Dynamic Inefficiencies in an Employment-Based Health-Insurance System: Theory and Evidence*

Hanming Fang† Alessandro Gavazza‡

November, 2010

Abstract

We investigate the effects of the institutional settings of the U.S. health-care system on individuals' life-cycle medical expenditures. We argue that health is a form of human capital that affects labor productivity, and that the employment-based health-insurance system may lead to inefficient investment in individuals' health care. The reason is that labor turnover and frictions in the labor market prevent an employer-employee pair from capturing the entire surplus from investment in an employee's health. Thus, the pair underinvests in health capital, and this underinvestment increases medical expenditures during retirement.

We provide extensive empirical evidence consistent with the comparative statics predictions of our model using two datasets, the Medical Expenditure Panel Survey (MEPS) and the Health and Retirement Study (HRS). The magnitude of our estimates suggests a significant degree of inefficiency in health investment in the U.S.

JEL Classification Numbers: D84, D91, I12

*We are grateful to Daron Acemoglu, Luis Cabral, Michael Chernew, Keith J. Crocker, Amy Finkelstein, Igal Hendel, Stephen Morris, Jörn-Steffen Pischke, Aloysius Siow, as well as seminar participants at Connecticut, Maryland, Rice/Houston, Texas A&M, Fudan, Peking, Stanford, Yale, NBER, ERIU Conference (Ann Arbor), and IOMS Workshop (Shanghai) for many helpful comments and suggestions. Special thanks to Ray Kuntz and Michael Nolte for help with the MEPS and HRS data, respectively. We are responsible for all shortcomings.

†Department of Economics, University of Pennsylvania, 3718 Locust Walk, Philadelphia, PA 19104; and the NBER. Email: `hanming.fang@econ.upenn.edu`

‡New York University, Leonard N. Stern School of Business, 44 West 4th Street, Suite 7-81, New York, NY 10012. Email: `agavazza@stern.nyu.edu`

1 Introduction

The United States is unique among industrialized nations in that it lacks a national health-insurance system, and a private, employment-based system provides insurance to most of the working-age population. In this paper, we investigate the effects of the institutional settings of the U.S. health-care system on individuals' life-cycle medical expenditures. The core idea of this paper is that in labor markets with frictions, an employment-based system can lead to inefficiently low investment in employees' health because part of the returns from the current health investment accrues to future employers.

Our premise is that health is a form of general human capital (Becker, 1964) and that health investment—medical expenditures, in particular—determines the evolution of health stock (Grossman, 1972). Hence, like all other forms of human capital, health increases labor productivity, thereby affecting the surplus generated in the employment relationship. Current health expenditures, therefore, are an investment that affects the surpluses of *both* current and future employment relationships. We embed this link between health investment and employment surplus in a frictional labor-market model, as in Acemoglu and Pischke (1999), and derive the implications of employee turnover on the employer-employee pair's incentives to invest in the employee's health.[1]

We show that employee turnover leads to an inefficiently low level of investment in employees' health and that the investment is lower and the inefficiencies larger when employee turnover is higher. The reason is that labor-market frictions imply that future employers capture part of the surplus generated from the current investment in the employee's health. Hence, the employer-employee pair does not internalize the full social surplus created by the current investment in the employee's health. As a result, the pair underinvests in health capital. Further, we show that this inefficiently low level of medical expenditures during the working years increases medical expenditures during retirement, possibly increasing overall expenditures.

We provide extensive empirical evidence consistent with the predictions of the model using two datasets, the Medical Expenditure Panel Survey (MEPS) and the Health and Retirement Study (HRS). Our empirical model is designed to deal explicitly with two issues that may make it difficult to identify the effect of job turnover on health investment. The first is

[1] Any health expenditure that affects an individual's future health conceptually falls under our definition of health investment. Examples of such health investment include any preventive care, such as cancer screening, cholesterol checks, diabetes management, etc. Moreover, to the extent that not completely recovering from illnesses has long-lasting negative health effects, most, if not all, curative-care expenditures are health investments, as well.

selection: Workers may select into different jobs due to unobserved characteristics, such as ability, discount factor, risk aversion, etc., that could potentially be correlated with both their job turnover and health investment. The second is *reverse causality*: Workers' health outcomes and health expenditures could affect their job turnover. We deal with these issues using panel data to control for fixed and persistent unobservables that could affect selection into different jobs, along with demand-side instruments (e.g., plant closures) that arguably are not affected by reverse causality.[2]

We find that workers with shorter job tenures spend less on health care. However, we find a stark reversal of expenditures among the elderly, in that retirees who had longer pre-retirement job tenures spend less on health care. The magnitude of our results is considerable: Workers whose log job tenures are one standard-deviation longer have medical expenditures about \$500 higher per year; however, individuals over 65 whose tenure at their main pre-retirement job is one standard-deviation longer spend about \$4,160 less per year on health care. Using these estimates, we can perform a back-of-the-envelope calculation to compare the lifetime medical expenditures of two workers whose only difference is their job tenures. Suppose that both individuals work 45 years and then retire for 15 years before dying, but the first individual's job tenure is one standard-deviation longer than the second individual's. According to our estimates, during their working years, the first individual spent approximately \$22,250 more on health care than the second individual did; however, during retirement, the first individual's health expenditures would be approximately \$62,500 lower than the second individual's. The first individual's total lifetime health expenditures are about \$40,000 less than the second individual's. This calculation suggests that one additional dollar of health expenditures during one's working years may lead to approximately 2.8 dollars of savings in retirement. Obviously, our calculation is very rough, as it does not incorporate discounting, does not adjust for the inflation of medical prices, and does not adjust for differences in quality of life and life expectancy. Nonetheless, it suggests that the dynamic externalities highlighted in our model can be substantial and may account, in part, for the high overall medical expenditures in the United States.[3]

This paper makes several contributions. First, it sheds light on the incentives generated

[2] In online Appendix C, we present an alternative empirical approach that uses a measure of the importance of specific skills in each industry as a proxy for an industry's labor-turnover rate. The results are qualitatively similar.

[3] The U.S. spends more than twice as much on health care as a fraction of G.D.P. as other developed countries. For example, in 2005, the U.S. and the U.K. spent about 17 and eight percent of their GDP, respectively, on health care (Hagist and Kotlikoff, 2005).

by the employment-based health-insurance system. We wish to emphasize at the outset that our paper is *not* about health insurance *per se*. Rather, we investigate how the health-insurance system affects incentives to invest in health. By focusing on health investment, we do not tackle the difficult incidence issue of how much of the health-insurance premium is actually paid for by the firms and by the workers (Gruber, 1994). Instead, we focus on how an employment-based system fails to internalize the entire surplus generated by health investment, leading to dynamic inefficiencies.

Second, the paper suggests that different institutional arrangements of the health-care system can lead to different life-cycle dynamics of health expenditures. Our analysis indicates that in the U.S., because of job turnover, the increase in expenditures over the life-cycle is steeper when the parties—i.e., the employer-employee pair—appropriate a smaller share of the entire surplus generated by their health investment. Thus, our paper suggests that an employment-based system, as compared to a national health-insurance system, may steepen the increase of health expenditures over an individual's life-cycle.[4] Moreover, by not internalizing the full long-term benefits of health investment, an employment-based health system can also increase the overall expenditure level.

Third, taking the view that health is a form of general human capital, our paper also serves as an empirical analysis of how firms and workers invest in general human capital. In fact, we believe that health expenditures are particularly suited to studying how firms and workers jointly determine the *level* of general human capital investment. The reason is that health expenditures are typically well-recorded, as most health investment is provided by third-party medical professionals with well-documented charges. In contrast, for almost all other investments in general human capital, it is quite difficult to obtain a quantitative measure of total costs and each party's contribution.[5]

The remainder of the paper is structured as follows. Section 2 reviews the related literature. Section 3 presents a simple model and derives its testable implications. Section 4 describes the data sets. The main empirical analysis is performed in Section 5. Section 6 provides additional evidence and presents robustness checks. Section 7 discusses several alternative hypotheses. Section 8 concludes. The Appendix provides more-detailed information on the

[4]Systematic comparisons of the dynamics of individuals' total health expenditures over the life-cycle across different countries are limited. One related piece of evidence is in Hagist and Kotlikoff (2005), which focuses only on public health expenditures. They report that the ratio of per capita health expenditures of the 65-69 age group relative to that of the 50-64 age group is approximately five times higher in the U.S. than in nine other OECD countries.

[5]In these situations, it is often the case that only firms' general training expenditures may be recorded, while workers' contribution to general investment is unobserved.

Arellano and Bond (1991) methodology that we employ in the empirical analysis of Section 5. The online appendices collect additional results, including an extension of the model that accommodates firm-specific capital, along with an alternative empirical strategy that obtains similar qualitative and quantitative results. We discuss some of the results reported in these online appendices in the main text.

2 Related Literature

The economic hypothesis that lies at the heart of our paper is that medical expenditures improve health, and healthy workers have higher productivity. The literature on this subject is vast, and, using different methods and different data, most papers share the findings that medical expenditures improve health and that healthier individuals are more productive. For a thorough survey on the relationships among medical expenditure, health and productivity, see Tompa (2002).

The paper is related to several strands of the literature. The most closely related papers are those that focus on dynamic inefficiencies in markets with frictions—labor and insurance markets, in particular. Specifically, one of the most celebrated results in the classical theory of human capital is that in a frictionless and competitive labor market, workers capture all the returns from their general human capital investments (Becker, 1962, 1964). Thus, workers pay for the entire costs of general human capital investments, as they obtain the full return from them and invest the efficient amount. The empirical observation that firms often pay for general training of their employees—in contrast to the predictions of the classical human capital theory—has stimulated a few recent theoretical explanations. Acemoglu and Pischke (1998, 1999) show that, when labor-market frictions lead to "wage compression," firms may pay for investments in the general skills of their employees.[6,7] The compression in the wage structure transforms "technologically" general skills into *de facto* "specific" skills, thus providing firms with incentives to invest in their workers' general skills. Even though Acemoglu and Pischke's theoretical models also yield testable predictions about the *level* of general human capital investment, most of the literature has focused exclusively on why firms *share* the costs of general training.

[6] Acemoglu and Pischke (1998, 1999) consider many potential forms of market frictions, including search friction, asymmetric information, complementarity between general and specific skills, etc.

[7] Recent papers by Balmaceda (2005) and Kessler and Lülfesmann (2006) show that, under some surplus-sharing rules, specific and general human capital endogenously interact. Thus, even if the labor market is competitive, an employer may choose to contribute to workers' general training.

Similarly, a few papers investigate dynamic inefficiencies in insurance markets (Hendel and Lizzeri, 2003; Crocker and Moran, 2003; Finkelstein, McGarry and Sufi, 2005, Herring, 2010; and Cebul *et al.*, forthcoming). Hendel and Lizzeri (2003), Crocker and Moran (2003), and Finkelstein, McGarry and Sufi (2005) consider a different inefficiency from the one that we highlight. In particular, these papers suggest that inefficient risk-sharing arises when parties do not commit to long-term insurance contracts since short-term contracts cannot insure the reclassification risk arising from a change in insurees' risk type.[8] To some extent, the dynamic inefficiency in our analysis is also related to the inability of workers to commit to long-term employment with the firm. Closer to our paper is Crocker and Moran (2003), which argues that workers in industries with higher specific-skill requirements are more committed to their firms, thereby allowing their employers to provide more complete *insurance* of health risks. In contrast, we focus on health investment and health outcomes, and on the trade-off between the short-term costs and the expected long-term gains of current health expenditures.

Beaulieu *et al.* (2007), Herring (2010) and Cebul *et al.* (forthcoming) consider a type of inefficiency similar to the one on which we focus. In an interesting study of diabetes management, Beaulieu *et al.* (2007) find that improved diabetes care has economic benefits for health plans, as well as valuable benefits for diabetics. However, some of the long-term savings from good care management are not realized because plan turnover limits the health plan's ability to privately capture the benefits from its investments. Herring (2010) argues that insurees' turnover may reduce an insurer's incentives to provide the socially-optimal level of preventive care. Using data from the Community Tracking Study's Household Survey, Herring finds that insurers' turnover has a negative effect on the utilization of preventive services. Cebul *et al.* (forthcoming) studies the effect of search frictions in the market for employer-based health insurance and makes the point that frictions in insurance markets may reduce incentives to invest in future health. While clearly complementary, there are several key differences between our paper and Beaulieu *et al.* (2007), Herring (2010) and Cebul *et al.* (forthcoming). First, we focus on employees' turnover rates, while these other papers focus on enrollees' turnover among insurance companies. Employers and workers enjoy most of the costs and benefits of medical expenditures, so we believe it is appropriate to focus on them. Moreover, almost half of all firms and more than 80 percent of firms with more than 5,000 employees are self-insured (Barr, 2007, p. 84). For these self-insured firms, insurers only administer the claims for the firms. Second, we examine the dynamics of medical expenditures

[8]Diamond (1992) mentions that the lack of long-term health insurance is an important market failure. Cochrane (1995) shows that sequences of short-term contracts with properly chosen severance payments can fully insure consumers against reclassification risk. See, also, Pauly, Kunreuther and Hirth (1995).

over an individual's life-cycle. Specifically, we investigate how retirees' medical expenditures and health status are related to their turnover rates prior to retirement. This allows us to understand the order-of-magnitude of the dynamic externality on which we focus.

The paper is also related to the literature on the interactions between health-care markets and labor markets. Several papers examine how employer-provided health insurance may lead workers to keep jobs they would rather leave, for fear of losing insurance coverage for preexisting conditions (Madrian, 1994; Gruber and Madrian, 1994, 1997, 2002; Currie and Madrian, 1999). Our paper complements these studies by focusing on a related, but conceptually different, link between the health-care market and the labor market in the U.S. In particular, in contrast to most papers in this strand of the literature, our paper delves deeper into the incentives generated by the institutional arrangements that govern health care, especially employer-provided health-insurance and the interaction between private and public insurance. Thus, our paper is also related to the literature that examines the interactions between public and private insurances (Cutler and Gruber, 1996; Brown and Finkelstein, 2008). Most of these papers focus on how public insurance programs crowd out the demand for private insurance. Thus, while these papers consider the *contemporaneous* interaction between the public and private insurances, we focus on the *intertemporal* interactions and on health investment, rather than on insurance.

3 A Simple Model

In this section, we present a simple model that adapts the theoretical framework of Acemoglu and Pischke (1999) to health expenditures. The goal of the model is to capture in the simplest way the effect of workers' turnover on the incentives to invest in health. In particular, we make the simplest assumptions to focus on the dynamic externality that we described in the Introduction.

3.1 Assumptions

There are two periods with no discounting. Health is a form of general human capital and, thus, it is an input in the production function of the worker. For simplicity, we assume that health is the only input in the production function $f(h)$, where $f(\cdot)$ is assumed to be increasing, differentiable and concave.[9] Workers are risk-neutral, and are endowed with an

[9]Of course, healthier individuals may also *directly* enjoy a higher quality of life. We abstract from these incentives to invest in health. As long as health investment affects workers' productivity, the qualitative results

initial stock of health h_1. In the first period, workers can invest m_1 in health at a unit cost p. Health stock evolves according to

$$h_2 = k\left(h_1, m_1\right),$$

where $k\left(\cdot,\cdot\right)$ is the health production function, which we assume to be continuous and increasing in the initial stock of health h_1 and in the investment in health m_1—i.e. $\partial k/\partial h_1 > 0$ and $\partial k/\partial m_1 > 0$.

In the second period, the firm and the worker separate with an exogenous probability $q \in (0,1)$. If they separate, the worker gets an outside wage of $v\left(h_2\right)$, and the firm gets a surplus of zero. If they do not separate for exogenous reasons, the worker decides whether to stay with the firm and obtain the (endogenous) wage $w_2\left(h_2\right)$ or to quit and obtain the (exogenous) outside wage of $v\left(h_2\right)$. It is important to note that the worker's productivity is $f\left(h_2\right)$ in both the current and outside firms; however, if the worker leaves her current firm, for either exogenous or endogenous reasons, she receives a wage equal to $v\left(h_2\right)$.[10] Acemoglu and Pischke (1999) assume that $v\left(h_2\right) < f\left(h_2\right)$ to reflect labor-market frictions and, more importantly, that $v'\left(\cdot\right) < f'\left(\cdot\right)$, which they term *wage compression.* Acemoglu and Pischke (1999) provide a variety of mechanisms that can lead to a wedge between $f\left(h_2\right)$ and $v\left(h_2\right)$—i.e., between a worker's productivity and her wage at other firms. Similarly, they describe several mechanisms that endogenously generate wage compression.[11]

We follow Acemoglu and Pischke's (1999) *full-competition regime,* in which firms in the first period compete for workers by offering them $\{w_1, m_1\}$, and in equilibrium they make zero profits.

3.2 Equilibrium

If the worker and the current firm do not separate for exogenous reasons, their employment relationship generates a surplus equal to $f\left(h_2\right) - v\left(h_2\right)$ since $f\left(h_2\right)$ is the output generated by the worker, and $v\left(h_2\right)$ is the wage that the worker gets if she quits voluntarily. We assume that this surplus $f\left(h_2\right) - v\left(h_2\right)$ is divided between the worker and the firm according to the Nash Bargaining solution, in which $\beta \in (0,1)$ represents the worker's bargaining power. Hence, the

of the model are not affected if workers also enjoy direct utility from health.

[10]The results do not change if we assume that the worker's productivity in the outside job is equal to $\gamma f\left(h_2\right)$, with $0 < \gamma < 1$.

[11]Several papers provide empirical evidence on wage compression: Beckmann (2001) and Frazis and Loewenstein (2006), among others.

wage $w_2(h_2)$ that the worker obtains if she does not quit is:

$$w_2(h_2) = (1-\beta)\, v(h_2) + \beta f(h_2).$$

Thus, the firm's expected profit in period two is:

$$\begin{aligned}\pi_2(h_2) &= (1-q)\left[f(h_2) - w_2(h_2)\right] \\ &= (1-q)(1-\beta)\left[f(h_2) - v(h_2)\right].\end{aligned}$$

The firm's first-period profit is:

$$\pi_1(h_1) = f(h_1) - w_1 - pm_1,$$

where w_1 is the worker's first-period wage, and m_1 is the worker's first-period medical expenditures, both to be determined in equilibrium.

Thus, the sum of profits for the firm in the two periods (recall the no-discounting assumption for simplicity) is:

$$\Pi = \pi_1(h_1) + \pi_2(h_2) = f(h_1) - w_1 - pm_1 + (1-q)(1-\beta)\left[f(h_2) - v(h_2)\right]. \tag{1}$$

Ex-ante competition among firms for the worker requires that the firm choose m_1 and w_1 to maximize the sum of profits Π, subject to the constraint that the worker receives as much utility as that offered by other firms U—i.e.,

$$w_1 + (1-q)\left[(1-\beta)\, v(h_2) + \beta f(h_2)\right] + qv(h_2) \geq U. \tag{2}$$

Competition for the worker among firms implies that the utility level U is high enough such that, in equilibrium, the firm makes zero profits—i.e., $\Pi = \pi_1(h_1) + \pi_2(h_2) = 0$.

Now, from equation (2), we have that, in equilibrium, the wage satisfies:

$$w_1 = U - (1-q)\left[(1-\beta)\, v(h_2) + \beta f(h_2)\right] - qv(h_2). \tag{3}$$

Substituting the equilibrium worker's wage (3) into the firm's profit function (1) and maximizing with respect to the level of medical expenditures m_1, we obtain that the equilibrium level of medical expenditures m_1^* solves the following first-order condition:

$$\left[qv'(k(h_1, m_1^*)) + (1-q)\, f'(k(h_1, m_1^*))\right] \frac{\partial k}{\partial m_1} = p. \tag{4}$$

Equation (4) implies that investment in health is socially inefficient unless there is never separation ($q = 0$). To see this, note that the efficient level of health investment $\hat{m}_1$ solves

$$f'(k(h_1, \hat{m}_1)) \frac{\partial k}{\partial m_1} = p, \tag{5}$$

which equates the marginal social benefit of medical expenditures $f'(k(h_1, \hat{m}_1)) \partial k/\partial m_1$ to their marginal cost p. The social benefit of health investment is given by the worker's productivity $f(h_2)$, which is independent of her employer, reflecting the nature of health as a form of general capital. The comparison between (4) and (5) reveals that the equilibrium health investment m_1^* is lower than the socially efficient level $\hat{m}_1$ because of wage compression—i.e., $v'(\cdot) < f'(\cdot)$.

Moreover, Proposition 1 investigates the effect of the turnover probability q on the equilibrium level of medical expenditures m_1^*, yielding the first implication that we empirically test in Section 5.1:

Proposition 1 *A decrease in the turnover rate q increases equilibrium health expenditures m_1^*.*

Proof. From equation (4), let us define $\lambda(m_1^*, q)$ as:

$$\lambda(m_1^*, q) = [qv'(k(h_1, m_1^*)) + (1-q) f'(k(h_1, m_1^*))] \frac{\partial k}{\partial m_1} - p = 0.$$

Using the implicit function theorem, we have:

$$\frac{\partial m_1^*}{\partial q} = -\frac{\partial \lambda(m_1^*, q)/\partial q}{\partial \lambda(m_1^*, q)/\partial m_1^*}.$$

From the wage compression assumption $f' > v'$, we can obtain the following inequality:

$$\frac{\partial \lambda(m_1^*, q)}{\partial q} = -[f'(k(h_1, m_1^*)) - v'(k(h_1, m_1^*))] \frac{\partial k}{\partial m_1} < 0.$$

Moreover, the necessary second-order condition implies that:

$$\begin{aligned}\frac{\partial \lambda(m_1^*, q)}{\partial m_1^*} &= [qv''(k(h_1, m_1^*)) + (1-q) f''(k(h_1, m_1^*))] \left(\frac{\partial k}{\partial m_1}\right)^2 \\ &\quad + [qv'(k(h_1, m_1^*)) + (1-q) f'(k(h_1, m_1^*))] \frac{\partial^2 k}{\partial m_1^2} < 0.\end{aligned}$$

■

3.3 Dynamics of Health Expenditures

We now provide a simple extension of our model to understand how health expenditures early in life affect health expenditures later on. In particular, we now assume that there is also a third period, in which the individual is retired. In this third period, health still affects the utility of the individual—because of domestic production, for example. Formally, we assume that the utility of the individual is $d(h_3)$, with $d'(\cdot) > 0$. Moreover, h_3 evolves according to the following function:

$$h_3 = \min\left\{k(h_2, m_2), \overline{h}_3(h_2)\right\},$$

where h_2 is the individual's pre-retirement health, m_2 is the medical expenditures in period two, and $k(\cdot,\cdot)$ is the standard health production function with $\partial k(\cdot)/\partial h_2 > 0$ and $\partial k(\cdot)/\partial m_2 > 0$. The function $\overline{h}_3(\cdot)$, with $\overline{h}_3'(\cdot) \geq 0$, captures in a reduced-form way the idea that the pre-retirement health stock h_2 determines the maximum level of health that can be achieved during retirement. For simplicity, we assume that all expenditures m_2 come *at no cost* to the retiree. This stark assumption reflects the fact that almost all retirees are covered by Medicare, and, thus, they do not bear the full costs of their medical expenditures.

Given these assumptions, all individuals choose medical expenditures m_2^* so that their health reaches $\overline{h}_3(h_2)$—i.e.,

$$k(h_2, m_2^*) = \overline{h}_3(h_2). \tag{6}$$

Applying the implicit function theorem to equation (6), we obtain that:

$$\frac{\partial m_2^*}{\partial h_2} = \frac{\partial \overline{h}_3/\partial h_2 - \partial k/\partial h_2}{\partial k/\partial m_2}.$$

Thus, we have $\partial m_2^*/\partial h_2 < 0$ if and only if $\partial \overline{h}_3/\partial h_2 - \partial k/\partial h_2 < 0$. A sufficient condition for this assumption to be satisfied is that one's health potential in retirement $\overline{h}_3(\cdot)$ is not too sensitive to current health stock h_2 (i.e., $\partial \overline{h}_3/\partial h_2$ is sufficiently small). For example, it is trivially satisfied if $\overline{h}_3(\cdot)$ is constant.

We can now combine the above discussion with our Proposition 1 and provide the full set of empirical implications that we test in Section 5:[12]

Proposition 2 *If $\partial \overline{h}_3/\partial h_2 < \partial k/\partial h_2$, then workers in jobs with lower turnover rates have:*

(i) higher medical expenditures m_1^* while working; and

(ii) lower medical expenditures m_2^* and better health during retirement.

[12]The extension of the model to include a retirement period will change the first-order condition for equilibrium level of m_1^* from (4) to:

$$\left[qv'(k(h_1, m_1^*)) + (1-q) f'(k(h_1, m_1^*)) + d'\left(\bar{h}_3(h_2)\right)\bar{h}_3'(h_2)\right]\frac{\partial k}{\partial m_1} = p.$$

Proposition 1 and its proof remain unchanged.

4 Data

We use several distinct data sources in our empirical analysis. In particular, we use the annual Medical Expenditure Panel Survey (MEPS) and the bi-annual Health Retirement Study (HRS) to study the medical expenditures and medical care utilization of working individuals and retirees, respectively. We complement MEPS and HRS with additional variables that we use to construct instruments obtained from the Statistics of U.S. Businesses (SUSB). Furthermore, we use the annual British Household Panel Survey (BHPS) to perform falsification tests on U.K. workers. Since all these datasets are publicly available, we describe them only briefly here and refer the reader to their respective websites for a more thorough description.[13]

Medical Expenditure Panel Survey (MEPS). The Medical Expenditure Panel Survey (MEPS) is a set of large-scale annual rotating panel surveys of families and individuals, their medical providers, and employers across the U.S. It is designed to provide nationally representative estimates of health care use, expenditures, sources of payment, and insurance coverage for the U.S. civilian non-institutionalized population.

MEPS has several components, and the Household Component (HC) serves our purposes. HC provides data from individual households and their members, supplemented by data from their medical providers. HC surveys households in two consecutive years, collecting detailed information for each person in the household on demographic characteristics, health conditions, health status, use of medical services, charges and source of payments, access to care, satisfaction with care, health-insurance coverage, income, and employment. The public version of the survey reports the one-digit codes of industry and occupation of the individual.[14] In our empirical analysis in Section 5.1, we use MEPS data from the 1996-2006 surveys. We deflate all monetary values using the GDP Implicit Price Deflator, with 2000 as the base year.

Health and Retirement Study (HRS). The Health and Retirement Study (HRS) began as a panel survey of a nationally representative sample of people aged 51 to 61 in 1992, as well as their spouses, with over-samples of blacks, Hispanics and Florida residents. This original cohort (wave one) has been re-interviewed every other year since then. In 1998, the sample was supplemented with both older and younger cohorts. Eight waves are currently available.

[13]The MEPS is available at `http://www.meps.ahrq.gov`; the HRS is available at `http://hrsonline.isr.umich.edu`; the SUSB is available at `http://www.census.gov/csd/susb`; and the BHPS is available at `http://www.iser.essex.ac.uk/survey/bhps`.

[14]The three-digit industry codes are contained in a version restricted from public access.

HRS contains detailed information about the current and past health status of respondents, along with rich data on their job history and information about economic and demographic variables, including education, income, and wealth. Beginning with wave three, the survey asks questions about total medical expenditures. In some waves, a continuous value is reported, while in others, a series of unfolding bracket questions are asked. Based on these brackets (and some additional variables), the RAND Corporation imputes a continuous value of total medical expenditures in each wave, and this is the main dependent variable that we use in our empirical analysis on retirees. As with MEPS, we also deflate all monetary values using the GDP Implicit Price Deflator, with 2000 as the base year.

The HRS also asks questions about the individual's employment history. A respondent is asked about past jobs at his/her first interview. From the responses, the RAND Corporation reconstructs the years of tenure at the longest reported job and the one-digit industry codes of the longest job.[15] Because total medical expenditures were surveyed from 1996 (wave three), we use HRS data from 1996 to 2002 in the analysis in Section 5.2.[16] Furthermore, our sample includes only individuals over 66 years of age. This age restriction is dictated by the fact that in each wave, HRS reports the medical expenditures for the previous two years, and we want our individuals to have access to similar medical coverage through Medicare.

Statistics of U.S. Businesses (SUSB). The Statistics of U.S. Businesses (SUSB) is a data set extracted from the Business Register, a file of all known single- and multi-establishment companies maintained and updated by the U.S. Census Bureau. The Business Register is the same database that is used to produce County Business Patterns (CBP). SUSB shares some features with CBP. It provides national and sub-national data on the distribution of economic data by size and industry, reporting the number of establishments, employment, and annual payroll for each geographic-industry-size cell.

More importantly, SUSB reports the number of establishments and corresponding employment change for births, deaths, expansions, and contractions by employment size of enterprise, industry, and state. We use data on establishment deaths to construct our instruments for job turnover in the empirical analyses in Sections 5.1 and 5.2.

[15]Employing the procedure that the RAND corporation uses for the one-digit industry code, we construct the three-digit industry code from the restricted-access HRS data, which are used in Section C.2 of the online Appendix.

[16]Only six waves were available when we started this project.

Table 1: Descriptive Statistics of Key Variables in MEPS and HRS Samples

	MEPS (1995-2005)		HRS (1996-2002)		BHPS (1995-2002)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Individual Medical Expenditure	1,832	6,111	8,327	24,707	...	...
Job Tenure	6.67	7.71	...	...	6.1	7.2
Longest Job Tenure	...	...	23.8	12.7	...	...
Age	38.92	11.89	75.1	6.8	41.1	12.3
Yrs. of Education	12.87	2.90	11.9	3.2	11.8	2.4
Income	$31,519	$25,525	...	...	£ 28,934	£ 22,129
Total Assets/10,000	...	...	3.34	8.12	...	...
Male	0.50	0.50	0.51	0.50	0.46	0.49
White	0.80	0.39	0.85	0.35	0.96	0.18
Black	0.14	0.34	0.13	0.33	...	...
Married	0.59	0.49	0.59	0.49	0.60	0.48
Family (Household) Size	3.21	1.60	1.94	0.93	3.00	1.32
Union	0.13	0.33	...	...	0.96	0.29

Notes: (I) Medical expenditures, income and total assets have been deflated to correspond to 2000 dollars in MEPS and HRS.

British Household Panel Survey (BHPS). The British Household Panel Survey (BHPS), an annual panel survey that began in 1991, follows about 5,500 households and 10,300 individuals drawn from 250 areas of Great Britain. It is a data set with rich individual-level demographic, social and economic variables, as well as detailed information on health-related issues, such as number of doctor visits and self-perceived health status.

4.1 Summary Statistics

Table 1 reports summary statistics for the main variables of the three data sets that we use in our analysis. Average annual medical expenditures are about 1,800 dollars per individual in MEPS, and about 8,300 dollars in HRS. Obviously, individuals are younger in MEPS than in HRS (39 years old versus 75 years old), and they have, on average, shorter job tenures (the average current job tenure in MEPS is 6.7 years, while the average longest pre-retirement job tenure in HRS is 23.8 years). Other individual characteristics—i.e., education, race, gender, and marital status—are roughly similar across the two data sets.

We employ multiple, distinct data sets because we are not aware of a single, publicly available data set that both follows many individuals over a long period of time and reports their employment history and their medical expenditures at several points in their lives, including retirement. MEPS and HRS are the best available data sets we know of to investigate how current and past job turnover affects the health expenditures of employed and retired individuals, respectively. In particular, these data sets report very detailed characteristics of the individuals, including the outcome variable that is the focus of our model: health expenditures. This richness of the data implies that we can control for several observed individual characteristics that are often unobserved in other studies. In particular, the time-series dimension of the data implies that we can construct an empirical model (described in detail in Section 5) that controls for unobserved factors that may simultaneously affect individual labor-market choices and health expenditures. Moreover, the similarity of data sets allows us to use the same variables—i.e., number and rates of plant closures—to construct instruments that shift labor-market histories.

5 Empirical Analysis

In this section, we test the main implications of the model. The empirical analysis closely follows Propositions 1 and 2: Using MEPS data, Section 5.1 investigates how job attachment affects the medical expenditures of employed individuals, and, using HRS data, Section 5.2 analyzes how past job attachment affects the medical expenditures of retired individuals.

5.1 Health Expenditures of Workers

To investigate the effect of job attachment on individuals' health investment and health status, we specify the following reduced-form regression equation:

$$y_{jirt} = \beta_0 + \beta_T \textsc{log}(\textsc{Job Tenure}_{jirt}) + \boldsymbol{\beta}_X \mathbf{X}_{jirt} + \eta_{rt} + \zeta_j + \epsilon_{jirt}, \tag{7}$$

where the dependent variable y_{jit} is one of the outcomes of interest (e.g., individual medical expenditures, individual doctor visits) for individual j working in industry i in region r in year t. The main explanatory variable of interest is (the log of) $\textsc{Job Tenure}_{jirt}$: the number of years the individual has been employed in his/her current job; $\mathbf{X}_{jirt}$ is a large set of control variables—e.g., a cubic polynomial in age, gender, race, years of education, annual income, family size, etc.; η_{rt} is a region r-year t fixed effect; ζ_j is an individual fixed effect; and ϵ_{jirt} is an unobservable component.

5.1.1 Empirical Challenges and Solutions

Two main issues challenge the identification of the effect of Job Tenure in equation (7). The first is selection: Workers are not randomly allocated to jobs. Individual characteristics induce different people to select into different jobs and different industries. If these characteristics are unobserved—as is the case with ability, discount factor, risk aversion, etc.—and are correlated with Job Tenure, then the estimated coefficient β_T will be biased. The second issue is reverse causality: Individual health may affect labor-supply decisions and, thus, individuals who have higher medical expenditures could be more or less likely to change jobs. For example, individuals in poor health may quit their jobs to receive medical care, leading to a downward bias in the coefficient β_T. Alternatively, as the literature on "job lock" has highlighted (e.g., Madrian, 1994), individuals without health insurance could be more likely to change jobs, and not having health insurance may lead them to spend less on health care, resulting in an upward bias in the coefficient β_T.

The panel component of MEPS (two years, at most) allows us to deal with selection by including individual fixed effects ζ_j to control for any fixed, individual unobserved factor. Moreover, we deal with the reverse causality due to labor-supply decisions by using instruments that shift the main endogenous variable—Job Tenure—for plausibly exogenous reasons. In particular, the SUSB data set reports the number and the rate of deaths of establishments in industry i and region r, as well as the number and the rate of workers that lost their jobs due to establishment deaths in industry i and region r. Hence, we link these variables to the industry and the region in which each individual is working, and use them as instruments for Job Tenure. We further construct interactions of these instruments with the individual's age, and a binary indicator equal to one if the individual is a male, and zero otherwise.

The idea of these instruments is that they are correlated with workers' Job Tenure, as they shift labor demand, and their effect differs according to observable individual characteristics, such as education and gender. Moreover, the instruments arguably do not suffer from reverse-causality concerns, since, for example, it is unlikely that individuals with higher or lower health expenditures cause establishment deaths. The validity of these instruments further relies on two assumptions: 1) The employer-employee pair forms expectations about plant closures that are correlated with their realizations, so that expected turnover and actual turnover generated by plant closures covary; and 2) establishment deaths do not *directly* affect individual medical expenditures—i.e., the exclusion restriction. Several papers report evidence in favor of this exclusion restriction, in particular for short-run expenditures. For example, Browning *et al.* (2006) find that being displaced does not cause hospitalization for stress-related disease, and Kuhn *et al.* (2009) report that job loss following a plant closure does not cause a significant increase in public health costs associated with take-up of health provisions.[17] In addition, since individual Job Tenure is self-reported and, thus, potentially mismeasured, the use of instruments corrects the attenuation bias generated by the measurement error of our key explanatory variable.

To gain intuition about identification, we report the results of the "first-stage" regression in full detail in Panel A of Table A1 in the online Appendix A. The key findings are that the instruments are jointly significant (the F-test on the exogenous instruments has a value above 23), and that larger values of the instruments—i.e., more plant closures and more workers losing jobs due to plant closures—reduce job tenure, as expected.

5.1.2 Results on Medical Expenditures

Table 2 presents the results for the (log of) individual medical expenditures. We present the results of several specifications. Column (1) presents the results of a simple OLS regression. Column (2) presents the results of an IV regression, instrumenting for Job Tenure using the instruments described in the previous Section. Column (3) presents the results of an IV regression with individual fixed effects.[18] Column (4) presents the results of a specification that uses the Arellano and Bond (1991) methodology. The main advantage of this methodology is that it allows us to control for additional persistent unobservable components (beyond fixed characteristics captured by the fixed effects) that may induce individuals to select into different jobs. However, since the panel component of MEPS is limited to two years, while this methodology requires a longer panel, we generate a synthetic panel by constructing cohorts of people grouped by sex, decade of birth, one-digit industry, and Census Region. In the Appendix, we describe the methodology and the construction of the cohorts in greater detail.

The results reported in Table 2 indicate that the coefficients of log(Job Tenure) are positive in all specifications. Thus, these coefficients are consistent with the idea that an employer-employee pair invests more in the employee's health when the employee's expected turnover is lower, as Proposition 1 predicts. The magnitude of the estimated effect of Job Tenure varies across specifications, and the coefficients are larger as we use instruments to correct for the endogeneity of Job Tenure. Moreover, the coefficients of specifications (2) to

[17]One potential drawback of these papers is that they focus on different countries.

[18]The number of observations varies across specifications (1)-(3) because the instruments used in specification (2) do not apply to individuals working in public administration and in the active military. Further, the fixed effect IV specification of column (3) requires individuals to appear in two surveys. The OLS specification (1) performed on the same sample as the IV specification (2) yields almost identical results.

Table 2: The Relationship Between Workers' Job Tenure and Individual Medical Expenditures

	(1) OLS	(2) IV	(3) IV with fixed effects	(4) Arellano-Bond with AR(1) errors
Log (Job Tenure)	0.032***	0.505***	0.801*	0.535**
	(0.007)	(0.208)	(0.454)	(0.256)
Age	-0.712***	-0.792***	-1.481***	-0.598**
	(0.035)	(0.051)	(0.616)	(0.263)
Age Squared	0.018***	0.019***	0.026***	0.013*
	(0.0008)	(0.001)	(0.012)	(0.006)
Education	0.232***	0.239***	-0.035	0.189***
	(0.005)	(0.007)	(0.064)	(0.022)
Income/10,000	0.214***	0.073	0.007	0.036
	(0.015)	(0.059)	(0.028)	(0.067)
Male	-2.223***	-2.261***		-1.090***
	(0.026)	(0.030)		(0.058)
Married	0.767***	0.691***	0.044	0.265*
	(0.030)	(0.047)	(0.134)	(0.142)
Family Size	-0.346***	-0.354***	-0.251***	-0.212***
	(0.009)	(0.011)	(0.044)	(0.041)
Union	0.450***	0.097***	-0.182	0.284
	(0.037)	(0.129)	(0.337)	(0.196)
ρ				0.262***
				(0.028)
# Obs	108,427	91,287	72,330	4,216
Panels			36,165	594

Notes: (I) All regressions also contain Age Cubed, Income Squared, Firm Size, Race and year fixed effects (not reported). (II) Robust standard errors in parentheses. (III) *, **, *** denote significance at ten, five and one percent, respectively.

(4) indicate that the economic significance of the effect is non-trivial. Specifically, increasing Job Tenure by ten percent increases workers' annual individual medical expenditures by five to eight percent, a rather large effect.

5.1.3 Results on Doctor Visits

We further investigate whether individuals are more likely to visit a doctor when job turnover is lower. These additional regressions have three goals. First, total medical expenditures include many different types of expenditures, and it is useful to check whether the results also apply to a more-narrow and basic category of health care. Second, the price of medical expenditures may differ across individuals, and doctor visits offer a *quantity* of services acquired. Third, in Section 6.2, we compare patterns of health investment in the U.S. and the U.K., and the U.K. data—like data from many countries with a national health system—report only the quantity of medical services acquired, not the expenditures.

Thus, we estimate linear probability models in which the dependent variable is equal to one if the individual *did not* visit a doctor in the previous year, and Table 3 reports the estimated coefficients. As in Table 2, we present the results of several specifications. Column (1) presents the results of a simple OLS regression. Column (2) presents the results of an IV regression, instrumenting for job tenure using the instruments described in Section 5.1.1. Column (3) presents the results of an IV regression with individual fixed effects. Column (4) presents the results of a specification that uses the Arellano and Bond (1991) methodology. Since the unit of observation in the specification of column (4) is a cohort, the dependent variable is equal to the fraction of people in the cohort who did not visit a doctor in the previous year.

The results reported in Table 3 indicate that the coefficients of log(Job Tenure) are negative in all specifications, confirming the idea that an employer-employee pair invests more in the employee's health when the employee's expected turnover is lower. Moreover, the estimated coefficients in columns (3) and (4) imply that increasing Job Tenure by ten percent decreases the probability of not visiting a doctor at least once per year by 1-1.7 percentage points, which represents a three- to four-percent decrease from the average sample probability of not visiting a doctor, equal to .39.

5.1.4 Assessment of Our Estimates

Our simple model in Section 3 is intended to provide the qualitative comparative statics predictions summarized in Proposition 1. Overall, the results reported in Table 2 provide

Table 3: The Relationship Between Workers' Job Tenure and Individual Doctor Visits

	(1) OLS	(2) IV	(3) IV with fixed effects	(4) Arellano-Bond with AR(1) errors
Log (Job Tenure)	-0.003***	-0.041***	-0.172**	-0.098**
	(0.0007)	(0.015)	(0.085)	(0.043)
Age	0.049***	0.055***	0.282***	0.039
	(0.004)	(0.005)	(0.097)	(0.039)
Age Squared	-0.001***	-0.001***	-0.004**	-0.0005
	(0.0001)	(0.0001)	(0.002)	(0.001)
Education	-0.015***	-0.015***	-0.0001	-0.023***
	(0.0005)	(0.0006)	(0.007)	(0.003)
Income/10,000	-0.018***	-0.007	-0.0001	-0.0001
	(0.001)	(0.004)	(0.003)	(0.011)
Male	0.221***	0.226***		0.208***
	(0.003)	(0.003)		(0.010)
Married	-0.071***	-0.067***	-0.013	-0.023
	(0.003)	(0.004)	(0.016)	(0.022)
Family Size	0.028***	0.029***	0.024***	0.015**
	(0.0009)	(0.001)	(0.006)	(0.006)
Union	-0.038***	-0.011***	0.059	-0.002
	(0.004)	(0.010)	(0.054)	(0.031)
ρ				0.093***
				(0.031)
# Obs	108,427	91,287	72,330	4,216
Panels			36,165	594

Notes: (I) All regressions also contain Age Cubed, Income Squared, Firm Size, Race and year fixed effects (not reported). (II) Robust standard errors in parentheses. (III) *, **, *** denote significance at ten, five and one percent, respectively.

strong *qualitative* evidence consistent with these predictions. An interesting and important question is whether our estimated elasticity of medical expenditures with respect to job tenure is also *quantitatively* consistent with the key economic mechanism of our paper and with existing evidence in the literature. To provide a quantitative assessment of our estimates—reported in Table 2 to be in the range 0.5-0.8—we consider in online Appendix D an infinite-horizon extension of the model (also adapted from Acemoglu and Pischke, 1998) that retains our key idea—i.e., that frictions in the labor market prevent an employer-employee pair from capturing the entire surplus from investment in an employee's health. Using some plausible functional forms and some parameters from the existing literature, we show that this extension of the model delivers a calibrated elasticity of medical expenditure with respect to job tenure equal to 0.7, which lies in the range of our estimates.

5.2 Health Expenditures of Retirees

The analysis of retirees' medical expenditures follows as closely as possible from the previous analysis of workers' medical expenditures. Nonetheless, some slight modifications are necessary because of the different data, and we now describe them in detail. Our reduced-form equation now reads:

$$y_{jt} = \beta_0 + \beta_T \text{LOG}(\text{Past Tenure}_{jt}) + \beta_X \mathbf{X}_{jt} + \eta_t + \zeta_j + \epsilon_{jt}, \tag{8}$$

where the dependent variable y_{jt} is one of the outcomes of interest (e.g., individual medical expenditures, health status) of individual j in year t. The main explanatory variable of interest is (log of) Past Tenure$_{jt}$: the number of years of the longest job tenure. $\mathbf{X}_{jt}$ is again a set of control variables: a cubic polynomial in the age of the individual; years of education; total assets; total assets squared; size of the family; gender; and race. η_t is a year fixed effect, ζ_j is an individual effect, and ϵ_{jt} is an unobservable component. In summary, the variables included in equation (8) are almost identical to the variables employed in the analysis of workers' medical expenditures. The main differences are that we use assets instead of income since most people in the HRS sample are retired, and we cannot include union status in the specification since the union status of the longest job tenure is not reported in HRS.[19]

Since the HRS is a panel data set, we could potentially control for unobserved heterogeneity with individual fixed effects. However, the HRS sample is composed mainly of retired individuals, and, thus, the main variable of interest—i.e., Past Tenure—has almost no

[19]The fixed effects included in the regression also differ slightly, because the instruments exploit a different variation. Thus, the subscripts in equations (7) and (8) differ.

within-panel variation. Hence, we cannot treat ζ_j as individual fixed effects, and, instead, treat them as individual random effects. Nonetheless, since almost all individuals in the HRS are retired, their labor-market histories were clearly determined many years before the sample period (1996-2002). This temporal lag implies that period-t shocks that may affect medical expenditures should not be correlated with past labor-market history. Moreover, this temporal lag helps us in the construction of the instruments and, thus, in the identification of the effect of Past Tenure on medical expenditures in equation (8).

In particular, the HRS reports the Census division of birth of each individual. Our instruments exploit the variation in the rate of establishment deaths and in the rate of workers who lost their jobs due to establishment deaths in 1990 in the division of birth of each individual. We further construct interactions of these instruments with the individual's years of education, and a binary indicator equal to one if the individual is a male, and zero otherwise. Thus, the instruments are exactly the same as those we employed in the analysis of workers, although they now empasize a slightly different variation in the data. More precisely, the absence of variation within individuals in the main variable of interest—i.e., Past Tenure—prevents us from exploiting the temporal variation of plant closures (as in the analysis of MEPS data), and we exploit only its geographic variation. Thus, the key idea of the instruments is that the Census division of birth is arguably exogenous to the individual, and so are its plant closures. Plant closures differ across geographic regions, and their effect differs according to observable individual characteristics, such as education and gender. Thus, the instruments are plausibly uncorrelated with unobserved individual characteristics that may simultaneously determine past labor-market outcomes and retirees' current medical expenditures. Panel B of Table A1 in online Appendix A reports the results of the first-stage regression in detail. The key findings are that the instruments are jointly significant (the F-test on the exogenous instruments has a value above 18) and that a larger value of the instruments—i.e., a greater rate of plant closures and a greater rate of workers losing jobs due to plant closures—reduces job tenure, as expected.

5.2.1 Results on Medical Expenditures

Panel A of Table 4 presents the results for the (log of) individual medical expenditures in the HRS sample. These results are remarkable. As Proposition 2 predicts, the coefficient of log(Past Tenure) in column (1) is negative and significant. Moreover, the economic significance of the coefficient is large. The magnitude of the coefficient of log(Past Tenure) in column (1) means that increasing Past Tenure by ten percent decreases annual individual medical expenditures by approximately 6.5 percent.

Table 4: The Relationship Between Retirees' Past Job Tenure and Medical Expenditures (Panel A) and Health Status (Panel B)

	Panel A: Log Individual Medical Expenditure	Panel B: Health Status
	(1)	(2)
Log (Past Tenure)	-0.643*** (0.247)	-0.265*** (0.058)
Age	1.213 (0.817)	0.141 (0.178)
Age Squared	-0.015 (0.106)	-0.002 (0.002)
Education	0.044*** (0.011)	-0.016*** (0.002)
Total Assets/1,000,000	0.032 (0.036)	-0.025** (0.008)
Male	0.351*** (0.120)	0.151*** (0.029)
Married	-0.040 (0.043)	-0.021** (0.010)
Household Size	0.011 (0.020)	0.001 (0.004)
# Obs	17,530	17,530
Panels	7,055	7,055

Notes: (I) The dependent variable for Column 2 is a dummy variable taking value one if the retiree reported being in the lowest two categories of self-reported health (i.e., fair and poor), and zero otherwise. (II). The estimated equations also contain: Age Cubed; Total Assets Squared; Year, Race, and Census Division fixed effects. Their coefficients are not reported. (III). Standard errors in parentheses. (IV) *, **, *** denote significance at ten, five, and one percent, respectively.

5.2.2 Results on Health Status

We further investigate whether retirees with higher past job attachment report better health. Panel B of Table 4 reports the coefficient of a regression in which the dependent variable is equal to one if the retiree reported being in the lowest two categories of self-reported health (i.e., fair and poor), and zero otherwise. The coefficient estimate of log(Past Tenure) is negative and statistically significant at the one-percent level. The magnitude of the coefficient indicates that the probability of a retiree reporting poor health decreases by almost three percentage points when his job tenure prior to retirement increases by ten percent.

In summary, our analysis indicates that retirees with a longer past job tenure have lower medical expenditures and are in better health, consistent with the predictions of Proposition

2 of our model.

5.3 Assessing the Magnitude of Life-Cycle Inefficiency

Our previous analysis shows that the differences in medical expenditures among workers and among retirees with different job tenures are large. Moreover, the analysis reveals a stark reversal in medical expenditures: Individuals with higher expenditures during their working years have lower expenditures during retirement. In this section, we combine the previous estimates of workers' and retirees' expenditures and seek to quantify the dynamic externality that lies at the heart of this paper. More precisely, we wish to compare the lifetime expenditures of two workers, A and B, whose only difference is their job tenures. We want to be explicit that calculating the exact size of the externality implied by our regressions is complicated, in particular because our main variable of interest—job tenure—is measured at two different points in time. Nevertheless, we try to perform a simple back-of-the-envelope calculation.

Suppose that both individuals work for 45 years and then retire for 15 years before dying. Individual A works in a job in which mobility is high, while individual B works in a job in which mobility is low. For example, let us assume that individual B's log job tenure is one standard deviation higher than that of individual A. Using the coefficient of LOG(JOB TENURE) in the Arellano-Bond specification (4) in Table 2, and applying it to one standard deviation of LOG(JOB TENURE) in MEPS cohort data—equal to 0.52—we obtain $0.52 * 0.53 = 27$ percent. At the average MEPS medical expenditures ($1,814), this implies that individual A has expenditures lower than B's by approximately $500 per year.

Let us now consider both individuals' medical expenditures during retirement. In particular, let us assume that the cross-sectional difference in job tenure in MEPS data carries over and, thus, one standard deviation in log tenure in MEPS translates into one standard deviation in log tenure in HRS. One standard deviation of log tenure in the HRS data is equal to 0.77. Multiplying that by the coefficient of log tenure in the HRS regressions, we obtain $0.65 * 0.77 = 50$ percent. At the average HRS medical expenditures ($8,327), this implies that individual A has expenditures higher than B's by approximately $4,160 per year.

Thus, if individuals A and B work for 45 years and then retire for 15 years, not discounting their expenditures, we have that, during their working years, individual A's health expenditures are approximately $22,500 lower than individual B's. And, during retirement, individual A's health expenditures are approximately $62,500 higher than individual B's. The total difference is approximately $40,00, a rather large difference. This calculation suggests that one additional dollar of health expenditures during the working years may lead to approximately 2.8 dollars of savings in retirement.[20] Obviously, this is a very rough calculation that neglects many important factors, such as mobility between low-attachment and high-attachment jobs. Moreover, it comes from two different data sets, and not from a single, long panel. In addition, on the one hand, it neglects discounting, but on the other hand, it also neglects that the price of medical care has been rising more than the interest rate. Furthermore, it neglects any effect of the changes in life-cycle medical expenditures on the quality of life and on mortality. In summary, we believe that this calculation neglects many other factors that are important in assessing the full effect of the externality. Nonetheless, we believe it describes in a simple way the externality we have in mind and its magnitude in the data.

6 Additional Evidence

The results of the previous empirical analysis provide strong evidence that job turnover affects health expenditures, as Propositions 1 and 2 predict. Nevertheless, we acknowledge that our empirical strategies may have limits. Like many papers that cannot employ a randomized experiment, despite our best attempts to control for individual characteristics and to use arguably exogenous instruments, it is possible that the instruments are correlated with unobserved characteristics that affect medical expenditures. Precisely because we are concerned by this possibility, we have performed several additional tests. We now report on additional regressions that investigates employers' provision of health plans to their employees; on falsification tests that use data from the U.K. BHPS; and on a robustness check that uses a different set of instruments for retirees' job tenure. Online Appendix B further reports on robustness checks that control for the potential mismeasurement of workers' job tenure; online Appendix C.2 also provides additional evidence that supports our argument using an alternative empirical strategy. While we acknowledge that none of these alternatives alone is definitive, we believe that each has different strengths, and we find that all these alternative approaches deliver results consistent with our main ones.

[20] The magnitude of our back-of-the-envelope calculation is lower if we use individual data rather than cohort data, since the standard deviation of LOG(JOB TENURE) is lower in cohort data than in individual data (because the within-cohort variation is suppressed). If we use the standard deviation of individual LOG(JOB TENURE) in our calculation, we obtain that savings would be equal to about 1.7 dollars.

6.1 Provision of Health Plans

The goal of this Section is to investigate how workers' job tenure affects whether firms offer them a health plan. These additional regressions have one main goal. In an employment-based health-insurance system, employers' investments in their employees' health involve the provision of a health plan. Thus, these regressions investigate precisely this channel. Specifically, we use a linear probability model in which the dependent variable is equal to one if the individual is offered a health plan in his current main job. As in Tables 2 and 3, we present the results of several specifications. Column (1) presents the results of a simple OLS regression. Column (2) presents the results of an IV regression, instrumenting for job tenure using the instruments described in Section 5.1.1. Column (3) presents the results of an IV regression with individual fixed effects. Column (4) presents the results of a specification that uses the Arellano and Bond (1991) methodology, in which the unit of observation in the specification of column (4) is a cohort. Thus, the dependent variable is equal to the fraction of people in the cohort who are offered a health plan in their current main job.

The results reported in Table 5 indicate that the coefficients of LOG(JOB TENURE) are positive in all specifications, indicating that employers are more likely to provide a health plan when employees' expected turnover is lower. Moreover, the estimated coefficients in columns (2) to (4) imply that increasing JOB TENURE by ten percent increases the probability that the employer provides the employee with a health plan by 1.7-1.8 percentage points, which represents a 2.5-percent increase from the average sample probability of being offered a health plan, equal to 0.68.[21]

6.2 Falsification Test: U.K. Workers

In this section, we investigate whether individuals in the U.K.—a country with a national health system—exhibit the same patterns that we documented for individuals in the U.S. We believe that this is a useful comparison: while the employment-based health care system is unique to the U.S., wages and turnover patterns are very similar across many developed countries (Katz, Loveman and Blanchflower, 1995). In a national health insurance system, an employer-employee pair does not directly pay for the employee's health investment. Thus, the dynamic inefficiency that we emphasize is not as relevant as in the U.S. system. Hence, if the employment-based health insurance system is indeed responsible for the relationship between

[21]Further evidence that the provision of health plans is the main channel through which employers affects employees' health expenditures comes from the fact that the tenure effects documented in Tables 2 and 3 are reduced when we add the explanatory variable HEALTH PLAN OFFERED in those regressions.

Table 5: Job Tenure and Health Plan Offerings

	(1)	(2)	(3)	(4)
	OLS	IV	IV with fixed effects	Arellano-Bond with AR(1) errors
Log (Job Tenure)	0.051***	0.189***	0.172**	0.161***
	(0.0007)	(0.015)	(0.064)	(0.037)
Age	0.090***	0.073***	-0.034	0.049
	(0.003)	(0.005)	(0.077)	(.039)
Age Squared	-0.002***	-0.001***	0.001	-0.001
	(0.0001)	(0.0001)	(0.001)	(0.001)
Education	0.012***	0.013***	-0.001	0.016***
	(0.0005)	(0.0007)	(0.005)	(0.003)
Income/10,000	0.086***	0.047***	0.004	0.105***
	(0.004)	(0.005)	(0.003)	(0.011)
Male	0.014***	0.012***		-0.007
	(0.002)	(0.003)		(0.005)
Married	0.030***	0.009***	0.001	0.030
	(0.002)	(0.004)	(0.014)	(0.026)
Family Size	-0.020***	-0.025***	-0.016***	-0.019***
	(0.0008)	(0.001)	(0.005)	(0.006)
Union	0.109***	0.024***	0.187*	0.038
	(0.002)	(0.009)	(0.055)	(0.030)
ρ	...			0.444***
				(0.044)
# Obs	101,881	86,009	65,480	4,216
Panels			32,740	594

Notes: (I) All regressions also contain Age Cubed, Income Squared, Firm Size, Race and year fixed effects (not reported). (II) Robust standard errors in parentheses. (III) *, **, *** denote significance at ten, five and one percent, respectively.

job turnover and health expenditures in the U.S., we would expect that similar relationship does *not* hold in U.K. Therefore, we conduct "falsification" tests by replicating as closely as possible some of the analysis of Section 5.1 using data from the British Household Panel Survey (BHPS), a data set that reports quite-detailed information on individual labor-market histories, along with some information on health-related issues.

Unfortunately, we cannot directly investigate the relationship between medical expenditures and job tenure, as in Table 2. The reason is that BHPS does not report total medical expenditures at the individual level.[22] Indeed, we are not aware of any non-U.S. data set that, like MEPS, collects this information at the individual level. Nonetheless, the BHPS reports the number of doctor visits for a sample of U.K. individuals. This allows us to conduct a falsification test by replicating the analysis of doctor visits for U.S. individuals, as we reported in Table 3. If the employment-based health-care system in the U.S. is responsible for the relationship we documented in Table 3, then we should not expect the number of doctor visits of U.K. workers to have the same relationship with job tenure.

We implement this falsification test in a panel regression in which the dependent variable is a binary variable equal to one if the individual did not visit a doctor in the last year, and zero otherwise. The specification is as close as possible to the specification of Table 3, with the additional advantage that we can use the Arellano-Bond procedure on individual data since the BHPS is a long panel data set, with several individuals samples in at least three surveys. Moreover, the BHPS reports rich individual-level variables that allow us to construct instruments for the potentially endogenous variable Job Tenure. Unfortunately, we cannot use the same instruments—i.e., plant closures—that we used on MEPS and HRS data since we are not aware of any U.K. public data set that collects the same information collected in the U.S. SUSB. Nonetheless, the BHPS reports the district of birth of the individual, so we use as instruments for (the log of) Job Tenure of individual i (the log of) the average tenure of all individuals of the same sex born in the same five-year window and in the same district as individual i. The idea of the instruments is that the district of birth is obviously exogenous to the individual, as is its industrial composition, for example. However, continuing the example, the industrial composition of the district of birth affects the skills that the individual accumulates (say, through inter-generational transmission of human capital or the type of schooling). Therefore, individuals are more likely to work in industries that are popular in the labor market of their area of birth. Through such a mechanism, the longest job tenure of each individual is correlated with the job tenure of all individuals born in the same district.

[22]The BHPS collects only information about out-of-pocket medical expenditures, but this represents only a small fraction of total medical expenditures in a national health-insurance system.

However, the instruments are plausibly uncorrelated with individual ability or risk attitudes, the main unobserved individual effects that may simultaneously determine health investment and labor-market outcomes, as we discussed in Sections 5.1 and 5.2. Moreover, since the career choices of men and women are quite different, we separate the instruments by gender.

Table 6 presents the results of the same specifications reported in Table 3. All specifications show that individuals with a longer job tenure are not more likely to visit a doctor in the U.K., in sharp contrast with the U.S. evidence reported in Table 3. Moroever, this result is robust to several different methodologies—OLS (column (1)); IV (column (2)); IV with individual fixed effects (column (3)); and Arellano-Bond procedure with autoregressive residuals (column (4)). The coefficient of the log of JOB TENURE is never negative and statistically significant in any of these specifications.[23]

6.3 Alternative Instruments for Retirees' Job Tenure

As we highlighted in Section 5.2, in our analysis of retirees' medical expenditures, we cannot employ individual fixed effects/first-differences to purge unobserved individual characteristics because the independent variable LOG(PAST TENURE) has almost no variation within individuals, as individuals are retired. Conversely, the variation exploited by the instruments—i.e., Census division of birth—appears truly exogenous to the individual and, thus, uncorrelated with individual characteristics.

Nevertheless, to verify the robustness of the results, we have re-run the regressions on retirees' medical expenditure using a different set of instruments. Specifically, the HRS reports the Census division of birth of each individual. Our instruments exploit the variation in employment protection across Census divisions and the variation in the effects of protection across workers with heterogeneous, predetermined characteristics—i.e., education, gender, and age. More precisely, Autor, Donohue, and Schwab (2006) investigates the labor-market impacts of wrongful-discharge protections adopted by U.S. state courts between 1972-1999. They find that one doctrine—the implied contract exception—reduced employment and that the short-term impact was most pronounced for demographic subgroups that change jobs most frequently: female, younger, and less-educated workers. Thus, arguably, the implied contract exception affected PAST TENURE, and the effect was different according to individual

[23]The number of observations varies across specifications (1)-(4) because the IV specification with individual fixed effects of column (3) requires individual to appear in at least two surveys, and the Arellano-Bond specification with autoregressive residuals of column (4) requires individual to appear in at least three surveys. The OLS specification (1) performed on the same sample as the IV specification (3) yields almost identical results.

Table 6: Falsification Test: The Relationship Between Workers' Job Tenure and Individual Doctor Visits in the U.K.

	OLS	IV	IV with Fixed Effect	Arellano-Bond with AR(1) Residual
	(1)	(2)	(3)	(4)
Log (Job Tenure)	0.008***	0.011	-0.011	0.111
	(0.001)	(0.018)	(0.019)	(0.101)
Age	0.007*	0.007***	0.016*	0.022
	(0.004)	(0.003)	(0.009)	(0.048)
Age Squared	$3.5*10^{-5}$	$3.6*10^{-5}$	$-3.4*10^{-6}$	-0.0002
	$(9*10^{-5})$	$(7*10^{-5})$	$(1.4*10^{-7})$	(0.001)
Education	0.002***	0.002***	...	0.002
	(0.0006)	(0.001)		(0.002)
Income/10,000	0.007***	0.007***	-0.002	-0.001
	(0.0009)	(0.0006)	(0.001)	(0.003)
Male	0.155***	0.155***	...	0.134***
	(0.002)	(0.002)		(0.005)
Married	-0.005	-0.005	0.0003	-0.006
	(0.003)	(0.004)	(0.007)	(0.009)
Household Size	0.002	0.002**	0.002	-0.0001
	(0.001)	(0.001)	(0.002)	(0.003)
Union	-0.015***	-0.016***	-0.007	-0.012
	(0.005)	(0.004)	(0.006)	(0.011)
ρ	...		...	0.130***
				(0.007)
# Obs	94,015	94,015	93,709	75,955
Panels			15,931	15,760

Notes: (I) The dependent variable in each specification is a dummy variable taking value one if the individual did not visit a doctor in the last year, and zero otherwise. (II) All regressions also include Age Cubed, Income Squared, Race, year fixed effects and geographic region fixed effects. Their coeffients are not reported. (III) Standard errors in parentheses; and *, **, *** denote significance at ten, five and one percent, respectively.

characteristics, such as education, gender, and age. Autor, Donohue, and Schwab (2006) construct an annual panel, reporting whether each state implemented the implied contract exception. Since the HRS reports the Census division, we take the average of all states within a Census division for the years 1980 and 1990, and we further construct interactions of these two instruments with: the age of the individual in 1980 and 1990, respectively; a binary indicator equal to one if the individual reports more than 13 years of education, and zero otherwise; and a binary indicator equal to one if the individual is a male, and zero otherwise.

Panel A of Table 7 presents the results for the (log of) medical expenditures of individuals in the HRS sample, confirming that the coefficient of LOG(PAST TENURE) in column (1) is negative and significant, as Proposition 2 predicts. Moreover, the economic significance of the coefficient is large. The magnitude of the coefficient of LOG(PAST TENURE) in column (1) means that increasing PAST TENURE by ten percent decreases the annual medical expenditures by approximately 7.5 percent. Panel B reports the coefficient of a regression in which the dependent variable is equal to one if the retiree reported being in the lowest two categories of self-reported health (i.e., fair and poor), and zero otherwise. The coefficient estimate of LOG(PAST TENURE) is negative and statistically significant at the one-percent level. The magnitude of the coefficient indicates that the probability of a retiree reporting poor health decreases by approximately four percentage points when his job tenure prior to retirement increases by ten percent.

The results reported in Table 7 are remarkable: They are very similar to the results in Table 4, although they came from a very different set of instruments. The magnitudes are slightly larger, but the hypothesis of identical coefficients of LOG(PAST TENURE) cannot be statistically rejected.

7 Alternative Hypotheses

We now consider several alternative hypotheses. For most of these alternatives, we discuss how our empirical model allows us to distinguish the implications of our model from other plausible explanations. The analysis confirms and strengthens the previous findings.

Good Jobs versus Bad Jobs. Several papers document true wage differentials across industries and jobs, as well as a negative correlation between wage differentials and quit rates (e.g., Pencavel, 1970; Krueger and Summers, 1988; Gibbons and Katz, 1992). If workers are less likely to leave "good jobs" than "bad jobs"—good jobs offer higher wages and richer benefits, including health insurance—and if health insurance and health expenditures are

Table 7: The Relationship Between Retirees' Past Job Tenure and Medical Expenditures (Panel A) and Health Status (Panel B)—Alternative Instruments

	Panel A: Log Individual Medical Expenditure	Panel B: Health Status
	(1)	(2)
Log (Past Tenure)	-0.746** (0.356)	-0.430*** (0.063)
Age	0.222 (0.442)	-0.234** (0.109)
Age Squared	-0.001 (0.005)	0.003** (0.001)
Education	0.033*** (0.010)	-0.011*** (0.002)
Total Assets/1,000,000	-0.052 (0.033)	-0.013** (0.006)
Male	0.441*** (0.169)	0.228*** (0.031)
Married	-0.066** (0.033)	0.010 (0.009)
Household Size	0.011 (0.016)	0.001 (0.041)
# Obs	27,229	27,229
Panels	10,395	10,395

Notes: (I) The dependent variable for Column 2 is a dummy variable taking value 1 if the retiree reported being in the lowest two categories of self-reported health (i.e., fair and poor). (II). The estimated equations also contain: Age Cubed; Total Assets Squared; Year, Race, and Census Division fixed effects. Their coefficients are not reported. (III). Standard errors in parentheses. (IV) *, **, *** denote significance at ten, five, and one percent, respectively.

related—in the data, they are—then differences between good jobs and bad jobs could imply a positive correlation between job attachment and health expenditures.

However, as we described in Section 5.1, our empirical model on workers' medical expenditures is designed to precisely control for fixed and for persistent unobserved effects that may induce different workers to select into different jobs/industries. Moreover, the instruments that we employ in the empirical analysis on workers' medical expenditures exploit demand-side (i.e., firms) variation in turnover across regions and industries, precluding any reverse-causality hypothesis based on supply-side (i.e., workers) variation in quits. Similarly, the instruments we use in the empirical analysis on retirees' health expenditures exploit variations in plant closures across individuals' regions of birth, as well as the heterogeneous effect of these plant closures across individuals with heterogeneous, exogenous characteristics.

What about Job-lock? An influential literature shows that the employment-based health-insurance system provides inefficiently low separation between mismatched workers and firms (Madrian, 1994; Gruber and Madrian, 1994, 1997, 2002). This "job-lock" literature postulates that workers are less likely to leave jobs that offer health insurance than to leave comparable jobs without health insurance. If health insurance and health expenditures are related—and in the data, they are—these hypotheses could also imply a positive correlation between job attachment and health expenditures.

However, we emphasize that our empirical analysis is designed to circumvent this reverse-causality hypothesis (and others). Moreover, if job-lock were the *only* mechanism at work in the data, we would expect individuals with worse health to select jobs with more-generous health benefits since less-healthy workers presumably benefit more from them. Thus, in steady state, we should expect to find less-healthy workers in jobs with lower turnover. Instead, Panel B of Table 4 shows that the opposite is true: Healthier individuals were working in lower-turnover jobs.

In summary, we believe that wage differentials and job-lock are well-suited to addressing the question of why mobility differs across individuals and jobs. However, we think that they cannot explain the empirical patterns in health-care expenditures that are the focus of our paper. Most likely, they are valid explanations for complementary facts but do not provide alternative interpretations of all the empirical findings in this paper.

Is Health More Important in Jobs that Have also Higher Attachment? The empirical relationship between job attachment and health expenditures could simply be due to the fact that health is more important in industries that have higher job attachment.

However, the evidence from U.K. workers does not substantiate this claim. The results reported in Table 6 indicate that U.K. workers with longer job tenures are not more likely to visit a doctor, in sharp contrast to the results for U.S. workers reported in Panel B of Table 2. This difference in health care utilization between the U.K. and the U.S. is also in stark contrast with many labor-market patterns—i.e., wages and inequality—that are remarkably similar in the two countries (Katz, Loveman and Blanchflower, 1995; Gosling and Lemieux, 2004).

What about Myopic Workers? A potential explanation of our empirical findings has to do with different wage profiles over time. If, in high-turnover jobs, wage profiles are flatter (relatively higher earlier, slower growth later), more-myopic people choose these jobs, attracted by the higher initial wage. These people are likely to have a different intertemporal discount—i.e., they value today much more than tomorrow. This could explain why their health expenditures are lower.

However, this explanation is not consistent with current theories of human capital. *General* human capital *steepens* wage-tenure profiles because workers must pay, in the form of lower wages, for any training that is general and, thus, transferable across employers. Early in their career, workers receive lower wages and investment in human capital. When human capital begins to increase productivity later in their career, workers have higher earnings. Because general human capital is transferable, firms must pay workers their full marginal product in the post-investment period. Conversely, any type of *specific* human capital *flattens* wage-tenure profiles because the firm makes a specific investment but recoups its investment later, once the workers are locked in. Indeed, this is exactly what the extension of our model presented in online Appendix C.1 predicts.

Moreover, in high-turnover jobs, the relative importance of specific human capital is presumably lower than that of general human capital. As a result, we should expect high-turnover jobs to have steeper, not flatter, wage profiles (as this alternative explanation needs). Indeed, Crocker and Moran (2003) provide empirical evidence consistent with these predictions of human-capital theories. In the wage regressions reported in Table 2 of their paper, they find that returns to tenure are higher in high-turnover jobs.

Is it a Pure Wealth Effect? Another potential explanation is a pure wealth effect. If wages are higher in low-turnover jobs, then a simple wealth effect might explain why health expenditures are higher in low-turnover jobs. Indeed, Hall and Jones (2006) argue that the growth of health spending in the past half-century is a rational response to the growth of income per person. According to their model, health spending is a superior good with an income elasticity well above one.[24]

Clearly, our explanation and that of Hall and Jones are not mutually exclusive. Hall and Jones focus on the growth of expenditures in the last 20 years, while we focus on the intertemporal profile of expenditures. However, we believe that the wealth effect cannot fully explain a number of our cross-sectional results. First, all our regressions on workers' medical expenditures include workers' current income and the best proxy for permanent income—i.e., education. Moreover, in the regressions on retirees' medical expenditures, we find that the coefficient of total assets is negative, and not significant. Thus, we have no evidence that

[24] However, Acemoglu, Finkelstein and Notowidigdo (2009) use oil-price shocks and cross-sectional variation in the oil reserves across different areas of the U.S. and find that the income elasticity of health expenditures is almost always less than one.

wealthier retired individuals spend more on health.

8 Conclusion

In this paper, we investigate how the employment-based health-insurance system in the U.S. affects individuals' life-cycle health-care decisions. We take the viewpoint that health is a form of human capital that affects workers' on-the-job productivity, and we derive implications of employees' turnover for the incentives to undertake health investment. Our model suggests that employees' turnover leads to dynamic inefficiencies in health investment. In particular, it suggests that the employment-based health-insurance system may lead to an inefficient, low level of individual health investment during individuals' working lives. Moreover, we show that underinvestment in health is more severe when workers' turnover rate is higher, and this leads to increased medical expenditures during retirement.

We present a model that makes this process explicit and then investigate its empirical relevance using data from the Medical Expenditure Panel Survey and the Health and Retirement Survey. We document a large number of empirical patterns, all consistent with our model. Moreover, the magnitude of our estimates suggests a significant degree of intertemporal inefficiencies in health investment in the U.S. Our back-of-the-envelope calculations suggest that, on average, one dollar of medical expenditures during the working years may decrease medical expenditures during retirement by about 2.8 dollars.

References

[1] Acemoglu, Daron, Amy Finkelstein, and Matthew J. Notowidigdo (2009). "Income and Health Spending: Evidence From Oil Price Shocks." NBER Working Paper No. 14744.

[2] Acemoglu, Daron and Jörn-Steffen Pischke (1998). "Why Do Firms Train? Theory and Evidence." *Quarterly Journal of Economics*, Vol. 113, No. 1, 79-119.

[3] Acemoglu, Daron and Jörn-Steffen Pischke (1999). "The Structure of Wages and Investment in General Training." *Journal of Political Economy*, Vol. 107, 539-572.

[4] Arellano, Manuel and Stephen Bond (1991). "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies*, Vol. 58, No. 2, 277-297.

[5] Autor, David, John Donohue III, and Stewart Schwab (2006). "The Costs of Wrongful-Discharge Laws." *The Review of Economics and Statistics*, Vol. 88. No. 2, 211-231.

[6] Balmaceda, Felipe (2005). "Firm-Sponsored General Training." *Journal of Labor Economics*, Vol. 23, No. 1, 115-133.

[7] Barr, Donald A. (2007). *Introduction to U.S. Health Policy: The Organization, Financing, and Delivery of Health Care in America*. Second Edition. The Johns Hopkins University Press: Baltimore, MD.

[8] Beaulieu, Nancy D., David Cutler, Katherine Ho, George Isham, Tammie Lindquist, Andrew Nelson and Patrick O'Connor (2007). "The Business Case for Diabetes Disease Management for Managed Care Organizations." *Forum for Health Economics and Policy*, Vol. 9: Issue 1.

[9] Becker, Gary (1962). "Investment in Human Capital: A Theoretical Analysis." *Journal of Political Economy*, Vol. 70, No. 1, 9-49.

[10] Becker, Gary (1964). *Human Capital,* New York: Columbia University Press.

[11] Beckmann, Michael (2001). "Wage Compression and Firm-sponsored Training: Empirical Evidence for the Acemoglu-Pischke Model from German Establishment Data." Mimeo, University of Freiburg.

[12] Blundell, Richard. and Stephen Bond (1998). "Initial conditions and moment restrictions in dynamic panel data models." *Journal of Econometrics*, Vol. 87, Issue 1, 115-143.

[13] Brown, Jeffrey and Amy Finkelstein (2008). "The Interaction of Public and Private Insurance: Medicaid and the Long-Term Care Insurance Market." *American Economic Review*, Vol. 98, No. 3, 1083-1102.

[14] Browning, Martin, Anne Moller Dano and Eskil Heinesen (2006). "Job displacement and stress-related health outcomes." *Health Economics*, Vol.15, Issue 10, 1061-1075.

[15] Cebul, Randall, Ray Herschman, James B. Rebitzer, Lowell J. Taylor and Mark Votruba (forthcoming). "Unhealthy Insurance Markets: Search Frictions and the Cost and Quality of Health Insurance." *American Economic Review*.

[16] Cochrane, John (1995). "Time Consistent Health Insurance." *Journal of Political Economy*, Vol. 103, No. 3: 445-473.

[17] Crocker, Keith J. and John R. Moran (2003). "Contracting with Limited Commitment: Evidence from Employment-Based Health Insurance Contracts." *RAND Journal of Economics*, Vol. 34, No. 4, 694-718.

[18] Currie, Janet and Brigitte C. Madrian (1999). "Health, Health Insurance and the Labor Market." In *Handbook of Labor Economics*, Volume 3C, edited by David Card and Orley Ashenfelter, Amsterdam: North Holland, pp. 3309-3407.

[19] Cutler, David and Jonathan Gruber (1996). "Does Public Insurance Crowd Out Private Insurance?" *Quarterly Journal of Economics*, Vol. 111, No. 2, 391-430.

[20] Diamond, Peter (1992). "Organizing the Health Insurance Market." *Econometrica*, Vol. 60, No. 6, 1233-1254.

[21] Fang, Hanming and Alessandro Gavazza (2007). "Dynamic Inefficiencies in an Employment-Based Health Insurance System: Theory and Evidence." NBER Working Paper No. 13371.

[22] Finkelstein, Amy, Kathleen McGarry and Amir Sufi (2005). "Dynamic Inefficiencies in Insurance Markets: Evidence from Long-Term Care Insurance." NBER Working Paper No. 11039.

[23] Frazis, Harley and Mark A Loewenstein (2006). "Wage Compression and the Division of Returns to Productivity Growth: Evidence from EOPP." Mimeo, U.S. Bureau of Labor Statistics.

[24] Gibbons, Robert and Lawrence Katz (1992). "Does Unmeasured Ability Explain Inter-Industry Wage Differentials?" *The Review of Economic Studies*, Vol. 59, No. 3, 515-535.

[25] Gosling, Amanda and Thomas Lemieux (2004). "Labor Market Reforms and Wage Inequality in the United Kingdom and the United States." In *Seeking a Premier Economy: The Economic Effects of British Economic Reforms, 1980-2000*, edited by R. Blundell, D. Card, and R. Freeman, Chicago: University of Chicago Press for NBER.

[26] Grossman, Michael (1972). "On the Concept of Health Capital and the Demand for Health." *Journal of Political Economy*, Vol. 80, No. 2, 223-255.

[27] Gruber, Jonathan (1994). "The Incidence of Mandated Maternity Benefits." *The American Economic Review*, Vol. 84, No. 3, 622-641.

[28] Gruber, Jonathan and Brigitte C. Madrian (1994). “Health Insurance and Job Mobility: The Effects of Public Policy on Job-Lock.” *Industrial and Labor Relations Review*, Vol. 48, No. 1, 86-102.

[29] Gruber, Jonathan and Brigitte C. Madrian (1997). “Employment Separation and Health Insurance Coverage.” *Journal of Public Economics*, Vol. 66, No. 3, 349-382.

[30] Gruber, Jonathan and Brigitte C. Madrian (2002). “Health Insurance, Labor Supply and Job Mobility: A Critical Review of the Literature.” NBER Working Paper 8817.

[31] Hagist, Christian and Laurence J. Kotlikoff (2005). “Who’s Going Broke? Comparing Healthcare Costs in ten OECD Countries”, NBER Working Paper No. 11833.

[32] Hall, Robert E. and Charles I. Jones (2007). “The Value of Life and the Rise in Health Spending.” *Quarterly Journal of Economics*, Vol. 122, No. 1, 39-72.

[33] Hendel, Igal and Alessandro Lizzeri (2003). “The Role of Commitment in Dynamic Contracts: Evidence from Life Insurance.” *Quarterly Journal of Economics*, Vol. 118, No. 1, 299-327.

[34] Herring, Bradley (2010). “Sub-optimal Coverage of Preventive Care Due to Market-Level Turnover Among Private Insurers.” *Health Economics*, Vol. 19, No. 4, 438-448.

[35] Katz, Lawrence F., Gary W. Loveman, and David G. Blanchflower (1995). “A Comparison of Changes in the Structure of Wages in Four OECD Countries.” In *Differences and Changes in Wage Structures*, edited by Richard B. Freeman and Lawrence F. Katz, Chicago: University of Chicago Press for NBER.

[36] Kessler, Anke S. and Christoph Lülfesmann (2006). “The Theory of Human Capital Revisited: On the Interaction of General and Specific Investments.” *The Economic Journal*, Vol 116, No. 514, 903-923.

[37] Krueger, Alan B. and Lawrence H. Summers (1988). “Efficiency Wages and the Inter-Industry Wage Structure.” *Econometrica*, Vol. 56, No. 2, 259-293.

[38] Kuhn, Andreas, Rafael Lalive and Josef Zweimüller (2009). “The Public Health Costs of Job Loss.” IZA Discussion Paper No. 4355.

[39] Madrian, Brigitte C. (1994). “Employment-Based Health Insurance and Job Mobility: Is There Evidence of Job Lock?” *Quarterly Journal of Economics*, Vol. 109, No. 1, 27-54.

[40] Pauly, Mark, Howard Kunreuther and Richard Hirth (1995). "Guaranteed Renewability in Insurance." *Journal of Risk and Uncertainty*, 10, 143-156.

[41] Pencavel, John (1970). *An Analysis of the Quit Rate in American Manufacturing Industry*. Industrial Relations Section, Princeton University: Princeton, N.J.

[42] Tompa, Emile (2002). "The Impact of Health on Productivity: Empirical Evidence and Policy Implications," *The Review of Economic Performance and Social Progress*, Vol. 2, 181-202.

APPENDIX: Arellano and Bond (1991) Method and Synthetic Cohorts

If the unobservables in equation (7) have a persistent component—i.e., $\epsilon_{jirt} = \rho\epsilon_{jirt-1} + \nu_{jirt}$—then fixed effects or first-differences are not sufficient to eliminate the persistent component of the error term, as $\Delta y_{jirt} = \boldsymbol{\beta}\Delta\mathbf{Z}_{jirt} + \Delta\eta_{rt} + \Delta\epsilon_{jirt}$, where $\mathbf{Z}_{jirt}$ is the set of all control variables—i.e., $\mathbf{Z}_{jirt} = \Big(\text{LOG}(\text{JOB TENURE}_{jirt}), \mathbf{X}_{jirt}\Big)$. However, the Arellano and Bond (1991) procedure is specifically designed to handle persistent unobservables in panel data. Arellano and Bond suggest subtracting ρy_{jirt-1} from y_{jirt} to eliminate $\epsilon_{jirt} - \rho\epsilon_{jirt-1}$, leaving only the innovation ν_{jirt} of the unobservable:

$$y_{jirt} = \rho y_{jirt-1} + \boldsymbol{\beta}\mathbf{Z}_{jirt} - \rho\boldsymbol{\beta}\mathbf{Z}_{jirt-1} + (1-\rho)\,\zeta_i + \eta_{rt} - \rho\eta_{rt-1} + \nu_{jirt}. \tag{9}$$

Taking first-differences, the following equation obtains:

$$\Delta y_{jirt} = \rho\Delta y_{jirt-1} + \boldsymbol{\beta}\Delta\mathbf{Z}_{jirt} - \rho\boldsymbol{\beta}\Delta\mathbf{Z}_{jirt-1} + \Delta\eta_{rt} - \rho\Delta\eta_{rt-1} + \Delta\nu_{jirt}. \tag{10}$$

In the differenced form, however, the new errors $\Delta\nu_{jkit}$ are correlated with the differenced lagged dependent variable Δy_{jit-1} by construction, and, potentially, with the variables ΔZ_{jkit} and ΔZ_{jkit-1}, as well. Therefore, a vector W of instruments is required to construct moments $E\left(\Delta\nu_{jkit} * W\right)$, and to estimate equation (10) via GMM. Arellano and Bond use the lagged values y_{jkit-h} and Z_{jkit-h} with lags $h \geq 2$ as instruments for Δy_{jkit-1} and ΔZ_{jkit-l}, $l = 0, 1$, respectively, as the new error term $\Delta\nu_{jkit}$ is uncorrelated by construction with lags of order higher than two. These instruments, y_{jkit-h} and Z_{jkit-h} with lags $h \geq 2$, are "mechanically" correlated with the potentially endogenous variables Δy_{jkit-1} and ΔZ_{jkit-l}. Hence, following Arellano and Bond, we can use y_{jkit-h} with lags $h \geq 2$ as instruments for the lagged endogenous variable Δy_{jkit-1}. Moreover, we also follow Arellano and Bover (1995) and Blundell and Bond (1998), who suggest adding the original equation (9) in levels to the GMM criterion, instrumenting the endogenous variables in levels with first-differences of the instruments. The SUSB data provide us with instruments for the main endogenous variable—Job Tenure—that have a stronger economic content than Arellano and Bond's instruments—i.e., instruments that shift the endogenous variable for plausibly exogenous reasons. In particular, we use lags (of order higher than two) of the variables described in Section 5.1.1 as instruments for Job Tenure, since lags purge any undesired correlation with $\Delta\nu_{jkit}$, the first difference in the innovation in the unobservables.[25] Unfortunately, the panel component of MEPS is too limited (two years) to use the Arellano-Bond procedure on individual data. Since the procedure has the attractive feature that it allows us to control for persistent unobserved heterogeneity—including, for example, any industry-region-specific trend that could threaten the validity of our exclusion restriction—we use MEPS data to construct synthetic panels. As in all papers that use synthetic panels, the definition of a cohort is arbitrary. In our case, we are constrained by the sample size of each MEPS survey and by the limited geographic and industry information available in the public version of the MEPS. As a result, we choose to define cohorts by grouping people by sex, decade of birth, one-digit industry, and Census Region. With a slight abuse of notation, we can write the cohort version of the empirical model defined by equations (7) and (10) as:

$$\begin{aligned} y_{jt} &= \beta_0 + \beta_T \text{LOG}(\text{Job Tenure}_{jt}) + \boldsymbol{\beta}_X \mathbf{X}_{jt} + \eta_{rt} + \zeta_j + \epsilon_{jt} && (11) \\ \Delta y_{jt} &= \rho \Delta y_{jt-1} + \boldsymbol{\beta} \Delta \mathbf{Z}_{jt} - \rho \boldsymbol{\beta} \Delta \mathbf{Z}_{jt-1} + \Delta \eta_{rt} - \rho \Delta \eta_{rt-1} + \Delta \nu_{jt}, && (12) \end{aligned}$$

where the subscript j now denotes a cohort, for which industry i and region r are fixed over time. The dependent variable y_{jt} is again one of the outcomes of interest for cohort j (working in industry i in region r) in year t. Similarly, Job Tenure$_{jt}$ is the average number of years individuals in cohort j have been employed in their current firm. $\mathbf{X}_{jt}$ is now the cohort-average of a large set of control variables: the average age of individuals in the cohort, age squared, age cubed, average education, annual income, annual income squared, size of the family, fraction of whites, and fraction of blacks. η_{rt} is, as before, a year fixed effect for each region r. ζ_j is now a fixed effect for cohort j (again, working in industry i in region r). ϵ_{jt} is an unobservable, autoregressive component with innovation ν_{jt}—i.e., $\epsilon_{jt} = \rho\epsilon_{jt-1} + \nu_{jt}$.

[25] As Blundell and Bond (1998) demonstrates, the Arellano and Bond procedure does not work well if the dependent variables are very persistent. However, this does not appear to be a concern in our case, as our dependent variables exhibit year-to-year variation. Similarly, our main explanatory variable, Job Tenure, and its instruments (death rate of establishments and the fraction of workers that lost their jobs due to establishment deaths) exhibit substantial variation.

ONLINE APPENDICES

A First-stage Regressions

Panel A in Table A1 reports the results of a regression of the endogenous variable Log (Job Tenure) on the exogenous instruments on the sample of workers in the MEPS data set. The signs of the coefficients of the instruments are largely as expected. In particular, on average, a larger value of the instruments—i.e., more plant closures and more workers losing jobs due to plant closures—reduces job tenure, and the effect is stronger for older workers and males. Moreover, the instruments are jointly significant: The F-test on the exogenous instruments has a value above 23 in the specification of Panel A. Similarly, Panel B in Table A1 reports the first-stage regression of retirees' past tenure on the instruments using HRS data. It shows that the signs of the coefficients of the instruments are largely as expected. In particular, on average, a larger value of the instruments—i.e., a larger rate of plant closures and a larger rate of workers losing jobs due to plant closures—reduces job tenure, and the effect is stronger for less-educated workers and males. The instruments are again jointly significant: The F-test on the exogenous instruments has a value above 18 in the specification of Panel B.

B Mismeasurement of Workers' Job Tenure

An important robustness check is to verify the results of Section 5.1 on workers' medical expenditures in light of potential mismeasurement of workers' job tenure. The concern over potential mismeasurement arises because our analysis employs *current* job tenure, whereas the exact empirical equivalent of the variable used in the comparative statics of our theoretical analysis is *completed* job tenure. In Section 5.1, we made the implicit assumption that current job tenure and completed job tenure are related. Indeed, the two variables are identical if the probability of separation is independent of previous job tenure.[26] We address this potential concern by performing a robustness check using the Arellano-Bond specification. Specifically, we calculate retention/separation probabilities of cohort j in year t as the difference between (the log of) job tenure of cohort j in year t and the (log of) job tenure of the same cohort j in year $t-1$—i.e., $\textsc{log}(\textsc{Job Tenure}_{jt})$-$\textsc{log}(\textsc{Job Tenure}_{jt-1})$. The idea is that the higher

[26] For evidence that the probability of separation is independent of job tenure, see, among others, Van den Berg and Ridder (1998).

Table A1: The Relationship Between Workers' Job Tenure and the Instruments in MEPS (Panel A) and HRS (Panel B)

Panel A: MEPS: Log (Job Tenure)			Panel B: HRS: Log (Past Tenure)		
	Coefficient	Std. Error		Coefficient	Std. Error
Establishment Deaths$_t$	-4.27e-6***	(1.47e-7)	Rate of Workers Lost Job$_{1990}$	-40.976***	(8.203)
Rate of Establishment Deaths$_t$	0.676	(0.526)	Rate of Establishment Deaths$_{1990}$	18.064***	(6.170)
Workers Lost Job$_t$	7.80e-7***	(8.93e-8)	Rate of Workers Lost Job$_{1990}$$*$Education	3.091***	(0.611)
Rate of Workers Lost Job$_t$	-1.397***	(0.542)	Rate of Establishment Deaths$_{1990}$$*$Education	-1.447***	(0.457)
Establishment Deaths$_t$$*$Male	-1.75e-6***	(7.07e-7)	Rate of Establishment Deaths$_{1990}$$*$Female	-6.186	(4.190)
Establishment Deaths$_t$$*$Age	-7.74e-8***	(2.93e-8)	Rate of Workers Lost Job$_{1990}$$*$Female	10.722***	(2.852)
Age	0.163***	(0.017)	Age	-0.406	(0.311)
Age Squared	-0.002***	(0.0004)	Age Squared	0.051	(0.004)
Education	-0.015***	(0.002)	Education	0.030	(0.026)
Income/10,000	0.272***	(0.015)	Total Assets/1,000,000	0.088***	(0.011)
Male	0.072**	(0.021)	Male	1.324***	(0.144)
Married	0.156***	(0.014)	Married	-0.017***	(0.014)
Family Size	0.024***	(0.004)	Household Size	-0.018***	(0.006)
Union	0.579***	(0.015)			
# Obs	91,287			17,530	
Individuals				7,055	

Notes: (I) Panel A reports the first-stage regression of workers' (log of) job tenure on the instruments using MEPS data. Panel B reports the first-stage regression of the retirees' (log of) past job tenure on the instruments using HRS data. (II) The specification in Panel A also contains Age Cubed, Income Squared, Firm Size, Race and year fixed effects (not reported). (III) The specification in Panel B also contains Age Cubed, Total Assets Squared, Race and year fixed effects (not reported). (IV) *, **, *** denote significance at ten, five and one percent, respectively.

(lower) is the retention (separation) probability, the higher $\text{LOG}(\text{JOB TENURE}_{jt})$-$\text{LOG}(\text{JOB TENURE}_{jt-1})$ is. Because of sampling error, this newly-constructed variable sometimes is negative and sometimes larger than the theoretical maximum of $\text{LOG}(1+\frac{1}{\text{JOB TENURE}_{jt-1}})$. Hence, the instruments are particularly useful to correct the bias derived from this sampling error, as well.

Table B2 reports the results, using the specification of equation (12) that explicitly takes into account serial correlation in the unobservables ϵ_{jt}.[27] Column (1) reports the results for the (log of) medical expenditures, and column (2) reports the results for the fraction of people in the cohort who report that they *did not* visit a doctor in the last year—i.e., they had zero doctor visits. In both cases, the qualitative results are identical to those reported in Table 2, and the quantitative magnitudes are also similar, reinforcing the idea that job attachment is an important determinant of workers' medical expenditures, as our theoretical framework implies.

C Specific Capital

This Appendix has two goals: 1) to extend the model of Section 3 to allow for endogenous turnover; and 2) to present the results of an additional empirical strategy that closely follows the extension of the model. This empirical strategy differs substantially from the analysis in Sections 5.1 and 5.2. Nonetheless, the qualitative and quantitative results are remarkably similar.

C.1 An Extended Model

In the model of Section 3, the turnover probability q was exogenously fixed. Obviously, in many cases, employees decide to voluntarily leave employers and, thus, turnover is endogenous. We now consider a simple extension of the model that delivers endogenous turnover. The main new mechanism is firm-specific human capital. This extension is also particularly useful because in the next section, C.2, we use a measure of industry-specific human capital provided by the Department of Labor as an exogenous proxy for job turnover.[28] We assume that there is a continuum of jobs/industries, indexed by i, and that jobs/industries differ in the importance

[27] The number of observations is lower than in the corresponding regressions of Table 2 because the variable $\text{LOG}(\text{JOB TENURE}_{jt})$-$\text{LOG}(\text{JOB TENURE}_{jt-1})$ requires first-differencing and, thus, some observations are lost.

[28] Related models in which specific capital and turnover rates are endogenously modeled can be found in Chang and Wang (1995, 1996). They focus on the role of asymmetric information where current employers are assumed to know more than potential employers about workers' productivity.

Table B2: The Relationship Between Workers' Job Tenure and Medical Expenditures (Panel A) and Doctor Visits (Panel B)—Alternative Measure of Job Turnover

	Panel A: Log Medical Expenditures	Panel B: Fraction Not Visiting Doctors
	(1)	(2)
ΔLog (Job Tenure)	0.679***	-0.090**
	(0.233)	(0.045)
Age	-0.622**	0.037
	(0.305)	(0.038)
Age Squared	0.014*	-0.0005
	(0.007)	(0.0004)
Education	0.178***	-0.022***
	(0.024)	(0.003)
Income/10,000	0.009	0.001
	(0.070)	(0.012)
Male	-1.099***	0.203***
	(0.060)	(0.009)
Married (Fraction)	0.204	-0.029
	(0.156)	(0.024)
Family Size	-0.199***	0.020***
	(0.044)	(0.007)
Union (Fraction)	0.349**	0.010
	(0.191)	(0.031)
ρ	0.257***	0.099***
	(0.031)	(0.033)
# Obs	3322	3322
Panels	552	552

Notes: (I) Columns 1 and 2 report Arellano-Bond IV regressions assuming AR(1) errors. (II) All regressions also contain Age Cubed, Income Squared, Firm Size, Race and year fixed effects (not reported). (III) Standard errors in parentheses are calculated by applying the finite sample correction proposed by Windmeijer (2005) and are robust to autocorrelation and heteroskedasticity of unknown form. (IV) *, **, *** denote significance at ten, five and one percent, respectively.

of specific capital. In job i, the production function of a worker is

$$y_i = f(h, s_i),$$

where s_i are skills specific to job i. More precisely, a worker moving to a different job can transfer only a fraction $(1-i)$ of his skills s_i, so that a higher-indexed job i has more-specific skills. For simplicity, assume that the employee acquires the level of skills s_i during the first period with the employer via a learning mechanism, as in Jovanovic (1979), and that the level s_i is equal across all jobs.[29] To obtain endogenous turnover in the model, we assume that, in the second period, the worker can approach another firm at no cost. The new firm and the worker draw a match-specific productivity shock ϵ from the distribution $G(\epsilon)$. The worker's productivity in the new firm y_2^n is equal to

$$y_2^n = f(h_2, (1-i)s_i) + \epsilon.$$

In the new firm, the worker and the employer divide the surplus according to the Nash bargaining solution, so that, at the new firm, the worker gets a wage equal to:

$$w_2^n(y_2^n, y_2^o) = (1-\beta) w_2^o(y_2^o, y_2^n) + \beta y_2^n, \tag{C1}$$

where $w_2^o(y_2^o, y_2^n)$ and $y_2^o = f(h_2, s_i)$ are the wage and the production in the old firm, respectively. Similarly, at the old firm, the worker gets a wage equal to:

$$w_2^o(y_2^o, y_2^n) = (1-\beta) w_2^n(y_2^n, y_2^o) + \beta y_2^o. \tag{C2}$$

Solving the system of equations (C1) and (C2), we obtain

$$w_2^n(y_2^n, y_2^o) = \frac{(1-\beta) y_2^o + y_2^n}{2-\beta} \text{ and } w_2^o(y_2^o, y_2^n) = \frac{(1-\beta) y_2^n + y_2^o}{2-\beta}.$$

The worker leaves his old firm whenever the new firm offers him a higher salary. Thus, the probability that the worker leaves the old firm in the second period is equal to:

$$\Pr(w_2^n(y_2^n, y_2^o) \geq w_2^o(y_2^o, y_2^n)) = \Pr(y_2^n \geq y_2^o) = 1 - G(f(h_2, s_i) - f(h_2, (1-i)s_i)),$$

which is decreasing in i. Thus, the introduction of firm-specific human capital makes turnover endogenous. We state this result as a modified version of Proposition 1:

Proposition 3 *Workers in jobs with more-specific skills (higher i) have a lower turnover rate and, thus, higher health investment.*

[29] We can allow specific skills s_i to be endogenously accumulated at some cost. All results go through, at the cost of additional assumptions and calculations. Details are available from the authors upon request.

C.2 An Alternative Empirical Strategy

In this section, we report results from an empirical strategy that differs from the strategy of Sections 5.1 and 5.2. More precisely, we construct a proxy of current (for employed individuals) and past (for retirees) job attachment at the three-digit industry level using data from the 1991 Dictionary of Occupational Titles (DOT). We then match this proxy to MEPS and HRS data. We present the results of this alternative empirical strategy that more closely follow the results of Sections 5.1 and 5.2. In Fang and Gavazza (2007), we provide several additional tests, looking at whether firms offer health plans to their workers and what the characteristics of the offered health plans are. The results of these additional tests are all consistent with the results reported here.

Dictionary of Occupational Titles (DOT) and Average Specific Vocational Preparation (ASVP). The *Dictionary of Occupation Titles* compiled by the U.S. Department of Labor (1991) provides information about the training specificity required in various *occupations*. The variable, known as "Specific Vocational Preparation" (SVP), is defined as "the amount of time required to learn the techniques, acquire information, and develop the facility needed for average performance in a specific job-worker situation." It is based on nine numerical categories of vocational preparation, ranging from "Short demonstrations only" (category 1) to "Over 10 years" (category 9) [see U.S. Department of Labor (1991) for more details]. The Employee Retirement Income Security Act of 1974 (ERISA) requires employers to provide the same menu of health-care benefits to all workers in order for these benefits to be tax-exempt. Thus, firms presumably use the average job attachment of all workers in the firm as the relevant measure of job attachment when deciding what health benefits to offer to workers. Unfortunately, the data do not provide us with detailed information on the entire workforce of each individual firm. Thus, we focus on differences across *industries* in our analysis. More precisely, following the procedure described in Crocker and Moran (2003), we construct an Average Specific Vocational Preparation (ASVP) index for all the three-digit industry codes. Specifically, for each industry, we construct an ASVP by taking the weighted average of the SVPs of workers' occupations, where the weights are given by the five-percent sample from the 1990 Census. The industries with the three lowest values of ASVP are "Services to dwellings" (industry code 722), "Services to private households" (industry code 761) and "Taxicab service" (industry code 402)—all industries in which intuition suggests that specific human capital is not important. Industries with the highest values of ASVP are "Legal services" (industry code 841), "Engineering, architectural, and surveying services" (industry code 882) and "Miscellaneous professional and related services" (industry code 892).

Table C3: Means and Standard Deviations of the ASVP Variable

MEPS (1998)		HRS (2002)		BHPS (1997)	
Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
5.19	0.83	5.23	0.82	5.33	0.68

Intuition suggests that a higher ASVP value would be associated with a higher importance of industry-specific human capital, and, indeed, Crocker and Moran (2003) show that a higher industry ASVP value is a strong predictor of longer job tenure at the *firm* level. We match the constructed industry ASVP variable with individual-level data from MEPS (1998), HRS (2002) and BHPS (1997) in our analysis below. Table C3 shows the average ASVP for individuals' current industry in MEPS (1998) and BHPS (1997) and individuals' pre-retirement industry with longest job tenure in HRS (2002).

Empirical Specification. We match the ASVP index to the three-digit industry of each worker in the MEPS to investigate how current job attachment affects workers' current medical expenditures. We also match each individual's three-digit industry of the longest reported job in the HRS to investigate how past job attachment affects retirees' medical expenditures. The basic analysis is based on the following regression:

$$y_i = \alpha \text{ASVP}_i + \beta \mathbf{X}_i + \epsilon_i, \tag{C3}$$

where y_i is one of the several outcomes considered for individual i, such as total health expenditures, doctor visits, health status, etc.; $\mathbf{X}_i$ is a large set of control variables, including individual $i's$ age (also squared and cubed), education, gender, etc.. The coefficient of ASVP_i, α, measures the average effect of our proxy for job attachment on the outcome y_i, after controlling for a large number of factors included in the vector X_i.

C.2.1 Medical Expenditures of Workers

Table C4 presents the results of several regressions that investigate employees' medical expenditures (Panel A) and doctor visits (Panel B). Columns (1) and (2) report the coefficients of Tobit regressions in which the dependent variables are the level and the log of an individual's (annual) total medical expenditures, respectively. We employ Tobit regressions since the dependent variables are right-censored at zero expenditures. Columns (3) and (4) report the coefficients of negative binomial regressions in which the dependent variable is the number of office-based visits and the number of physician visits, respectively.[30]

Columns (1) and (2) show that individuals working in high-ASVP industries—i.e., industries with low turnover rates—have higher medical expenditures. The marginal effect calculated from the Tobit regression coefficient on the ASVP reported in Column 1 implies that a unit increase in ASVP increases annual medical expenditures by around \$113 dollars, or about six percent of the average medical expenditure, a rather large effect. The coefficient of the ASVP reported in Column 2 is much bigger: It implies that a unit increase in ASVP increases annual medical expenditures by about 15 percent.[31]

Columns (3) and (4) show that workers in high-ASVP industries visit medical providers more frequently. The magnitudes of the coefficients imply that a unit increase in ASVP is associated with an increase in the annual number of medical providers' visits and physician visits of about five percent, a rather large effect.

Overall, the results of Table C4 are consistent with Proposition 1 (and its extension, Proposition 3) of our model.

C.2.2 Medical Expenditures of Retirees

We now, using HRS data, investigate how past job attachment affects retirees' medical expenditures and health status. More precisely, the HRS reports individuals' longest job, along with its three-digit industry code. Thus, we match our ASVP proxy to the industry in which the individual had his longest job.

Column (1) in Table C5 presents the results of a Tobit regression that investigates how past ASVP affects retirees' current medical expenditures. Column (2) presents the results of an ordered Probit regression that investigates how past ASVP affects retirees' current health status. The dependent variable is a categorical indicator of self-reported health status, with 1 indicating "Excellent," 2 "Very Good," 3 "Good," 4 "Fair," and 5 "Poor."

Column (1) shows that medical expenditures are lower for individuals who worked in high-ASVP industries prior to retirement. The marginal effect from the estimated Tobit coefficients

[30]The number of office visits is the sum of visits to physicians and nonphysicians. MEPS classifies the following categories as nonphysicians: chiropractors, midwives, nurses and nurse practitioners, optometrists, podiatrists, physician's assistants, physical therapists, occupational therapists, psychologists, social workers, technicians, and receptionists/clerks/secretaries.

[31]The difference between the two coefficients suggests that individuals in low-turnover industries have higher average medical expenditures and a lower variance of medical expenditures. This is an implication of Jensen's inequality due to the log transformation of the dependent variable. See, also, Santos Silva and Tenreyro (2006).

Table C4: Relationship Between Industry ASVP and Total Medical Expenditures (Panel A) and Doctor Visits (Panel B)

	Panel A: Total Medical Expenditures		Panel B: Doctor Visits	
	Level	Log	Office-Based Visits	Physician Visits
Variables	(1)	(2)	(3)	(4)
ASVP	199.8**	0.22***	0.046*	0.053**
	(92.2)	(0.06)	(0.026)	(0.022)
Age	-135.5*	-0.24***	-0.005	-0.028*
	(72.6)	(0.05)	(0.023)	(0.016)
Age Squared	3.8**	0.006***	0.001	0.001***
	(1.7)	(0.001)	(0.000)	(0.000)
Education	74.5***	0.13***	0.039***	0.026***
	(27.9)	(0.02)	(0.008)	(0.009)
Male	-1257.7***	-1.63***	-0.593***	-0.622***
	148.4)	(0.11)	(0.043)	(0.038)
Income/10,000	-38.3*	-0.04***	-0.011	-0.019***
	(21.4)	(0.01)	(0.008)	(0.006)
Family Size	-239.4***	-0.19***	-0.071***	-0.043***
	(36.9)	(0.02)	(0.020)	(0.016)
Union	512.0***	0.43***	0.244***	0.231***
	(178.6)	(0.11)	(0.077)	(0.053)
Obs.	13,459	13,459	13,459	13,459

Notes: (I) Panel A reports the coefficient estimates from Tobit regressions with the total medical expenditures (level) or Log (1+Total Medical Expenditures) as the dependent variable. Panel B reports the coefficient estimates from negative binomial regressions where the dependent variables are "Number of Office Based Visits" and "Number of Visits to Physicians," respectively. (II) All regressions include a constant and additional controls for Firm Size, Race, Census Region and MSA dummies, as well as Age Cubed. Their coefficient estimates are not shown. (III) Robust standard errors clustered at the industry level are in parentheses. (IV) *, **, *** denote significance at ten, five and one percent, respectively.

Table C5: Relationship Between Retirees' Total Medical Expenditures and Perceived Health Status and the ASVP of their Pre-retirement Industries

Variables	Total Medical Expenditures		Perceived Health Status	
	(1)		(2)	
ASVP	-1,012.5*	(537.3)	-0.045**	(0.020)
Age	19,889	(23,447)	-0.046	(0.515)
Age Squared	-268.3	(307.4)	-0.001	(0.007)
Age Cubed	1.22	(1.34)	0.000	(0.000)
Education	132.1	(125.9)	-0.069***	(0.006)
Male	1766.0***	(730.6)	0.072***	(0.029)
Assets/100,000	-56.2***	(21.7)	-0.013***	(0.004)
Family Size	-100.3	(350.9)	0.034**	(0.014)
Married	-839.9	(791.3)	-0.178***	(0.037)
No. of Obs.	5,583		6,730	

Notes: (I) Column (1) reports the estimates from a Tobit regression with the total medical expenditures as the dependent variable. Column (2) reports the estimates from an ordered Probit regression with "Perceived health status 1: Excellent; 2: Very Good; 3: Good; 4: Fair; 5: Poor" as the dependent variable. (II) Both regressions include Race, Census Region and MSA dummies and their coefficient estimates are not shown. (III) Robust standard errors clustered at the industry level are in parentheses. (IV) *, **, *** denote significance at ten, five and one percent, respectively.

on ASVP shows that a one-unit increase in pre-retirement industry ASVP is associated with a decrease of $\$1,037$ in annual medical expenditures, a substantial effect. Column (2) of Table C5 shows that the coefficient of ASVP is negative and statistically significant, indicating that individuals who worked in high-ASVP industries prior to retirement have better self-reported health in retirement. This is particularly interesting since Column (1) shows that these same individuals have lower medical expenditures. Overall, these findings are consistent with Proposition 2 of our model.

C.2.3 Assessing the Magnitude of Life-Cycle Inefficiency

We now combine the estimates of the previous two sections to try to calculate the magnitude of the externality implied by our new set of regressions, in a parallel way to our calculations of Section 5.3.

Suppose that both individuals A and B work for 45 years and then retire for 15 years before dying. Individual A works in an industry in which the ASVP is low (i.e., turnover is high), while individual B works in an industry in which the ASVP is high (i.e., turnover is low). More precisely, individual A's ASVP is one unit lower than individual B's. The coefficient of the ASVP in the regressions of Table C4 on MEPS data implies that individual A's expenditures are lower than B's by $113 per year. Instead, the coefficient of the ASVP in the regressions of Table C5 on HRS data implies that individual A has higher medical expenditures than individual B by $1,037 per year.

Thus, if individuals A and B work for 45 years and then retire for 15 years, non-discounting their expenditures, we have that individual A has approximately $5,000 less in medical expenditures per year than individual B when working, but approximately $15,000 *more* in medical expenditures when retired. This calculation suggests that one additional dollar of medical expenditures during the working years may lead to about three dollars of savings during retirement. Again, we wish to emphasize that this calculation is very rough, as we already noted in Section 5.3. Nonetheless, it describes in a very simple way the externality we have in mind and its magnitude in the data. Moreover, it is quite interesting to note that the magnitude of the externality is close to the one that we calculated in Section 5.3, obtained with a different empirical methodology.[32]

C.2.4 Falsification Test: U.K. Workers

We now present the results of a falsification test that uses data from the U.K. BHPS, similar to the test we performed in Section 6.2. Specifically, we use the 1997 wave of British Household Panel Survey (BHPS) to investigate the relationship between ASVP and doctor visits for U.K. workers.

Column (1) in Table C6 reports the results from a negative binomial regression in which the dependent variable is the number of annual doctor visits. The estimated coefficient is almost zero, and is not statistically significant. This shows that our proxy for job attachment, ASVP, does not significantly affect the frequency of doctor visits, in sharp contrast to the evidence for the U.S., reported in Panel B of Table C4. Column (2) further reports the results of an ordered Probit regression that investigates the relationship between ASVP and a five-categorical indicator of self-reported health. Column (2) shows that the coefficient of the ASVP does not statistically differ from zero. This provides additional evidence in favor of

[32]The levels of the expenditures do not correspond to the levels reported in Section 5.3 because one unit of ASVP does not translate into one standard deviation of the log of job tenure.

Table C6: Falsification Test: Relationship Between Industry ASVP and Doctor Visits and Perceived Health Status for U.K. Workers.

Variables	Doctor Visits	Perceived Health Status
	(1)	(2)
ASVP	-0.007	-0.035
	(0.031)	(0.028)
Age	-0.031***	-0.006
	(0.008)	(0.008)
Age^2	0.0004***	0.000
	(0.0001)	(0.000)
Education	-0.001	-0.030**
	(0.008)	(0.009)
Male	-0.502***	-0.129***
	(0.032)	(0.035)
Income/10,000	-0.026***	-0.043**
	(0.008)	(0.011)
Family Size	-0.006	0.013
	(0.013)	(0.016)
Union	0.110**	0.052
	(0.044)	(0.047)
No. of Obs.	4,926	4,928

Notes: (I) Column (1) reports the coefficient estimates from a negative binomial regression where the dependent variables is the "Number of Annual Doctor Visits"; column (2) reports the coefficient estimates from an ordered Probit regression with "Perceived health status 1: Excellent; 2: Very Good; 3: Good; 4: Fair; 5: Poor" as the dependent variable. (II) Robust standard errors clustered at the industry level are in parentheses. (III) *, **, *** denote significance at ten, five and one percent, respectively.

the mechanism identified by our model.

D Quantitative Assessment of a Dynamic Search Model

In this Appendix, we show that an infinite-horizon extension of our model quantitatively matches the data well. Consider the following extension of our model. This extension closely follows the model in the Appendix of Acemoglu and Pischke (1998), but we allow the employer-employee pair to bargain over the level of investment in health, as in the model of Section 3.

Each worker is matched with a firm. The productivity of a worker with health h is equal to $f(h)$ in every period. For simplicity, suppose that investment in health is possible only in the first period. Both the firm and the worker are risk-neutral and discount the future at rate r. All worker-firm matches end at the exogenous rate q. A worker, once unemployed, finds a new firm at rate u_w, which is independent of her health, and a firm finds a new employer at rate u_f.

Suppose that all workers have health h^*, and consider a worker with health $h = k(h_0, m)$ where h_0 is the worker's initial health and m is the health investment to be determined in equilibrium, and $k(\cdot,\cdot)$ is the health production function. The value $J^E(h)$ of being employed satisfies

$$rJ^E(h) = w(h) + q\left[J^U(h) - J^E(h)\right], \tag{D4}$$

where $J^U(h)$ is the value of being unemployed. Equation (D4) has the usual interpretation of an asset-pricing equation. The worker receives a flow utility equal to her wage $w(h)$. At any date, at most, one possible event might happen to her: At rate q, she loses her current job, resulting in a capital loss equal to $J^U(h) - J^E(h)$. Similarly, the value of unemployment $J^U(h)$ satisfies:

$$rJ^U(h) = u_w\left[J^E(h) - J^U(h)\right]. \tag{D5}$$

For the firm, the value of employing a worker with health h, denoted by $J^F(h)$, satisfies

$$rJ^F(h) = f(h) - w(h) + q\left[J^V - J^F(h)\right], \tag{D6}$$

where J^V is the value of an unfilled vacancy, which itself satisfies:

$$rJ^V = u_f\left[J^F(h^*) - J^V\right]. \tag{D7}$$

Nash Bargaining between the employer and the employee over wage $w(h)$ and medical expenditures (i.e., health investment) m solves:

$$\max_{\{w,m\}}\left[J^E(h) - J^U(h)\right]^{\beta}\left[J^F(h) - J^V\right]^{1-\beta} - pm, \tag{D8}$$

where p is the price of medical expenditures and $h = k(h_0, m)$. Standard calculations following the first-order condition with respect to w yields the following wage function:

$$w(h) = \frac{(u_w + r + q)\left[\beta f(h) - \beta r J^V\right]}{r + q + \beta u_w}.$$

The first-order condition with respect to medical expenditures m is given by:

$$\left\{ \begin{array}{c} \beta\left[J^E(h) - J^U(h)\right]^{\beta-1}\left[J^F(h) - J^V\right]^{1-\beta}\left[J^{E\prime}(h) - J^{U\prime}(h)\right] \\ +(1-\beta)\left[J^E(h) - J^U(h)\right]^{\beta}\left[J^F(h) - J^V\right]^{-\beta} J^{F\prime}(h) \end{array} \right\} \frac{\partial k}{\partial m} = p. \tag{D9}$$

Using equations (D4)-(D7), we can simplify equation (D9) as:

$$\left[\beta^2\left(\frac{1-\beta}{\beta}\right)^{1-\beta} + (1-\beta)^2\left(\frac{\beta}{1-\beta}\right)^{\beta}\right]\frac{f'(h)}{q + r + \beta u_w}\frac{\partial k}{\partial m} = p. \tag{D10}$$

Suppose that we adopt the following functional form for $f(\cdot)$ and $k(\cdot,\cdot)$:

- $f(h) = zh$ where $z > 0$ is a constant;[33]
- $h = k(h_0, m) = h_0 m^{\alpha}$ where we assume $0 < \alpha < 1$ to guarantee an interior solution.

With these functional forms, the equilibrium condition (D10) becomes:

$$\left[\beta^2\left(\frac{1-\beta}{\beta}\right)^{1-\beta} + (1-\beta)^2\left(\frac{\beta}{1-\beta}\right)^{\beta}\right]\frac{z\alpha h_0 m^{\alpha-1}}{q + r + \beta u_w} = p. \tag{D11}$$

From (D11), we have:

$$m = \left\{\frac{(r + q + \beta u_w)\,p}{\left[\beta^2\left(\frac{1-\beta}{\beta}\right)^{1-\beta} + (1-\beta)^2\left(\frac{\beta}{1-\beta}\right)^{\beta}\right] z\alpha h_0}\right\}^{\frac{1}{\alpha-1}}.$$

Taking logs on both sides of the above equation, we obtain:

$$\begin{aligned}\ln m &= \frac{1}{\alpha-1}\ln(r + q + \beta u_w) + \frac{1}{\alpha-1}\ln p \\ &\quad - \frac{1}{\alpha-1}\ln\left\{\left[\beta^2\left(\frac{1-\beta}{\beta}\right)^{1-\beta} + (1-\beta)^2\left(\frac{\beta}{1-\beta}\right)^{\beta}\right] z\alpha h_0\right\}.\end{aligned}$$

[33]This is for simplicity only. The functional form for $f(\cdot)$ linking health to productivity is not relevant for the calculation of $\frac{\partial m}{\partial q}\frac{q}{m}$, as can be easily seen from Eq. (D10). This is because once we take logs on both sides, the function form for $f(\cdot)$ does not matter in our calculation of $\frac{\partial m}{\partial q}\frac{q}{m} \equiv \partial \ln m / \partial \ln q$.

Thus, the elasticity of medical expenditures m with respect to separation probability q is given by:

$$\frac{\partial m}{\partial q}\frac{q}{m} = \frac{q}{(\alpha - 1)(q + r + u_w \beta)}, \tag{D12}$$

and the elasticity of medical expenditures with respect to price is given by:

$$\frac{\partial m}{\partial p}\frac{p}{m} = \frac{1}{\alpha - 1}. \tag{D13}$$

Now, in our data, the mean job tenure is 6.7 years, as shown in Table 1. Thus, we have $q \approx 1/6.7$. Kowalski (2009) estimates that $\frac{\partial m}{\partial p}\frac{p}{m} \approx -2.3$. Hence, equation (D13) implies that $\alpha \approx 1 - 1/2.3 = \frac{13}{23}$. Furthermore, assuming that unemployment duration is six months, then $u_w = 2$. (Note that u_w and q imply an unemployment rate of $q/(q + u_w) = 0.074$, which matches the average unemployment rate reasonably well). Finally, Cahuc, Postel-Vinay and Robin (2008) estimate that the average bargaining parameter β is approximately .15. Taking an interest rate $r = .04$, we obtain from (D12) that

$$\frac{\partial m}{\partial q}\frac{q}{m} = \frac{1/6.7}{(13/23 - 1)(1/6.7 + .04 + 2 \times .15)} = -0.70.$$

Columns (3) and (4) of Table 2 reports our estimated elasticity of medical expenditures with respect to job tenure to be equal to 0.801 or 0.535, respectively. Because the elasticity of medical expenditures with respect to job tenure is equal to the negative of the elasticity with respect to separation probability q, our estimates straddle the calibrated elasticity above. Note that in this model, equation (D5) implies that $J^U(h) = u_w J^E(h) / (r + u_w)$. Given the values we assigned, $r = 0.04$, and $u_w = 2.0$, $J^U(h) = 0.98 J^E(h)$. Thus, the major reason for the sensitivity of equilibrium medical expenditures to turnover rate q in this model is the difference between $J^F(h)$ and J^V, which can be seen from equations (D6) and (D7).

Additional References

[1] Cahuc, Pierre., Fabien Postel-Vinay and Jean-Marc Robin (2006). "Wage Bargaining with On-the-job Search: Theory and Evidence." *Econometrica*, 74(2), 323-64.

[2] Chang, Chun and Yijiang Wang (1995). "A Framework for Understanding Differences in Labor Turnover and Human Capital Investment." *Journal of Economic Behavior and Organization*, Vol. 28, 91-105.

[3] Chang, Chun and Yijiang Wang (1996). "Human Capital Investment Under Asymmetric Information: The Pigovian Conjecture Revisited." *Journal of Labor Economics*, Vol. 14, No. 3, 505-520.

[4] Fang, Hanming and Alessandro Gavazza (2007). "Dynamic Inefficiencies in an Employment-Based Health Insurance System: Theory and Evidence." NBER Working Paper No. 13371.

[5] Jovanovic, Boyan (1979). "Job Matching and the Theory of Turnover." *Journal of Political Economy*, Vol. 87, No. 5, 972-990.

[6] Kowalski, Amanda (2009). "Censored Quantile Instrumental Variable Estimates of the Price Elasticity of Expenditure on Medical Care." NBER Working Paper 15085.

[7] Santos Silva, Joao and Silvana Tenreyro (2006). "The Log of Gravity." *Review of Economics and Statistics*, Vol. 88, No. 4, 641-658.

[8] van den Berg, Gerard. and Geert Ridder (1998). "An Empirical Equilibrium Search Model of the Labor Market." *Econometrica*, Vol. 66, No. 5, 1183-1223.

[9] Windmeijer, Frank (2005). "A Finite sample correction for the variance of linear efficient two-step GMM estimators." *Journal of Econometrics*, Vol. 126, Issue 1, pp. 25-51.