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UNEMPLOYMENT AND WELFARE IMPLICATIONS OF THE CURRENT U.S. TAX TREATMENT OF EMPLOYER-PROVIDED MEDICAL INSURANCE

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The U.S. tax system currently provides an incentive for individuals to obtain medical insurance through their employers. This unique tax treatment is widely excoriated as resulting in high costs and distorting consumption decisions. To study this issue, we develop a general equilibrium search model with endogenous health accumulation and a unique feature of the U.S. tax code, which exempts employer-provided medical benefits from taxation, to jointly account for the U.S. long-term unemployment rate and medical expenditure-to-aggregate consumption ratio. Through various counterfactual experiments, we find that (1) eliminating the employment-based tax subsidy lowers medical expenditure but, via a general equilibrium labor market effect, increases unemployment and lowers output, and contrary to conventional wisdom, lowers welfare; (2) having government raise taxes to finance the provision of medical care substantially increases the unemployment rate, while reducing income and welfare.

Keywords: Unemployment, Taxation, Medical Insurance

1. INTRODUCTION

The current U.S. tax code allows compensation in the form of employer-provided medical insurance to be free of taxation. This tax structure is an anomaly dating back to World War II, to be explained in the following, that is unique to the U.S. economy. This distinctive tax treatment is widely excoriated as distorting consumption decisions, resulting in overconsumption of medical services relative to other commodities, and a loss in welfare. Support for this notion can be found in the observation, to be illustrated in the following, that the medical sector occupies a much larger share of aggregate spending in the United States, than in most OECD countries. At least since the argument made by Feldstein and Friedman

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(1977), the conventional wisdom has been that the resulting welfare cost of such a distortion in consumption can be "very large." Based on this assessment, Feldstein and Friedman urged that "eliminating the special tax subsidies of health insurance premiums should be a high priority subject for tax reform." This consensus view seems to be shared by policymakers who have been investigating ways to reduce medical expenditure [e.g., Congressional Budget Office (2009)].

The objective of the current paper is to suggest a potentially important countervailing effect of the special tax treatment of employer-provided medical insurance on labor market decisions: Unemployed workers may search harder to find a job and employed workers may work harder to retain a job, in order to obtain and maintain tax-exempt medical benefits.[1] This can result in a higher transition rate from unemployment to employment, a lower transition rate from employment to unemployment,[2] and thus a lower unemployment rate and a higher output level. Support for this notion can be found in the observation, illustrated in the following, that the United States has a relatively low unemployment rate and the U.S. workers typically work longer hours (and conceivably work harder) than in most OECD countries. It has also been documented that gross job and worker flows are larger and unemployment durations are shorter in the United States than in most European countries [e.g., Layard et al. (1991), Pries and Rogerson (2005), Bassanini and Marianna (2009)].

In the framework of this paper, the tax exemption for employer-provided medical insurance will have several impacts: on one hand it will lower unemployment and raise output and income, but on the other hand it will result in greater effort and total hours worked. These forces have opposite effects on households' utility, and the latter negative effect exacerbates the efficiency cost of overconsumption of medical services relative to nonmedical commodities resultant from the preferential tax treatment. The net effect that this would have on welfare in general equilibrium is not only of a theoretical curiosity, but also of considerable policy interest and concern.

To aid our investigation of this issue, we construct a general equilibrium model with labor market search, and with endogenous health accumulation, coupled with the unique feature of the U.S. tax system that allows the purchase of employer-provided medical insurance to be tax-exempt. Our analytical framework generalizes Grossman's (1972) classic formulation of demand for health into a variant of the neoclassical growth model with the special tax code. The model is augmented to include job market search and transitions into and out of employment and unemployment, to capture the notion that government policies or institutions can influence individuals' incentives to seek and retain jobs. In our model, the effort exerted by an unemployed worker to find a job and that by an employed worker to retain a job affect the job finding and separation probabilities. But such effort bears utility costs. As is consistent with the postwar U.S. experience, worker compensation in the model includes not only the taxable wage, but also nontaxable medical benefits provided through the employer. On the other hand, the workers derive utility from not only their consumption of nonmedical commodities, but also from

their health capital, which is subject to a natural rate of depreciation, and which can also be accumulated through obtaining health care services. Production and physical capital accumulation are modeled in a standard way, as in the standard neoclassical framework, and the government taxes labor and capital income to finance its spending. The model that is presented here is thus intended to capture various important features of the current U.S. system. We wish to emphasize at the outset that our paper is not about health insurance per se. Rather, it focuses on how the special tax treatment of employment-based health insurance affects the incentives that workers have to obtain or maintain employment, and to consume medical commodities.[3]

As we will show hereafter, the model can jointly account for the labor market and health care expenditure data discussed previously, in particular, the U.S. long-term unemployment rate and medical expenditure-to-aggregate consumption ratio. Health care services are a significant fraction of total consumption and output in our model, as in the data, and thus the mechanism by which medical services are allocated has a significant impact on search effort and employment decisions in the model, as in the current U.S. economy. Therefore, the model captures the fact that American workers may seek employment, in part, based on the payoff in terms of tax-exempt medical coverage provided through the employment relationship, along with many of the other salient features of the current U.S. system. This will then permit the study of how alternative tax treatments for medical expenditures influence the transition rates of workers to and from employment and unemployment, and in turn affect the durations of unemployment and employment spells, unemployment rate, output, and welfare. In sum, the model is useful in that it can be used to study the impact that various mechanisms for the allocation of medical services can have on aggregate economic outcomes.

We then use the model to conduct a series of counterfactual experiments based on this line of thinking. In these experiments, aggregate economic outcomes from our benchmark model, with employer-provided medical benefits being tax-exempt, which is meant to proxy the current U.S. economic system, are compared with those obtained in alternative systems. One alternative considered is a system in which individuals purchase their own health care services without preferential tax treatment. A second alternative is a system in which the government provides health care services to the entire population. Last, as a useful point of comparison, a laissez-faire system is also studied in which all distortional policies are removed and there is no government intervention at all.

Our main findings here are summarized as follows. First, we consider eliminating the special tax treatment of employment-based medical benefits, while maintaining all other institutional features and government policies. *This results in a net loss rather than gain in welfare*. On one hand, this partial reform leads to more efficient substitution between the two types of commodities, with the consumption of medical services falling relative to that of nonmedical goods. This represents an efficiency gain in the market for goods. On the other hand, the partial reform reduces workers' incentive to seek employment because of the lost tax

shelter. Both the effort by unemployed workers to search for jobs and that by employed workers to maintain jobs are lower. Thus the transition rate from unemployment to employment is lower and that from employment to unemployment is higher. This results in a higher rate and longer duration of unemployment, and a lower rate and shorter duration of employment. Additionally, the level of physical capital is also lower. Consequently, aggregate output and income are lower. Even after the reduced disutility due to the lowered employment effort is taken into account, the effect from the lost capital, production, and income due to the depressed labor market activities more than offsets the efficiency gain from improved substitution in the goods market. The net effect is a *welfare loss*. To gain some perspective on the magnitude of this welfare loss, it is compared with the welfare gain that would result from a laissez-faire system in which there was no government intervention in the economy at all.

Next, we consider having the government provide health care services to the entire population. Whether this policy is financed by raising the labor (or capital) income tax rates, or by cutting the existing government spending while maintaining the current tax rates, it results in substantial increases in the unemployment rate and decreases in output and welfare. The results are dramatically worse if the tax rates are raised to finance the government-run health care program.

The rest of the paper is organized as follows. In Section 2, we present some observations on health care and the labor market for a group of countries to further motivate our study. We proceed to set up our model in Section 3, and to derive and explain the model's equilibrium conditions in Section 4. In Sections 5 and 6, the model is parameterized to conform to the observed behavior of the United States under the current tax system. Here we show that the model can jointly account for the labor market and health care expenditure data of the United States. In particular, the focus here is on the U.S. long-term unemployment rate and medical expenditure- to-aggregate consumption ratio. Section 7 is focused on analyzing the consequences of the partial reform, and Section 8 is devoted to analyzing the behavior of the government regime, both using our baseline model framework. Some final remarks can be found in Section 9.

2. SOME OBSERVATIONS ON HEALTH CARE AND THE LABOR MARKET

The current U.S. tax code enables employers to compensate their employees by providing them with medical benefits, and neither the employers nor the employees are required to pay taxes on this form of compensation. This tax structure is an artifact that dates back to World War II. During that time, wage and price controls were in place and, because of this and the fact that the war itself also contributed to a shortage of labor, employers were grappling with the issue of how to compete in attracting scarce labor. It was then ventured that employers might try to offer nonwage compensation, and in particular, medical insurance. In summary, this feature of the tax code does not appear to be the result of any well-conceived or well-designed process, with economic efficiency in mind. Because aggregate

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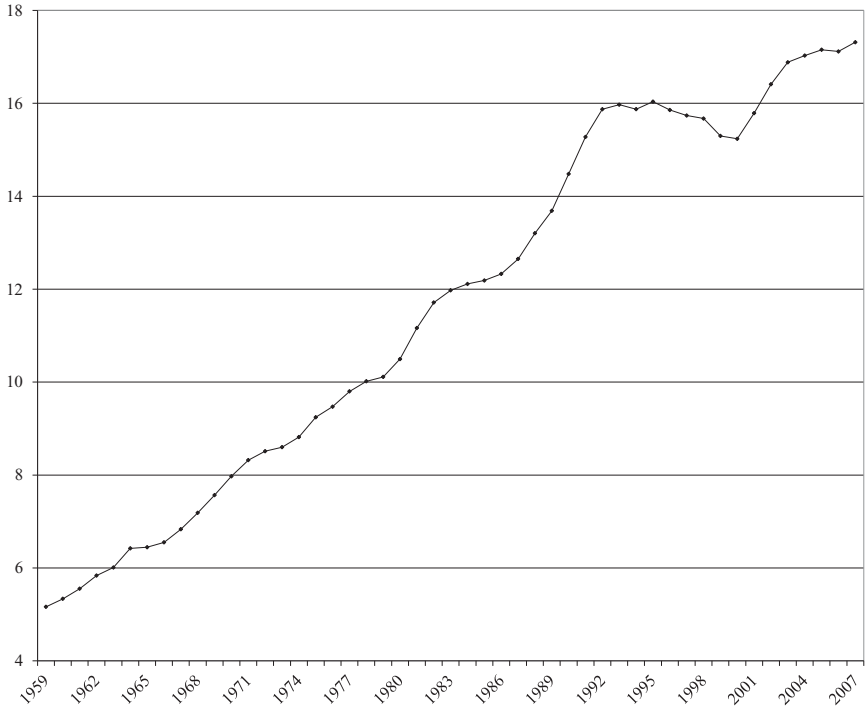

FIGURE 1. Medical consumption as a percentage of total private consumption in the United States.

expenditures on health care were comparatively small at that time, the effect of this policy was thought to be inconsequential.

As the population has aged, and increased incomes have combined with important (and increasingly expensive) medical breakthroughs, expenditures on medical services have outpaced other types of expenditures. Because the tax code permits individuals to obtain these medical services tax-free, through their employers' plans, this has only increased the amount of medical services that individuals have sought to purchase. It is now a much-publicized fact that health care expenditures have grown substantially in recent decades. This is illustrated in Figure 1, which shows the share of private consumption expenditure that is devoted to medical services in the United States.[4] As can be seen from the figure, this fraction grew from just 5% in 1959 to over 17% in 2008. Even the "dip" that is present during the 1990s is a period in which the consumption of medical services actually rose, just not as much as other components of private consumption.

This is further illustrated by Figure 2.[5] This figure shows that growth in real wages in the United States, from 1983 until 2005, was very low. In fact, the cumulative growth in real wages over this period was only 12.5%. However,

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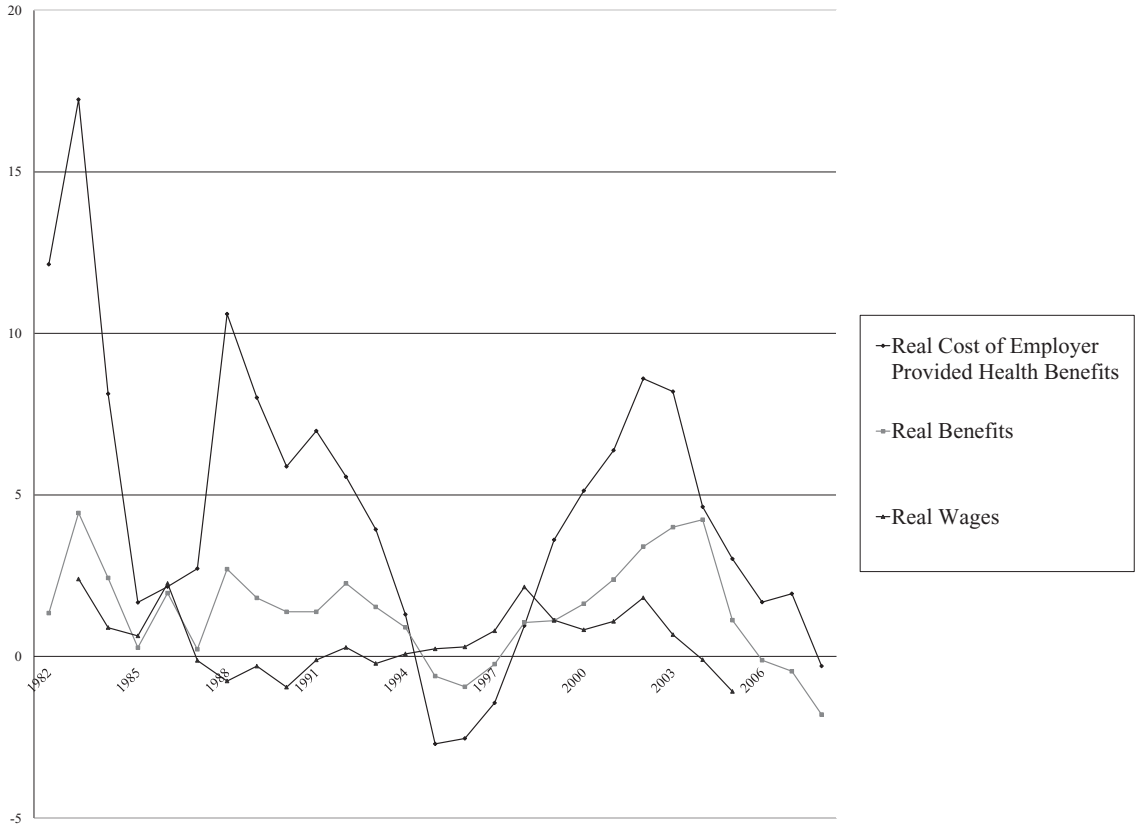

FIGURE 2. Growth rates of real wages and health benefits and costs (%).

the total growth in real benefits, per hour worked, over this same period was 46%. Perhaps the most important portion of these benefits is employer-financed medical care. From 1983 until 2005 the cumulative growth in the real cost of private industry health insurance, per hour worked, was 182%! It is clear that there has been a dramatic shift in labor compensation from wages, which are taxable, to other forms of compensation, such as medical insurance or care, which are tax-exempt.

This special tax structure is unique to the United States.[6] This may help explain, without precluding other potential explanations, why medical expenditure is much higher in the United States than in most OECD countries. As is clear from Figure 3, although total health care expenditure as a fraction of GDP has generally risen in all countries (for reasons not explored in this paper), it has been persistently higher in the United States than in the other countries. The difference in health care expenditure between the United States and the other countries—to the extent that it is related to the special tax structure—is more striking than Figure 3 shows, because this figure illustrates the fraction of *all* spending that is devoted to medical expenditures, including both private and government spending.[7] However, the United States has a much smaller share of health care expenditure that is paid for by public funds than the other countries have (this can be seen from Figure 4). It is worth pointing out that, although the share of public expenditure on health care as a percentage of total health expenditure is smaller in the United States than in the other countries, the United States actually has a larger *total* amount of public health expenditure per capita than most of the other countries, as is apparent from Figure 5. Here the important and relevant point is that U.S. private health care expenditure is relatively even greater, and because much attention has been devoted to this fact, this is a focal point of the decision-making of U.S. families or households.[8]

It is a message of this paper that the special tax treatment of employer-provided medical benefits may promote the incentives that U.S. workers have to seek and maintain employment. This may help explain, once again without excluding other potential accounts, the observed differences in labor market outcomes between the United States and other OECD countries. For instance, Table 1 shows the average annual unemployment rates for a variety of countries from 2000 until 2008. It is clear from the table that the United States has a comparatively low unemployment rate when compared with other countries. In fact, the average unemployment rate for the Eurozone countries over this period was 8.3%, whereas that of the United States was 5.1%. The table further indicates that in the United States workers typically work more hours than in most European countries. Also, as is discussed in the Introduction, gross job and worker flows are considerably smaller, unemployment durations are considerably longer, and the ratios of aggregate employment to working age population are consistently lower in most European countries than in the United States. The vastly different patterns of employment and unemployment between the United States and the European countries are well documented, and have been known for quite some time. It is our view that these

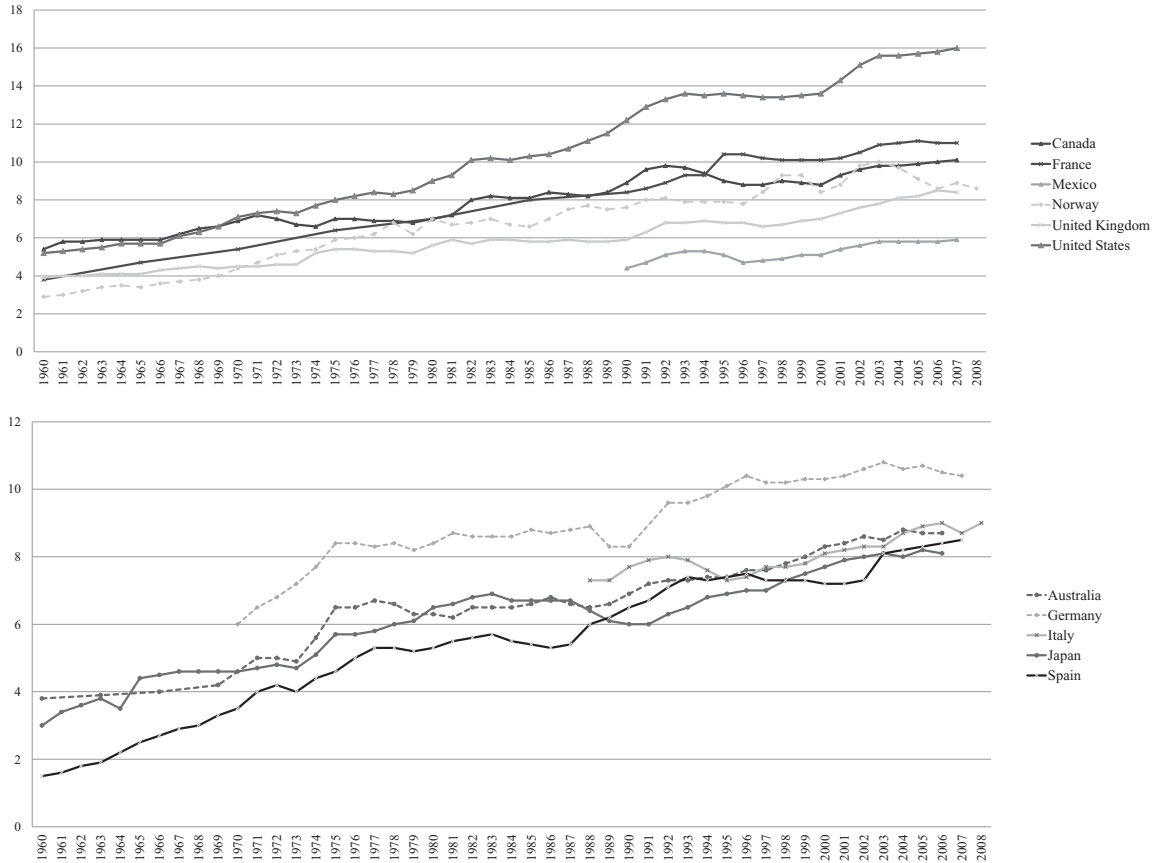

FIGURE 3. Total health care expenditure as a percentage of GDP.

FIGURE 4. Public expenditure on health care as a percentage of total health expenditure.

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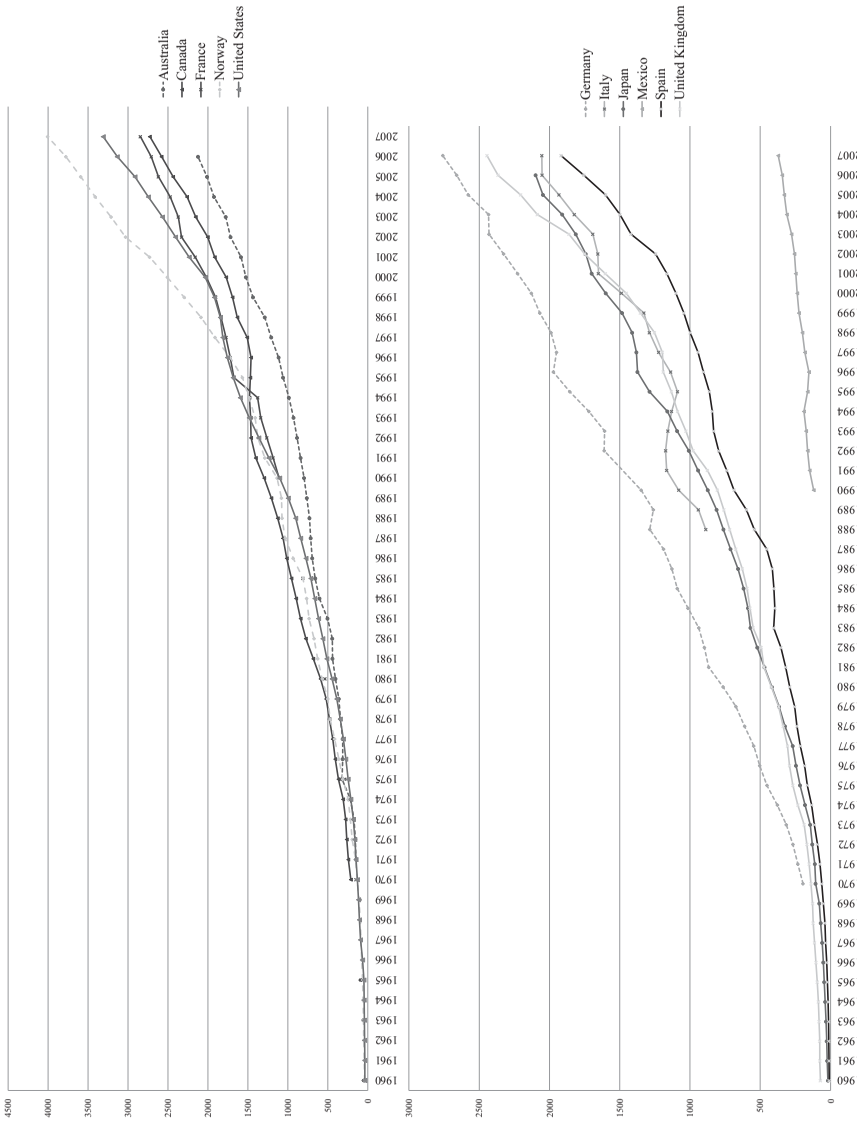

FIGURE 5. Public expenditure on health care (US$ per capita).

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TABLE 1. Unemployment rate and hours worked

	Unemployment rate (%)	Average annual hours worked per worker
Austria	4.3	1,650
Belgium	7.7	1,565
Canada	6.9	1,744
Czech Republic	7.2	2,001
Denmark	4.5	1,586
Finland	8.3	1,725
France	8.7	1,555
Germany	8.7	1,443
Greece	8.0	1,827
Hungary	6.6	2,008
Italy	8.0	1,827
Japan	4.6	1,792
Korea	3.6	2,421
Netherlands	3.4	1,374
Norway	3.5	1,421
Poland	15.7	1,981
Portugal	6.4	1,754
Slovak Republic	15.9	1,759
Spain	10.2	1,684
Sweden	6.0	1,610
Switzerland	3.6	1,654
UK	5.2	1,683
US	5.1	1,806

Source: Organisation for Co-operation and Economic Develoment. Data are annual averages from 2000 until 2008.

cross-country differences in labor market outcomes may in part have to do with the different medical insurance schemes in the various countries.

In summary, it is clear that, compared with many European countries, the United States has for some time simultaneously spent more on medical care, with a unique tax system for subsidizing this spending through an employment relationship, and had a lower unemployment rate. It is a message of this paper that these two observations may be related to each other, and the model presented next will illustrate this connection.

3. THE MODEL

Our analytical framework integrates endogenous health accumulation into a variant of the neoclassical growth model with labor and capital income taxes, augmented to include job market search and transitions into and out of unemployment, and a unique feature of the U.S. tax code, under which employer-provided medical benefits are tax-exempt. The model presented here is intended to capture various

important features of the current U.S. economic system that are essential to address the topic at hand.

There is a measure one of households each containing a measure one of potential working families that may differ in their employment statuses. To preserve simplicity, but without loss of generality or insight, we assume that the families within each household can perfectly insure each other against variations in their labor income due to variations in job status. This feature of the model is similar to that of Merz (1995), and one such insurance scheme is described in Andolfatto (1996).

At each date t, each of the households derives utility from its total consumption of nonmedical goods and services for the date, c_t, and its total health stock at that date, h_t, as specified by a period utility function, $U(c_t, h_t)$, which is strictly increasing, strictly concave, and twice continuously differentiable in both of its arguments. The stock of health at date t is derived from its total consumption of medical goods and services at that date, m_t, and its health stock at the previous date, h_{t-1}, subject to a natural rate of depreciation, ρ, as governed by the following law of motion:

$$h_t = (1 - \rho)h_{t-1} + m_t. \tag{1}$$

This approach to modeling endogenous health accumulation generalizes Grossman's (1972) notion of the consumption motive for health care.[9]

At the same time, the household also determines how much effort each of its currently employed families should expend to keep its job, and how intensely each of its currently unemployed families should search for a job. The household cares about the disutility of each of its employed families resulting from exerting effort, a_{1t}, in trying to maintain a job, and of its unemployed families resulting from exerting effort, a_{2t}, in trying to obtain a job. This disutility is then characterized by the function $V(a_{1t}, a_{2t}; n_t)$, which is strictly decreasing, strictly concave, and twice continuously differentiable in the first two arguments, and is concave and twice continuously differentiable in the third argument, n_t, which is the fraction of the families within the household that are employed at date t, and thus, $(1 - n_t)$ is the fraction of the families within the household that are currently unemployed. Although the cost of such effort is measured in units of foregone utility or leisure, they could be interpreted broadly as any resources expended on retaining or obtaining employment.

The household's expected discounted lifetime utility can then be expressed as

$$\mathrm{E}\sum_{t=0}^{\infty} \beta^t \left[U(c_t, h_t) + V(a_{1t}, a_{2t}; n_t)\right], \tag{2}$$

where E is the expectation operator and β is the household's subjective discount factor.

An important characteristic of the model is that the effort exerted by the working families influences their transition probabilities into and out of employment and

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unemployment. This is meant to capture the idea that members of the labor force can exert effort, or can otherwise make decisions, that influence their likelihood of obtaining, or of maintaining, employment. To put this into notation, an employed family expending effort a_{1t} in period t will have a probability $\theta_1(a_{1t})$ of retaining the job in period $t+1$, and an unemployed family expending effort a_{2t} in period t will have a probability $\theta_2(a_{2t})$ of obtaining a job in period $t+1$, where the two probabilities are strictly increasing, strictly concave, and twice continuously differentiable in the corresponding effort levels. This search-matching technology implies the following law of motion for the fraction of employed families within the household:

$$n_{t+1} = \theta_1(a_{1t})n_t + \theta_2(a_{2t})(1 - n_t). \tag{3}$$

This approach to modeling how effort affects disutility and the transition probabilities into and out of unemployment are similar in spirit to those specified in Wang and Williamson (1996).

A defining feature of the model is that an employed family can obtain health care tax-free through the employment relationship. The post-tax unit labor compensation to a working family, $\bar{w}_t$, is then split into two components, a post-tax wage w_t and a tax-exempt medical benefit m_t^{b}, such that

$$\bar{w}_t = w_t + m_t^{\mathrm{b}}. \tag{4}$$

This employment-based tax shelter on medical care effectively ties the household's decisions on endogenous health accumulation and consumption to its decisions on labor market effort and, therefore, transitions into and out of employment and unemployment. The general equilibrium interactions between these multiple, yet interrelated dimensions in decision making by the household are central to our analysis of the current U.S. system and our various counterfactual experiments.

The household's budget constraint at date t is then given by

$$c_t + m_t + k_{t+1} = \bar{w}_t n_t + (1 + \bar{r}_t)k_t + g_t, \tag{5}$$

where $\bar{r}_t$ is the post-tax return on the household's holding of physical capital at date t, k_t, net of a capital depreciation rate δ, and g_t is a lump-sum transfer from the government to the household. Although it is up to the household to choose the level of its health care consumption, m_t, only those families with employed workers are entitled to the special tax subsidy, through their employment relationships, as is captured by the m_t^{b} component of $\bar{w}_t$ specified in (4). To make this latter point transparent, we recognize that the pre-tax unit labor cost to a firm, u_t, as the sum of a taxable wage and the compensation in the form of a nontaxable medical benefit, is given by

$$u_t = \frac{w_t}{1 - \tau_n} + m_t^{\mathrm{b}}, \tag{6}$$

where τ_n is the labor income tax rate. We can then rewrite the post-tax unit labor compensation to a worker as the sum of total compensation taxed at a uniform rate

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and a rebate for the amount of compensation in the form of medical benefits,

$$\bar{w}_t = (1 - \tau_n)u_t + \tau_n m_t^{\mathrm{b}}. \tag{7}$$

Using this expression, we can rewrite the household's budget constraint at date t as

$$c_t + \left[m_t - \left(\tau_n m_t^{\mathrm{b}}\right) n_t\right] + k_{t+1} = \left[(1 - \tau_n)u_t\right] n_t + (1 + \bar{r}_t)k_t + g_t. \tag{8}$$

As is clear from the second term in (8), only the employed families in the household (a fraction n_t) receive the tax rebate on medical benefits ($\tau_n m_t^{\mathrm{b}}$) specified by the last term in (7). The special tax treatment gives rise to a subsidy on consumption of the medical commodity to the extent that there is an employment relationship to back it up (and the benefits do not extend to outside of the family). It is in this sense that the tax shelter bundles the incentives that the workers have to seek or maintain employment with their families' needs for health insurance or care. This bundling holds the key to the paper's central mechanism for understanding the joint behavior of unemployment rate and medical expenditure-to-aggregate consumption ratio in the current U.S. economy and in our counterfactual analysis.

We shall keep our baseline model as simple as possible in order to focus on this central mechanism, and to isolate its role from other potential accounts of the current U.S. system. As is typically assumed, there are a large number of perfectly competitive firms, which rent capital and hire labor from the households to produce output. The representative firm has access to a production function, which generates $F(K_t, N_t; z_t)$ units of output from K_t units of capital and N_t units of labor inputs, under the level of technology z_t. The production function is of constant returns to scale with respect to the capital and labor inputs, and is strictly increasing, strictly quasi-concave, and twice continuously differentiable in both of these two variables. The firm's profit in period t is

$$F(K_t, N_t; z_t) - (r_t + \delta)K_t - u_t N_t, \tag{9}$$

where r_t is the pre-tax capital rental rate net of the capital depreciation rate δ, given by

$$r_t = \frac{\bar{r}_t}{1 - \tau_k}, \tag{10}$$

where τ_k is the capital income tax rate.

One simplification of our model has to do with the question of how hours worked and compensation for labor services, as well as its taxable and nontaxable components, should be determined, upon a successful search and matching. Instead of imposing an ad hoc, perhaps also necessarily complex multidimensional bargaining procedure, we deviate from much of the recent labor-market search-matching literature to adopt a more classical approach, along the line of Lucas and Prescott (1974). It is assumed that a matched worker supplies one unit of his time endowment as labor input inelastically; that he gets paid a competitive wage, in the sense that the pre-tax unit labor compensation is determined by the marginal

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product of labor; and that he also gets to determine the compensation structure that maximizes his household's expected lifetime utility. This feature of the model is consistent with the earlier specification of the search-matching technology under which the matching or separation probability is determined exclusively by the effort that a worker expends to search for a job, or to keep a job, without any explicit role for a firm posting a vacancy or engaging in the search activity at the same time. Because the model leaves no room for the firm to seek any surplus, it pays for both labor and capital inputs the competitive market values of their marginal products.[10] As such, because it has no bearing on profits, the firm does not care about the composition of the compensation into the wage and medical services component, as long as they add up to the same total value of compensation to labor. This permits the quantity of medical services to be chosen optimally by the household.

Another simplification of our model, already alluded to, and in contrast to much of the recent search-matching literature, is the absence of any externalities in the search-matching technology in the model. That is, the likelihood of an unemployed family obtaining a job, or of an employed family losing a job, is unrelated to the aggregate quantity of employed or unemployed families in the economy.

The model also abstracts from unemployment insurance and other government programs that may create impediments to individuals obtaining and maintaining employment. In our benchmark model, it is assumed that the government rebates the labor and capital income tax revenues to the households in the form of a nondistortional lump-sum transfer,

$$g_t = \tau_n \frac{w_t}{1-\tau_n} N_t + \tau_k r_t K_t. \tag{11}$$

The main focus here will be on how the distinctive tax treatment of employer-provided health benefits affects the incentives that workers have to obtain or maintain employment, and to consume medical commodities. For this purpose, the model also abstracts from transitions into and out of the labor force.[11]

Although this model has the maximum degree of simplicity, it exhibits all the features necessary to address the topic at hand. The endogenous health accumulation and labor-market search-matching features of our model enable it to account jointly for U.S. long-term unemployment rate and medical expenditure-to-aggregate consumption ratio. These features of the model are critical for evaluating how the various tax or spending policies, as they pertain to the treatment of the medical commodity, would influence the unemployment rate and duration, and, ultimately, the welfare of individuals. Our view is that it is important to understand the effects that the current tax policy for medical care and various contemplated reforms can have on employment incentives and the transition probabilities into and out of unemployment, and that our model presented in the preceding provides an arguably simplest possible general equilibrium framework for conducting these thought experiments.

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4. EQUILIBRIUM

In this section we provide a general characterization of the model's equilibrium conditions. Letting γ denote the fraction of the medical good that a working family chooses to consume that can be qualified as tax-exempt benefits (i.e., $m_t^{\mathrm{b}} = \gamma m_t$), we can rewrite the household's budget constraint in period t as

$$c_t + (1 - \gamma\tau_n n_t)m_t + (k_{t+1} - k_t) = (1 - \tau_n)u_t n_t + \bar{r}_t k_t + g_t. \qquad (12)$$

The right-hand side of this equation is the sum of total labor compensation taxed at a uniform rate, the post-tax return to capital net of depreciation, and any transfer from the government, whereas the left-hand side is the sum of consumption of the nonmedical good, consumption of the medical commodity net of any tax rebate that accompanies it through an employment relationship, and net investment in physical capital.

At each date t, a household chooses $c_t > 0$, $m_t \in (0, u_t/\gamma]$, $a_{1t} \geq 0$, $a_{2t} \geq 0$, $k_{t+1} \geq 0$, and $n_{t+1} \geq 0$ to maximize the expected utility subject to the laws of motion for employment and health, as well as the budget constraint, taking as given the initial conditions k_0, h_{-1}, and n_0, unit labor compensation, capital rental rates, and labor and capital tax rates.

The Euler equation associated with optimal intertemporal allocation of consumption of the nonmedical commodity, through optimal accumulation in physical capital, gives rise to the familiar condition

$$U_{\mathrm{c}}(t) = \beta \mathrm{E}_{\mathrm{t}}\left[U_{\mathrm{c}}(t+1)(1 + \bar{r}_{t+1})\right]. \qquad (13)$$

The left-hand side of this equation is the cost of giving up one unit of consumption, measured in terms of (marginal) utility, whereas the right-hand side is the present value of expected future benefit from investing the foregone consumption good in physical capital.

The Euler equation associated with optimal health accumulation gives rise to the condition

$$U_{\mathrm{c}}(t)(1 - \gamma\tau_n n_t) = U_{\mathrm{h}}(t) + \beta(1 - \rho)\mathrm{E}_{\mathrm{t}}\left[U_{\mathrm{c}}(t+1)(1 - \gamma\tau_n n_{t+1})\right]. \qquad (14)$$

This is in effect the condition for optimal intratemporal allocation of consumption of the medical commodity and of the nonmedical commodity, which equates the marginal utility of consuming another unit of the medical good with that of consuming an equal value of the nonmedical good. To see this, the left-hand side of this equation is the cost of consuming another unit of the medical good, measured in terms of the foregone (marginal) utility from consuming an equal value of the nonmedical good. "Equal value" means that this cost has to be adjusted for the fact that the medical commodity is purchased with pre-tax compensation, to the extent that there is an employment relationship to support it. The right-hand side of this equation is the benefit from consuming another unit of the medical commodity. The benefit includes better health (h_t) at the present date, and at future

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dates as well, with a decay factor of $(1 - \rho)$. The benefit, measured in terms of present and expected future (marginal) utilities, generalizes Grossman's notion of the consumption motive for health care, and relates it to the household's incentives in the labor market through the special feature of the tax code.

The Euler equation associated with optimal intratemporal allocation of effort levels in the labor market by employed and unemployed workers is given by

$$\frac{V_{a_1}(t)}{\theta_1'(a_{1t})n_t} = \frac{V_{a_2}(t)}{\theta_2'(a_{2t})(1 - n_t)}. \tag{15}$$

This condition equates the marginal disutility from having unemployed workers search more intensively for jobs with the marginal disutility of having employed workers exert more effort to retain their jobs, adjusted for the marginal effects of these effects on the transition probabilities of the workers into and out of employment and unemployment.

Finally, the intertemporal Euler equation for optimal employment and unemployment is given by

$$\begin{aligned}\frac{-V_{a_2}(t)}{\theta_2'(a_{2t})(1 - n_t)} &= \beta \mathrm{E}_t \{U_c(t+1)\bar{w}_{t+1} + V_n(t+1) \\ &+ \left[\theta_1(a_{1,t+1}) - \theta_2(a_{2,t+1})\right]\left[\frac{-V_{a_1}(t+1)}{\theta_1'(a_{1,t+1})n_{t+1}}\right]\Bigg\}. \end{aligned} \tag{16}$$

The left-hand side of this equation is the cost of having unemployed workers exert more effort to search for a job, measured in terms of (marginal) disutility, taking into account how the extra effort increases the marginal transition probability of the currently unemployed workers into employment in the next period. The right-hand side of the equation summarizes the present value of expected future benefits from the extra current effort. The first term shows the benefit from having higher employment next date (i.e., higher n_{t+1}) in terms of more produced output for consumption. The second term shows a net effect on marginal utility during the next period due to the tension that there will be fewer unemployed workers exerting effort to obtain a job, but more employed workers exerting effort to retain their jobs. The last term shows how the increased employment next period may increase employment in the subsequent period—note that the first component of the last term is $\partial n_{t+2} \backslash \partial n_{t+1}$—taking into account that effort must be exerted for the employed workers to retain their jobs (as captured by the second component of the last term).

At each date t, the representative firm chooses K_t and N_t to maximize its current-period profit, taking r_t and u_t (as well as its composition) as given. The optimization conditions for profit maximization take the familiar forms

$$r_t = F_K(K_t, N_t; z_t) - \delta, \quad u_t = F_N(K_t, N_t; z_t). \tag{17}$$

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TABLE 2. Baseline parameters

Preferences	$\beta = 0.9702, \phi = 0.3, \eta = 0.7$
Production technology	$\alpha = 0.4$
Capital depreciation	$\delta = 0.076$
Health depreciation	$\rho = 0.04$
Search technology	$\theta_1 = 13.9, \theta_2 = 2.6$
Government policy	$\tau_n = 0.35, \tau_k = 0.35, \gamma = 1$

The household and government budget constraints together give rise to the following resource constraint:

$$C_t + M_t + K_{t+1} - (1-\delta)K_t = F(K_t, N_t; z_t). \tag{18}$$

Finally, we note that, in equilibrium, it holds that $c_t = C_t$, $m_t = M_t$, $k_t = K_t$, and $n_t = N_t$. Equations (13)–(18), together with the laws of motion for employment and the health stock, characterize an equilibrium.

5. ACCOUNTING FOR THE CURRENT U.S. SYSTEM

In this section, we show that the model developed in the preceding can be made consistent with many of the salient features of the current U.S. economic system. In particular, we show that it can provide a joint account for the U.S. long-term unemployment rate and medical expenditure-to-aggregate consumption ratio.

To illustrate this point, we follow Yogo (2009) to parameterize the period utility $U(c_t, h_t)$ as follows:

$$U(c_t, h_t) = \frac{\eta}{\eta - 1} \log\left[(1-\phi)c_t^{\frac{\eta-1}{\eta}} + \phi h_t^{\frac{\eta-1}{\eta}}\right], \tag{19}$$

where the parameter $\phi \in (0, 1)$ determines the importance of health stock relative to consumption of the nonmedical commodity in the households' preferences, and the parameter $\eta > 0$ measures the elasticity of substitution between health status and the nonmedical consumption good. We parameterize the production function $F(K_t, N_t; z_t)$ in the standard Cobb–Douglas form,

$$F(K_t, N_t; z_t) = z_t K_t^{\alpha} N_t^{1-\alpha}, \tag{20}$$

where $\alpha \in (0, 1)$ determines the share of the cost of capital in the value-added productive inputs in the long-run stationary equilibrium.

For the purposes of this section, however, we do not need to specify any specific functional form for either the period disutility function, $V(a_{1t}, a_{2t}; n_t)$, or the transition probability functions, $\theta_i(a_{it})$, for $i = 1, 2$.

To proceed, we need to choose the benchmark values of the model's parameters (see Table 2). We set the share of payment to capital in the value-added productive factors, α, at 0.4, the subjective annual discount factor, β, to 0.9702, and the annual

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physical capital depreciation rate, δ, to 0.076. These are standard values used in the literature [e.g., Chen et al. (2009)].

We set $\gamma = 1$ in our baseline economy, in light of the observation that employment-based medical benefits are tax-exempt in the postwar U.S. system. Recent estimates point to an average annual depreciation rate of health stock of about 4% for the U.S. working-age population [e.g., Fonseca et al. (2008), Scholz and Seshadri (2010), Zhao (2010)], so we set $\rho = 0.04$, to be consistent with these studies. We set the parameter governing the relative importance of health in preferences as $\phi = 0.3$, as is common in the literature [e.g., Yogo (2009), Halliday et al. (2011)]. In terms of selecting a value for η, some recent studies adopt the standard Cobb–Douglas specification implying a unitary elasticity of substitution between health and nonmedical good consumption [e.g., Fonseca *et al.* (2008), Jung and Tran (2011)], whereas some other studies use a value much lower than unit [e.g., Scholz and Seshadri (2010), Halliday et al. (2001)]. Here, we set $\eta = 0.7$, to be consistent with the recent estimate by Yogo (2009) in a macroeconomic context.[12]

Following McGrattan and Prescott (2000), we set the capital income tax rate $\tau_k = 0.35$. Computing the tax rate on labor income is slightly more complicated. Again, it is important to focus on the fact that the typical decision maker in our model is a worker, or a potential worker, and so we need to look at the tax rates faced by such people. In the United States, almost all income tax is paid by individuals in the 28% federal bracket or higher.[13] State income tax rates vary from zero to 11%. The payroll tax on earnings is 12.4%, and currently applies to the first $106,800 of labor income. Most states have consumption taxes on various commodities, which also raise the effective tax rate on labor.[14] It would seem that a conservative estimate of the appropriate labor income tax rate would be 35%. However, if one adds a 28% federal rate to a modest state tax rate of 5%, a 12.4% payroll tax, and a 2.9% Medicare tax (with no income cap), one arrives at a 48.3% rate—ignoring the consumption tax.[15] Nevertheless, we choose a conservative benchmark value here by setting $\tau_n = 0.35$. Our results are robust to alternative values of the model's parameters within their empirically plausible ranges.

One parameter value that matters for the results quantitatively is the labor income tax rate. We choose a conservative value in the preceding, but at the same time acknowledge that this choice of labor income tax rate might well be an underestimate of the historical average in the data, and that the welfare effects of various counterfactual policy experiments to be conducted hereafter can be more pronounced for higher yet still empirically reasonable values of the labor income tax rate.

We can now proceed to compute the steady-state equilibrium for our benchmark economy. We compute the steady state by setting the technology level (z) to its unconditional mean of 1 and shutting off the time dimension. In what follows, we use a variable with an asterisk to denote its steady-state value. We begin by calculating the steady-state unemployment rate. Using the steady-state version of

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(3), we obtain

$$N^* = \frac{\theta_2(a_2^*)}{\theta_2(a_2^*) + 1 - \theta_1(a_1^*)}. \tag{21}$$

It should be noted that the steady-state transition probabilities from unemployment into employment, and from employment into unemployment, are $\pi_{ue}^* = \theta_2(a_2^*)$ and $\pi_{eu}^* = 1 - \theta_1(a_1^*)$, respectively. Empirical studies on gross worker flows in the postwar U.S. economy conducted by Abowd and Zellner (1985), Blanchard and Diamond (1990), Clark (1990), Mortenson (1990), Hall (2005a, 2005b), and Shimer (2007), among others, suggest average rates of transition from employment to unemployment between 2.6 and 4.52% (this does not count transitions from employment to nonparticipation, or to a new job), and from unemployment to employment between 49.1 and 83.4%. Matching up π_{eu}^* and π_{ue}^* with the midpoints of these two ranges of estimates, 0.0356 and 0.6625, respectively, and using (21), we can compute the steady-state employment as $N^* = 0.949$, which implies a steady-state unemployment rate of 5.1%, matching well the average unemployment rate in the postwar U.S. economy.

We can next use the steady-state version of (14) to derive

$$\frac{M^*}{C^*} = \rho \left\{ \frac{\phi}{(1-\phi)[1-\beta(1-\rho)](1-\gamma\tau_n N^*)} \right\}^{\eta}, \tag{22}$$

which is then equal to 0.1913 under the parameter configuration and solution for employment in the preceding, giving rise to a ratio of medical expenditure to total private consumption of 16.06 percent, matching well the figure in the current U.S. system.

Combining the steady-state versions of (10), (13), and the first relation in (17), we obtain

$$\frac{K^*}{N^*} = \left(\frac{1-\beta}{\alpha\beta} \frac{1}{1-\tau_k} + \frac{\delta}{\alpha} \right)^{\frac{1}{\alpha-1}}, \tag{23}$$

which, under the parameter configuration, is equal to 7.1137. This, together with the production function, implies a steady-state annual capital–output ratio of 3.2453, which is consistent with the U.S. data.

We can then substitute the results derived from (21)–(23) into (18) to obtain the steady-state level of medical and nonmedical consumption, $M^* = 0.2517$ and $C^* = 1.3155$, respectively. The levels of output and capital, as well as the other endogenous variables, can be derived easily using the preceding results and the steady-state versions of the rest of the equilibrium conditions.

6. REMAINING PARAMETERS

The technology and preferences are constructed and parameterized to mimic many of the characteristics of the U.S. economy. We have shown that the steady state of the model is consistent with some of the key features of the U.S. labor market

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and medical expenditure data. This is done without any specification of how effort affects disutility and transition probabilities.

To permit analysis of how the economy will react to various policy changes, we need to parameterize both the disutility function, $V(a_{1t}, a_{2t}; n_t)$, and the transition probability functions, $\theta_i(a_{it})$, for $i = 1, 2$. We postulate the forms

$$V(a_{1t}, a_{2t}; n_t) = -n_t a_{1t}^2 - (1 - n_t)a_{2t}^2 \tag{24}$$

for the disutility function and

$$\theta_i(a_{it}) = 1 - e^{-\theta_i a_{it}}, \quad \theta_i > 0, \quad i = 1, 2, \tag{25}$$

for the transition probability functions. It should be worth noting that this functional form of disutility from effort and the form of the two transition probabilities as functions of effort (and employment status) are similar to those specified in Wang and Williamson (1996). They clearly satisfy the general properties specified in Section 3. It is here also worth mentioning that the optimal effort level for an employed worker may differ from that for an unemployed worker if, with the same effort level, the probability for the former to retain employment differs from the probability for the latter to obtain employment, that is, if the two parameters governing the transition probabilities across different employment statuses, θ_1 and θ_2, differ from each other.

We shall let the data tell whether such a difference exits. To this end, we substitute the results obtained in Section 5 into the steady-state versions of (15) and (16) to get

$$\theta_1 = \sqrt{\frac{\frac{\log(\pi_{\text{eu}}^*)}{\pi_{\text{eu}}^*}\left[\pi_{\text{eu}}^* \log(\pi_{\text{eu}}^*) - (1 - \pi_{\text{ue}}^*)\log(1 - \pi_{\text{ue}}^*) + 2(1 - \pi_{\text{eu}}^* - \pi_{\text{ue}}^*) - \frac{2}{\beta}\right]}{\left\{\left[(1-\phi)(C^*)^{\frac{\eta-1}{\eta}} + \phi\left(\frac{M^*}{\rho}\right)^{\frac{\eta-1}{\eta}}\right]^{-1}(1-\phi)(C^*)^{-\frac{1}{\eta}}\right\}\left[(1-\tau_n)(1-\alpha)\left(\frac{K^*}{N^*}\right)^{\alpha} + \gamma\tau_n M^*\right]}},$$

$$\theta_2 = \theta_1\sqrt{\frac{\pi_{\text{eu}}^*}{\log(\pi_{\text{eu}}^*)}\frac{\log(1 - \pi_{\text{ue}}^*)}{1 - \pi_{\text{ue}}^*}},$$

which are then equal to 13.9 and 2.6, respectively. This means that, for a given effort level, the probability for an employed worker to retain employment is higher than the probability for an unemployed worker to obtain employment. It is in this sense that effort exerted by an employed worker in retaining employment is more effective than effort exerted by an unemployed worker in securing employment.

At this point the parameters of the benchmark model have all been specified. In the subsequent sections of the paper we use the model to conduct a series of counterfactual policy experiments.

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TABLE 3. Baseline results and counterfactual experiments

Variables	Baseline	Partial reform	Laissez-faire
Transition rate (e → u)	0.0356	0.0394	0.0292
Transition rate (u → e)	0.6625	0.6424	0.7085
Unemployment rate	5.1%	5.8%	3.96%
Fraction of "m" in total consumption	16.06%	12.6%	12.6%
% change in output from benchmark	—	−0.71	11.4
% change in welfare relative to benchmark	—	−1.98	4.4

7. PARTIAL REFORM

We can now proceed to our counterfactual analysis to be organized around the following question: Is the current U.S. practice of tax-supported medical benefits through employment relationships a sensible policy alternative to some easily contemplated alternative policies? To help answer this question, we first compute the steady-state equilibrium for an alternative economy that is identical to the benchmark economy in all respects, except that there is no tax deductibility for employment-based medical services (i.e., $\gamma = 0$). The results from this counterfactual experiment are reported in the second column of Table 3.

The partial reform of simply eliminating the employment-based, tax-deductible medical benefits lowers the effort by employed workers to retain employment and by unemployed workers to obtain employment. As a consequence, the rate of transition from employment to unemployment would be higher, and that from unemployment to employment would be lower, than in the benchmark economy (0.0394 versus 0.0356, and 0.6424 versus 0.6625, respectively). Hence, employment would be lower, giving rise to a higher unemployment rate of 5.8%, compared to the 5.1% unemployment rate in the benchmark economy with tax-supported medical commodities provided through employers. In terms of the effects on unemployment and employment durations, this partial reform would increase the average span of unemployment by 2.5 weeks and decrease the average span of employment by 2.7 years. The level of physical capital would be lower as well. With lower levels of labor and capital inputs, output would decline, by 0.71% from the level in the benchmark economy. Eliminating the employment-based tax shelter on medical care would also raise the price of medical goods relative to that of nonmedical goods. As a result, consumption of medical goods would fall and that of nonmedical goods would rise relative to each other, and the fraction of medical expenditure in total consumption would decline, from 16.06% in the benchmark economy, to 12.6% in the postreform economy.

As was discussed in much detail in Sections 1 and 2, it is well known that durations of unemployment are considerably longer, and rates of unemployment are considerably higher, in most European countries than in the United States. It has also been well documented that the fraction of health care expenditure in total consumption is considerably lower in other countries than in the United

States. The analysis conducted here shows that one possible explanation for these differences might be the different mechanisms that are used for the provision of medical care or insurance in these countries. This simple reform does not account for *all* the differences in unemployment, and medical expenditures as a fraction of consumption, between the United States and other industrialized countries. The current tax treatment is merely one of many factors that could contribute to the relatively low rate of unemployment or high ratio of medical to total consumption in the United States, and by no means are we suggesting that this feature alone could account for all the differences between the United States and other countries.

It is of critical importance to note that, in the model, removing the employment-based medical tax shelter brings with it a welfare *loss* rather than a *gain*.[16] In the spirit of Lucas (1987), we use a compensation-consumption-equivalence (CCE) measure to help quantify this welfare cost. More specifically, we measure the welfare cost (benefit) by the fraction that the benchmark nonmedical consumption would have to be decreased (increased) to lower (raise) the benchmark level of utility down (up) to the new "postreform" level, in order to make households indifferent between living in the benchmark economy and living in the postreform economy. We find that simply eliminating the medical tax shelter, while maintaining all of the other institutional features and government policies, would *lower* the CCE measure of welfare by 1.98%. In other words, households would be willing to give up 1.98% of the benchmark consumption in exchange for the medical tax shelter staying.

As was discussed in the Introduction, the conventional wisdom seems to be that the unique tax feature of the United States that gives rise to apparently high level of spending on medical services must be inferior to most policy alternatives. This result from our model should give pause to these critics of the current U.S. system. It is frequently assumed that the tax preference for employer-provided medical care must be nonoptimal, as it leads to distortion of the margins between nonmedical and medical consumption, yielding overconsumption of the latter. However, what this experiment shows is that the elimination of this distortion may not necessarily be welfare-improving, for two reasons. First, it leads to a *greater* distortion between the nonmedical commodity and leisure. Second, this in turn leads to a lower level of employment, and therefore output, which then produces a wealth effect that reduces welfare.

These results, although perhaps surprising, make intuitive sense. Eliminating the employment-based tax shelter on medical commodities reduces the incentives that individuals have to exert effort to secure employment. Both the effort by unemployed workers to obtain employment and that by employed workers to maintain employment are lower. Thus, the transition rate from unemployment to employment is lower, and that from employment to unemployment is higher, resulting in a higher rate and longer duration of unemployment, and a lower rate and shorter duration of employment. The levels of both physical capital and output are lower, and so is the level of total income. Although the partial reform reduces the distortion in the goods market, leading to more efficient substitution between

the two types of commodities, it magnifies the distortion in the labor market because of the presence of the labor income tax, which discourages individuals from exerting effort to secure and hold jobs, and the distortion in the capital market emerging from the general equilibrium connection between labor and capital, and magnified by the presence of the capital income tax. These labor and capital market distortions are of first-order significance. Even after the reduced disutility due to lowered effort is taken into account, the effects from the lost output and income, due to the depressed labor and capital market activities from the partial reform, more than offset the efficiency gain from improved substitution in the goods market. Hence, without removing these larger distortions in the factor markets in the first place, simply eliminating a counteracting factor, here the tax shelter on medical insurance or care purchased through employers, moves the economy to an inferior equilibrium. The effect is a net welfare loss.

With this partial reform, there is a resulting change in tax revenue that is then rebated back to individuals. If instead of this rebate being increase, the labor tax rate (τ_n) is reduced (from 35% to 28.4%) to keep tax revenue constant, this results in similar changes, although the magnitude of the effects is reduced modestly. For example, if the labor tax rate is reduced, this alternative reform results in a 1.7% welfare cost and a 5.35% unemployment rate. These compare with a 1.98% welfare cost and a 5.77% unemployment rate when the labor tax rate is held constant and the transfer is increased.[17]

Because a unique feature of the model studied here is the manner in which health spending affects decisions and preferences, it is also fitting that some exploration is undertaken to see how sensitive the results are to variations in the parameters of preferences [i.e., equations (1) and (19)]. When these preference parameters are varied, the parameters that govern the transition probability need to be calibrated accordingly, to be consistent with an initial benchmark unemployment rate of 5.1%.

The parameter η, which governs the elasticity of substitution between health and nonmedical consumption, and which is set to 0.7 in the benchmark case [as in Yogo (2009)], has an important effect in determining the response of a change in the tax rate. If this elasticity is reduced to 0.5, then the reform results in a 1.08% reduction in welfare (vs. 1.98% in the benchmark), and an unemployment rate of 5.58% (vs. 5.77%). If η is reduced further to 0.25, then the reform results in a reduction in welfare of 0.43%, and an unemployment rate of 5.4%, but in this circumstance the share of medical expenditure in total consumption prior to the reform is already very low (6.54%) and the reform also has very little impact on this share. Conversely, if η is increased to 0.9, then the reform results in a 3.51% decrease in welfare and an unemployment rate of 6.06%.

Additionally, it is interesting to consider changes to a parameter in equation (1). In particular, suppose that decreasing returns are introduced into this expression so that it now is as follows: $h_t = (1-\rho)h_{t-1} + m_t^{\xi}/\xi$. If $\xi = 0.5$, rather than 1, then the reform results in a 1.36% welfare cost and a 5.54% unemployment rate. If ξ is reduced further to 0.25, then the reform results in a 0.89% welfare cost

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and a 5.37% unemployment rate, but in this circumstance the share of medical spending in total consumption prior to the reform seems to be unreasonably low (6.08%).

The parameter ϕ governs the share of total consumption spending that goes to the medical commodity. In the benchmark $\phi = 0.3$, so that the medical share in total consumption is 16.06%. If instead we assume $\phi = 0.2$, then the share of medical expenditure in total consumption prior to the reform plummets to 11.6%. However, even in this case the reform still results in a 1.44% reduction in welfare and an unemployment rate of 5.59%. If ϕ is reduced further to 0.1, then the reform results in a 0.85% welfare cost and a 5.39% unemployment rate, but in this circumstance the share of spending that is devoted to the medical commodity before the reform takes place seems unreasonably low (6.92%).

In all of these additional experiments, comparable results are obtained when the labor tax rate is reduced along with the reform so that pre- and postreform tax revenue and transfer remain the same. We have conducted many more sensitivity analyses than discussed here, and found that the basic conclusions hold quite generally. In general these parameter changes have some quantitative influence on the results—sometimes very modestly, and other times to a greater degree—but in no case do they alter the qualitative nature of the results.

It is worth emphasizing that, with $\tau_n = 35\%$ as a benchmark choice, this calculation might be understating the true welfare cost of this partial reform. As mentioned before, the baseline calibration of a labor income tax rate of 0.35 might well be an underestimate of the historical average of labor income tax rates in the data. In a number of additional counterfactual experiments under slightly higher, yet still empirically plausible, labor income tax rates, we find that the effects of the partial reform are much more pronounced, and the resultant welfare costs are much greater. For example, if the benchmark model has a labor tax rate of 45%, then the reform of eliminating the medical tax shelter raises unemployment from 5.1% to 6.2%, with a resulting welfare cost of 2.38%. This should not be surprising. To the extent that a labor tax creates a first-order distortion in the labor market that discourages individuals from exerting effort to secure and hold jobs, the employment-based medical tax shelter, itself being a distortion in the goods markets, partially corrects for or offsets this labor market distortion. Thus, simply eliminating the medical tax shelter, without fixing the first-order distortion in the first place, would lead to lower effort, higher unemployment rate, and lower output and welfare. The higher the labor income tax rate is initially, the greater will be the loss from such partial reform of simply removing the tax shelter for employer-provided medical care.

For comparison, we also compute the steady-state equilibrium under laissez-faire by setting $\tau_n = \tau_k = 0$, which effectively eliminates the government. Although this is a far-fetched experiment to conduct, it can serve as a useful point of comparison to help us get an idea on how these previous two economies compare with the true optimum, which has no government intervention at all. The results are reported in the third column of Table 3.

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This drastic reform would remove all distortions, and thus would encourage individuals to exert effort in securing employment and to accumulate capital. In consequence, the rate of transition from employment to unemployment would be lower, and that from unemployment to employment would be higher, than in the benchmark economy (0.0292 versus 0.0356, and 0.7085 versus 0.6625, respectively). Unemployment rate would decline, to 3.96%, from 5.10% in the benchmark economy. The level of physical capital would be higher and, with higher levels of labor and capital inputs, output would increase by 11.4% from the level in the benchmark economy. The nonmedical commodity would become cheaper relative to the medical commodity and, as a result, the fraction of medical expenditure in total consumption would decline, from 16.06% in the benchmark economy to 12.6% under laissez-faire. Not surprisingly, with all distortions removed at once, welfare must be higher. Indeed, we find that the CCE measure of welfare would increase by 4.4% from the level in the benchmark economy.

8. GOVERNMENT PROVISION OF MEDICAL SERVICES

We now assess the welfare consequences of government provision of medical services. Within such a government regime, at each date t, a household chooses $c_t > 0$, $a_{1t} \geq 0$, $a_{2t} \geq 0$, $k_{t+1} \geq 0$, and $n_{t+1} \geq 0$ to maximize the expected utility, subject to the law of motion for employment, and a budget constraint,

$$c_t + k_{t+1} = \bar{w}_t n_t + (1 + \bar{r}_t)k_t + g_t,$$

taking as given the initial conditions k_0 and n_0, wage and capital rental rates, and the labor and capital income tax rates. An equilibrium is characterized by equations (13) and (15)–(18), together with the laws of motion for employment and for the health stock, and a government budget constraint,

$$M_t + g_t = \tau_n u_t N_t + \tau_k r_t K_t. \tag{26}$$

In this instance, all individuals, regardless of their employment statuses, get the same medical commodity (M_t) provided by the government, and they only need to purchase the nonmedical good and make decisions concerning labor market effort and physical capital accumulation. However, it is then important that the government choose a value for this medical expenditure, which is received by all individuals. Of course, either too high or too low a value of M_t would result in reduced welfare. Therefore, we will consider a range of values for M_t. This will have the added benefit of shedding some insight on the optimal value of M_t in this instance, which can then be compared with the value that results from the benchmark economy.

There is also the matter of how this extra government expenditure is financed. We will consider two options: one where existing government expenditures and transfers are slashed so that tax rates can be maintained at their benchmark levels,

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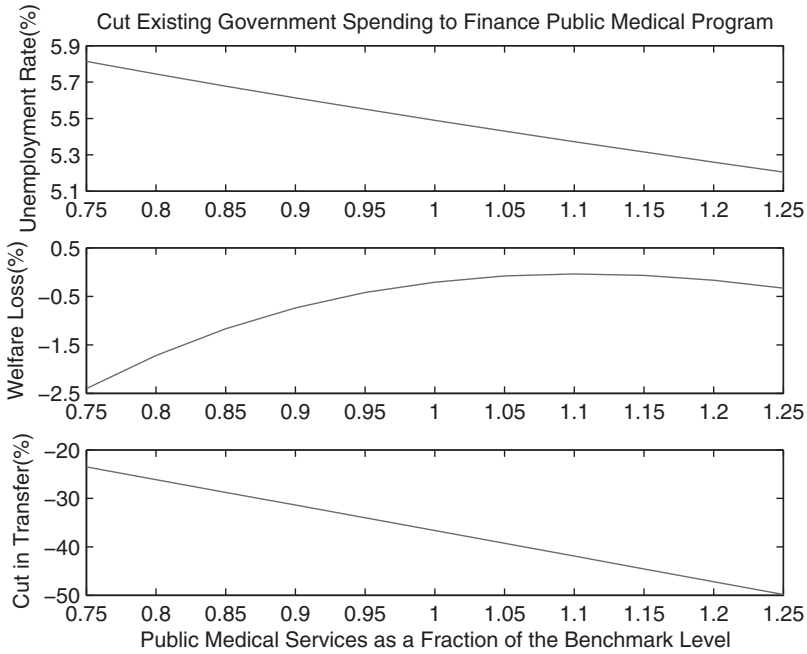

FIGURE 6. Unemployment rate (upper panel), welfare loss (middle panel), and required cut in existing government spending (lower panel) for financing various levels of government medical program.

and a second option where the tax rate on labor is increased to finance the previous level of government spending plus the new medical spending.

8.1. Holding Tax Rates Unchanged

We consider first the case in which the new government-run medical program is financed by cutting existing government spending (g_t). It would seem unrealistic to contemplate that the government is going to starve all of its many current programs in order to finance a new government-run medical program, but we can nevertheless study the effects of such a contemplated policy reform. Figure 6 plots the rate of unemployment, the compensation-consumption-equivalence measure of welfare loss relative to the level of welfare in the baseline economy, and the percentage cut in existing government spending that would be required to finance the government medical program. The horizontal axis is the ratio of government spending on the medical commodity (M_t) to the level of medical expenditure in the benchmark economy. A value less (more) than one means spending less (more) on the medical good in this regime than in the benchmark economy. This figure covers a range of different levels of government medical program, from $\pm 25\%$ of the level of medical spending in the baseline economy.

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As is apparent from the upper panel of the figure, all of the levels of M_t under consideration would result in higher rates of unemployment than in the baseline economy. The unemployment rate is 5.1% in the baseline economy, whereas this panel shows it ranging from 5.21% to 5.81% under the government regime with different levels of public medical services. Even when the level of government medical spending is maintained at the level of medical expenditure in the baseline economy, unemployment rate still rises to 5.5%.

The lower panel of the figure shows that the required reduction in the existing government spending increases monotonically with the level of government-run medical program. As can be seen from this panel, the cut would increase from 24% to 50%, as the level of government medical spending rises from 25% below to 25% above the level of medical spending in the baseline economy. Such a spending reduction is certainly a nontrivial amount.

The middle panel of the figure shows that this government regime would always result in a reduction in welfare regardless of the level of public medical services provided. Loss in welfare would be 0.21% from the level in the baseline economy, if the government medical program is run at a level comparable to that of medical spending in the baseline economy, but would be considerably greater if decreases or moderate to large increases in the level of government medical spending are contemplated.

It is also important to note that the middle panel of Figure 6 also shows something else that is important. In this case, if the government is providing medical care, then the optimal amount of the medical commodity will be approximately *10% greater* than in the benchmark economy. This would certainly conflict with the belief that having the government provide medical care must necessitate a reduction in total spending.

8.2. Holding Existing Government Spending Unchanged

Next, we examine the case in which spending on the new government-run medical program is financed by raising the labor income tax rate, whereas other government spending is maintained at its level in the benchmark economy. Figure 7 plots the rate of unemployment, the compensation-consumption-equivalence measure of welfare loss relative to the level of welfare in the baseline economy, and the labor income tax rate that would be required in order to finance the government medical program. Again, the figure covers a range of different levels of government medical program, from $\pm 25\%$ of the level of medical spending in the baseline economy.

As the upper panel of the figure indicates, this government regime would result in a substantial increase in unemployment rate. In fact, the rate of unemployment would rise monotonically with the level of government medical program, from 6.54% up to 6.87%, as the level of government medical spending increased from 25% below to 25% above the level of medical spending in the baseline economy. To provide public medical services at a level comparable to that of medical spending in the benchmark economy, this government regime would have an unemployment

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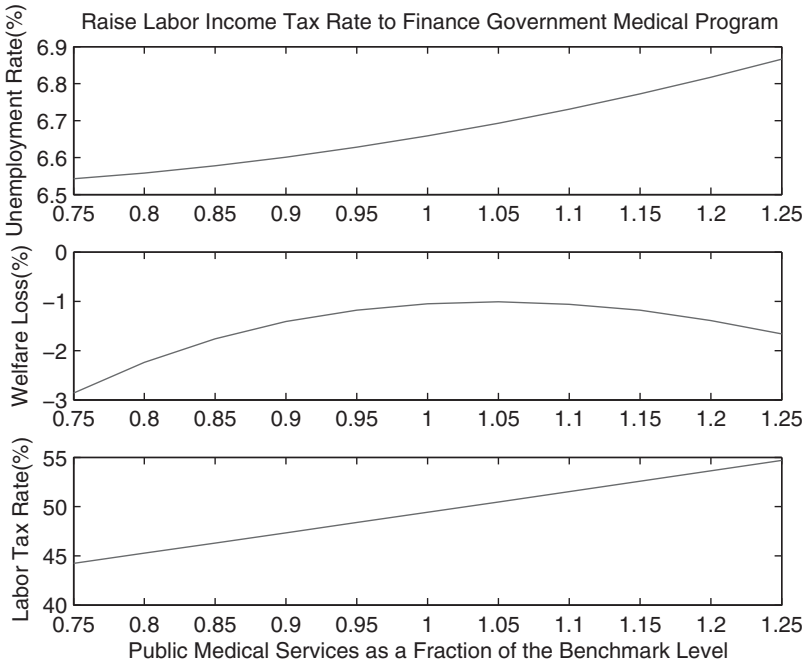

FIGURE 7. Unemployment rate (upper panel), welfare loss (middle panel), and required labor income tax rate (lower panel) for financing various levels of government medical program.

rate of 6.66%, a substantial increase over the unemployment rate of 5.1% in the benchmark economy.

As the lower panel of the figure reveals, one of the reasons for this substantial increase in unemployment rate is that the labor income tax rate is raised to finance the government medical program. Again, as the level of government medical spending increases from 25% below to 25% above the level of medical spending in the baseline economy, the labor income tax rate must be raised precipitously, from 44.2% to up to 54.7%, creating a huge disincentive in the labor market. Similarly, to provide public medical services at a level comparable to that of medical spending in the benchmark economy would necessitate raising the labor income tax rate from 35% to 50%.

The middle panel of the figure shows that this government regime would result in a substantial reduction in welfare for any level of public medical services provided. The loss in welfare would be 1.05% from the level in the baseline economy, if the government medical program were run at a level comparable to that of medical spending in the baseline economy, but would be considerably greater if decreases or small to large increases in the level of government medical spending were contemplated. Again, as in the prior figure, in this example, if the government is

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going to attempt to maximize welfare, then it should provide an amount of the medical commodity that is *greater* than in the benchmark economy.

As is clear from the preceding analysis, this option of raising the labor income tax rate to finance a government medical program would lead to outcomes much worse than the outcomes obtained from the first (though perhaps even less realistic) option through cutting existing government spending, with a much higher unemployment rate and much lower output and welfare.[18]

9. FINAL REMARKS

Empirical evidence suggests that the United States has had for some time higher expenditure on medical care relative to other commodities and a lower rate of unemployment, compared with most European countries. We have shown in this paper that these two observations may be related to each other, and a key to understanding the relationship may have to do with a unique feature of the U.S. tax system in which most working families obtain their health care tax-free, through their employers. Although this special tax shelter may lead to overconsumption of medical services relative to other goods, it may at the same time create an incentive for workers to seek and maintain employment.

To this end, we have developed a general equilibrium model with endogenous health accumulation and labor market search to capture various salient features of the current U.S. system, including the special tax structure. The model can jointly account for the U.S. long-term unemployment rate and medical expenditure-to-aggregate consumption ratio. We have used the model to demonstrate that eliminating the preferential tax treatment of employment-based medical benefits, while maintaining all other institutional features and government policies, would lower the medical expenditure-to-aggregate consumption ratio and raise the unemployment rate.[19]

Importantly, we have shown that, quite contrary to the conventional wisdom, such a simple reform would result in a welfare *loss* rather than a gain through the general equilibrium labor market effect, and that having the government raise taxes to finance the provision of medical care may lead to even worse outcomes.[20]

A crucial point of our analysis is that, although it creates a distortion in the goods market, the preferential tax treatment of employment-based medical benefits partially corrects for several other existing distortions: the distortions in the labor market that are created by the labor income tax, and a distortion in the capital market that is emerging from a general equilibrium connection between labor and capital that is magnified by the capital income tax. These labor and capital market wedges can be large because of the general equilibrium factor interaction and the intertemporal linkage through endogenous investment and capital accumulation. Hence, without removing these large distortions in the first place, simply eliminating a counteracting factor, such as a tax shelter on medical insurance or care purchased through employers, may move the economy to an inferior equilibrium.[21]

In light of the analysis that we have conducted in this paper, the current U.S. system seems to fare better than the partial reform and the government regime. However, one should not take this as suggesting that the current U.S. practice is the most desirable one. Clearly, it is not. The model implies that a laissez-faire system in which there was no government intervention at all would be optimal. Although this seems to be a far-fetched system to contemplate, perhaps some more systematic and more fundamental reforms than the ones considered in the counterfactual experiments in the current paper can lead to a system that is superior to the current one. These might include both government spending and tax cuts, in conjunction with eliminating the preferential tax treatment of employment-based medical benefits. Thus one can take the analysis of the current paper as issuing a word of caution that, until such a superior system can be identified and implemented, the current U.S. practice may be a reasonably sensible policy alternative to various easily contemplated alternative policies.

NOTES

1. In the United States, most firms offer some form of health insurance, and most workers obtain some form of health care through their employers. According to the Employee Benefit Research Institute (2000), the vast majority of insured nonelderly Americans obtain their health insurance through their own or a family member's employment. Gould (2004) documents that, in 2003, 60.4% of the total U.S. population had health insurance provided through an employment relationship.

2. An earlier strand of literature examined whether or not tying medical insurance to employment might discourage workers from changing jobs (without an intermittent spell of unemployment), to the extent that this might entail a change in their medical policies. There is no consensus that such conceivable impediments to worker mobility have any significant long-run effects, especially in the presence of various existing state and federal "continuation of coverage" laws (e.g., COBRA). Gruber and Madrian (2002) state that "there is virtually no evidence in the literature on the welfare implications of these results," and Fang and Gavazza (2011) find that these results "cannot explain the empirical patterns in health-care expenditures." Our focus in this paper is on health care expenditure and its relation with movements into and out of employment and unemployment, which have drawn considerable attention in the more recent literature.

3. Jeske and Kitao (2009) have also studied the costs and benefits of employer-provided Group Health Insurance (GHI), but they do so within the context of a very different model, and their focus is on different economic outcomes than those studied in this paper. Despite the regressive nature of GHI, they find that the current tax preference for GHI is preferable to eliminating this policy. In their model, eliminating employer-provided GHI results in lower welfare because of the partial collapse of the GHI market, resulting in lower insurance coverage and greater exposure to health shocks. Both the current paper and that of Jeske and Kitao find that although employer-provided health insurance may not be an optimal policy, it may be preferable to eliminating this tax benefit.

4. Source of data: Economic Report of the President (2008).

5. Source of data: Bureau of Labor Statistics (2008).

6. Although some countries, such as Japan, have alternative systems that require employers to pay labor-based taxes that are then dedicated to providing medical services, many other countries fund medical insurance out of general tax revenue. The United States appears to be the only country in which medical benefits provided through employment relationships are tax-exempt.

7. In contrast, Figure 1 shows the fraction of all private consumption spending that is devoted to medical spending in the United States.

8. Source of data for Figures 3–5: OECD (2008). Most U.S. public health care funds go to paying for health care for the elderly, who are usually retired, or for disabled or indigent individuals, as well

as for military and other government employees. These people are not the ones are thinking of as producing the output in the model to be presented. The focus of the current paper is on the behavior of typical U.S. working families or households. The basic decision-making unit in the model is a family or household of potential workers who can help produce output for consumption and investment. These families or households typically do not receive medical care from the government, and our baseline model will be consistent with the fact that these families mainly finance their own medical care or insurance through their employers.

9. Our model abstracts from the investment motive for health care, both in the sense, also discussed in Grossman (1972), that better health status may reduce sick time and thus make more of the time endowment available for work or leisure, and in the sense that "health stock" may enter as another productive factor, in addition to physical capital and labor, into the production function. Although the results to be presented do not rely on the investment motive for medical care, incorporating this additional feature into our model would strengthen the results of this paper, and especially could make the welfare effects of our counterfactual policy experiments much more pronounced.

10. Such a classical approach is standard in the joint-research literature that is used to avoid dealing with multidimensional bargaining, dating back at least to Burdett and Mortensen (1977), and applied more recently by Guler et al. (2011) and Mankart and Oikonomou (2011). An alternative interpretation of this structure would be that of the worker searching for the location where the employers or firms are producing. When the worker finds this location, the firms behave competitively because the gains from bargaining are quickly bid away so that the worker is just able to obtain a wage that is the marginal product of labor. The worker can keep receiving this wage until he loses his job, and he must then search again.

11. Although the results to be presented do not rely on any of these additional features, it is not difficult to imagine how some of these features might be incorporated into the model, and would in turn strengthen the results of this paper.

12. This value for η seems quite reasonable from a macroeconomic perspective. If η were to be close to zero, this would imply that a change in the relative price of the two consumption goods would not change the relative makeup of the consumption bundle, which is inconsistent with the observation that all other countries seem to consume fewer medical goods and services relative to total consumption, compared to people in the United States. On the other hand, if η were to be too large, then a small variation in the relative price would generate implausibly large shifts in the consumption bundle, which also seems to be inconsistent with casual observation. Therefore, it would seem that a reasonable number for this elasticity should be less than one, but not close to zero.

13. See p. 28 in McGrattan and Prescott (2000).

14. According to McGrattan and Prescott (2000), the average consumption tax rate is 8.6%. Of course, this should be added to the labor tax rate, because it is well known that a consumption tax has the same impact as a labor tax. Purchases of medical commodities are still subject to a sales or consumption tax, and so adding in this tax would not further distort the margin between medical goods and nonmedical goods. However, the addition of this tax would certainly reduce the incentive to seeking employment, and would make the effect of our policy experiments more pronounced.

15. Boskin (2011) suggests that the marginal tax rate on labor income is already at 44.1%, even though he also ignores the tax on consumption goods.

16. Obviously this is *not* to suggest that it is *optimal* to give a tax subsidy to the purchase of medical services. Clearly, the best policy is to reduce taxes to as low as possible, which is the policy that is to be studied in the following.

17. We have conducted a number of other sensitivity analyses. For example, the function in (25) describing the transition probability is of an exponential form, which is a special case of the Gamma distribution, with the shape parameter set to 1. If we replace it with a Gamma distribution, but set the shape parameter to 0.1 (5), while calibrating the scale parameter to be consistent with an initial benchmark unemployment rate of 5.1%, then this leads to very modest changes in results: the reform results in 1.85% (2.0%) welfare cost, and a 5.53% (5.74%) unemployment rate. Also, other functional forms are used in modeling disutility from labor, other than the quadratic form in (24). The results are resilient to such changes, and the basic conclusions continue to hold. For example, if the quadratic

form is changed to a power of 1.1 (10), whereas the parameters governing the transition probability are calibrated to be consistent with an initial benchmark unemployment rate of 5.1%, then the results from the reform have a 2.11% (1.74%) welfare cost and a 5.9% (5.35%) unemployment rate. In all such experiments, similar conclusions hold when the labor tax rate is reduced along with the reform so that tax revenue and transfer remain unchanged before and after the reform.

18. There is yet another finance option that could be contemplated. One could imagine the government providing the medical commodity to all households, and financing it by increasing the capital income tax rate. Because the capital tax results in rather high welfare costs, such a policy seems destined to result in a substantial reduction in output and welfare. The results from this could be very harmful.

19. Although declining considerably, the postreform ratio of medical expenditure to aggregate consumption would not go all the way down to the level observed in most European countries. In a similar vein, although increasing remarkably, the postreform unemployment rate would not increase to the level observed in most European countries. These should not be surprising, given that our counterfactual analysis is abstracted from other cross-country technological and institutional differences than the preferential tax treatment of employer-provided medical benefits, such as differences in tax wedges or unemployment insurance, which may also play important roles in shaping the cross-country differences in medical expenditure-to-aggregate consumption ratio or in unemployment rate.

20. These costs could be viewed as additional or supplementary costs to those documented by Jeske and Kitao (2009). They show how eliminating the current tax preference for employer-provided health insurance may harm insurance coverage for individuals.

21. The welfare result that we have demonstrated in this paper may even be strengthened by recognizing that, in a more general context, there may be similar additional benefits to tying the provision of medical insurance or care to employment. The general point is that, to the extent that there exist impediments to individuals obtaining and maintaining employment, the fact that employers may offer relatively inexpensive medical insurance or care may be a sufficiently attractive reward to motivate individuals to seek and retain employment. For example, one impediment or hindrance to having able-bodied individuals seek employment might be unemployment insurance, or other relevant government programs. To the extent that these programs result in higher unemployment, it may be desirable to have another program, such as a tax incentive for medical insurance or care purchased through employers, to raise the incentive to individuals to seek employment.

REFERENCES

Abowd, John and Arnold Zellner (1985) Estimating gross labor-force flows. *Journal of Business and Economic Statistics* 3, 254–283.

Andolfatto, David (1996) Business cycles and labor-market search. *American Economic Review* 86, 112–132.

Bassanini, Andrea and Pascal Marianna (2009) Looking inside the Perpetual-Motion Machine: Job and Worker Flows in OECD Countries. Discussion paper 452, Institute for Study of Labor, Bonn.

Blanchard, Olivier and Peter Diamond (1990) The cyclical behavior of the gross flows of U.S. workers. *Brookings Papers on Economic Activity* 2, 85–143.

Boskin, Michael J. (2011) Get ready for a 70% marginal tax rate. *Wall Street Journal*, p. A13, July 18.

Burdett, Kenneth and Dale T. Mortensen (1977) Labor Supply under Uncertainty. Discussion paper 297, Northwestern University, Chicago.

Chen, Kaiji, Ayse Imrohoroglu, and Selahattin Imrohoroglu (2009) A quantitative assessment of the decline in the U.S. current account. *Journal of Monetary Economics* 56, 1135–1147.

Clark, Kim B. (1990) Unemployment insurance and labor market transitions. In Lawrence Summers (ed.), *Understanding Unemployment*. Cambridge, MA: MIT Press.

Congressional Budget Office (2009) The Effects of Two Specified Policy Options to Health Care on the Federal Budget Deficit. Letter to the Honorable Paul Ryan. http://www.cbo.gov/ftpdocs/105xx/doc10563/09-21-RyanLtr.pdf.

Employee Benefit Research Institute (2000) Sources of Health Insurance and Characteristics of the Uninsured. Employee Benefit Research Institute, Washington, DC.
Fang, Hanming and Alessandro Gavazza (2011) Dynamic inefficiencies in an employment-based health-insurance system: Theory and evidence. *American Economic Review* 101, 3047–3077.
Feldstein, Martin and Bernard Friedman (1977) Tax subsidies, the rational demand for insurance and the health care crisis. *Journal of Public Economics* 7, 155–178.
Fonseca, Raquel, Pierre-Carl Michaud, Titus Galama, and Arie Kapteyn (2008) Retirement and the Demand for Health. Working paper, RAND, Santa Monica, CA.
Gould, Elise (2004) The Chronic Problem of Declining Health Coverage: Employer-Provided Health Insurance Falls for a Third. Economic Policy Institute.
Grossman, Michael (1972) On the concept of health capital and the demand for health. *Journal of Political Economy* 80, 223–255.
Gruber, Jonathan and Brigitte C. Madrian (2002) Health Insurance, Labor Supply, and Job Mobility: A Critical Review of the Literature. NBER Working Paper 8817, National Bureau of Economic Research.
Guler, Bulent, Fatih Guvenen, and Giovanni L. Violante (2011) Joint-Search Theory: New Opportunities and New Frictions. Working paper, University of Minnesota, Minneapolis.
Hall, Robert E. (2005a) Employment efficiency and sticky wages: Evidence from flows in the labor market. *Review of Economics and Statistics* 87, 397–407.
Hall, Robert E. (2005b) Job loss, job finding, and unemployment in the U.S. economy over the past fifty years. *NBER Macroeconomics Annual* 20, 101–137.
Halliday, Timothy J., Hui He, and Hao Zhang (2011) Health Investment over the Life-Cycle. Working paper, University of Hawaii, Manoa.
Jeske, K. and S. Kitao (2009) U.S. tax policy and health insurance demand: Can a regressive policy improve welfare? *Journal of Monetary Economics* 56, 210–221.
Jung, Juergen and Chung Tran (2011) Market Inefficiency, Insurance Mandate and Welfare: U.S. Health Care Reform 2010. Working paper, Towson University, Towson, MD.
Layard, Richard, Stephen Nickell, and Richard Jackman (1991) *Unemployment: Macroeconomic Performance and the Labour Market.* Oxford, UK: Oxford University Press.
Lucas, Robert E., Jr. (1987) *Models of Business Cycles*. Oxford, UK: Basil Blackwell.
Lucas, Robert E., Jr. and Edward C. Prescott (1974) Equilibrium search and unemployment. *Journal of Economic Theory* 7, 188–209.
Mankart, Jochen and Rigas Oikonomou (2011) Household Search and the Aggregate Labor Market. Job market paper, London School of Economics, London.
McGrattan, Ellen R. and Edward C. Prescott (2000) Is the stock market overvalued? *Federal Reserve Bank of Minneapolis Quarterly Review,* 20–40.
Merz, Monika (1995) Search in the labor market and the real business cycle. *Journal of Monetary Economics* 36, 269–300.
Mortensen, Dale T. (1990) Search Equilibrium and Real Business Cycles. Working paper, Northwestern University.
Pries, Michael and Richard Rogerson (2005) Hiring policies, labor market institutions, and labor market flows. *Journal of Political Economy* 113, 811–839.
Scholz, John Karl and Ananth Seshadri (2010) Health and Wealth in a Life-Cycle Model. Working paper 2010-224, University of Michigan, Ann Arbor.
Shimer, Robert (2007) Reassessing the Ins and Outs of Unemployment. NBER working paper 13421, National Bureau of Economic Research.
Wang, Cheng and Stephen Williamson (1996) Unemployment insurance with moral hazard in a dynamic economy. *Carnegie–Rochester Conference Series on Public Policy* 44, 1–41.
Yogo, Motohiro (2009) Portfolio Choice in Retirement: Health Risk and the Demand for Annuities, Housing, and Risky Assets. NBER working paper 15307, National Bureau of Economic Research.
Zhao, Kai (2010) Social Security and the Rise in Health Spending: A Macroeconomic Analysis. Working paper, University of Western Ontario.