1975 – 1985 using the data on social insurance expenditures and other labor taxes as a percent of "pay for time worked" for production workers in the U.S., (*SI*), which is available from 1975 and after.[93] *SI* includes not only insurance benefit expenditures, but also expenditures for legally required insurance programs.[94] Thus, in estimating v_b for 1975 – 1986 it is necessary to follow the following three steps:

(1) We apply the annual growth rate of *SI* for each of 1976 – 1986 to the sum of v_b and employer's legally required benefit cost (LRB), to obtain the estimated value of v_b + *LRB* for 1975 – 1985.[95]

(2) Since data on *LRB* is also only available from 1986 forward, we estimate *LRB* for 1975 – 1985 by (1) calculating the average ratio of *LRB* to the effective social security tax rate (*SST*) for 1986 – 1998, which was 1.615 and then (2) applying this ratio to *SST* for 1975 – 1985.[96]

(3) Then v_b for 1975 – 1985 is computed by subtracting *LRB* from (v_b + *LRB*) as estimated in step 1.

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[92] The data on insurance cost are not available by states. We used U.S. data in our estimation from the U. S. Department of Labor, Bureau of Labor Statistics, *Employer Costs for Employee Compensation, 1986-1998* (Washington D.C.: June, 2001) available from http://stats.bls.gov/news.release/ecec.toc.htm; Internet; accessed July 24, 2001.

[93] "Pay for time worked" includes basic time and piece rates plus overtime premiums, shift differentials, other premiums and bonuses paid regularly each time period, and cost of living adjustments. U.S. Department of Labor, Bureau of Labor Statistics, *International Comparison of Hourly Compensation Costs for Production Workers in Manufacturing, 1975-1999* (Washington, D.C.: 2000) available from http://stats.bls.gov/flshcind.htm; Internet; accessed July 24, 2001.

[94] Data on social insurance expenditures include employer's expenditures for legally required insurance programs and contractual and private benefit plans including health insurance, life and accident insurance and retirement pensions.

[95] The data on *LRB* is obtained from the same source as the data on v_b.

[96] *SST* is calculated by BHI.

Appendix 6. Estimation of Economic Effects for 2005

In estimating the economic effects of each plan for 2005, we follow the same general methodology described above for 2002. To accomplish this we make 2005 projections for health insurance and Medicaid premiums and for the uninsured population.

Estimation of 2005 Insurance Premiums

We estimate premiums for each year through 2005 using published health insurance premium growth rates for the period 1996-2000. Because growth-rate data are not available separately for individual premiums and for family premiums for 1996-1998, we use the annual average growth rates for combined individual and family premiums reported for 1996-2000 by the Kaiser Family Foundation for the South Region in the *Survey of Employer-Sponsored Health Benefits*, 2000.

We assume that 2001 and 2002 growth rates are equal to the 2000 growth rate, in view of the fact that the Foundation predicts future premiums increases at least at the same rate as in 2000. The calculated average growth rate is 4.84 percent for the period 1996-2002. Applying that growth rate to our estimated 2002 premiums – $3,077 for a single individual and $7,315 for a family – we estimate the 2005 premiums to be $3,545 and $8,429, respectively.

Estimation of 2005 Average Medicaid Expenditure

We apply the annual average growth rate of 2.56 percent calculated over the period 1996-1999 for the average Medicaid expenditure (see Method I) to our estimated 2002 average cost for individuals in eligible families, $2,303, to obtain the 2005 average cost for individuals in eligible families, $2,484. We assume that, in 2005 as in 2002, 69 percent of uninsured persons fall under 300 percent of the federal poverty level.

Estimation of 2005 Uninsured Population

In order to estimate the number of uninsured persons in 2005, we determine that the average ratio of uninsured persons to the total Maryland population over the period 1995-1998 was 14.18

percent.[97] We apply this ratio to the 2005 Maryland population, projected by the U.S. Bureau of the Census to be 5,467,125, and estimate the number of uninsured individuals in 2005 to be 1,135,357. We assume the same distribution of families and single adults both in the uninsured employed and uninsured unemployed populations as in 2002.

[97] U.S. Bureau of the Census, *Health Insurance Coverage*, (Washington D.C.: 1995, 1996, 1997, 1998) available from: http://www.census.gov/hhes/www/hlthins.html, accessed July 15, 2001.