Health Insurance and the College Premium *

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1 Introduction

The gap between the rich and the poor is rising. During the past 30 years, this difference has been especially pronounced between college graduates and non-college graduates. The ratio of skilled (college educated) wages to unskilled (non-college graduate) wages is called the skill premium, and it has also increased over the past 30 years. The increase in the skill premium has continued despite a dramatic increase in the supply of college graduates. In 1980, the skill premium was 1.37 and in 2009 it was 1.93. Common explanations for the rising skill premium include the increasing downward pressure on unskilled wages due to international trade (Thoenig and Verdier, 2003), immigration (Card, 2009), and deunionization (Asher and DeFina, 1997). An especially compelling explanation for the rise in the skill premium is the capital-skill complementarity hypothesis. The amount of capital equipment being used in the economy has been rising along with the skill premium. If capital and skill are complements, rising amounts of capital could lead to higher wages for skilled workers (see Griliches, 1969 and Krusell et al., 2004).

In addition, health insurance costs may also be contributing to increasing income disparity. Health insurance costs are rising and are an increasingly large part of employee compensation. For example, in 1980, employers paid an additional 2.5% of employees'

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wages in health insurance benefits (McDonnell, 2005), but by 2010 that percentage had risen to 8.4% (Bureau of Labor Statistics, 2011). Health insurance premiums paid by both employers and employees are rising. From 2000 to 2010, average annual premiums rose from \$6438 to \$13700 for family coverage, with employers covering \$4819 and \$9773 respectively (The Kaiser Family Foundation and Health Research and Educational Trust, 2011).

But not all workers are insured, and the percentage of skilled and unskilled workers covered by health insurance differs. Specifically, professionals are offered health insurance by their employers at twice the rate of service workers. Over 60% of professionals obtain health insurance from their employer, while around 25% of service workers do so (Mauersberger, 2012). Due to this disparity in the allocation of health insurance benefits, Chung (2003) argues that if benefits, like health insurance, were included, the skill premium would be even larger than currently estimated.

Because one can think of healthcare costs as an input cost for the firm, it is reasonable to explore the role of health insurance costs in relation to capital-skill complementarity and the rising skill premium. For example, the price of oil has been found to be related to changes in the skill premium (Polgreen and Silos, 2009). If the price of oil matters, health insurance costs may be contributing to the increasing skill premium as well. Indeed, it has often been cited that General Motors spends more money on healthcare than it does on steel[1].

Thus, the goal of this paper is to examine health insurance as a potential contributor to the rising skill premium in the context of capital-skill complementarity. We estimate an aggregate production function using data from the Bureau of Labor Statistics (BLS) on the cost of healthcare for employers and wage data from the Current Population Survey (CPS).

To our knowledge, no papers have examined skill complementarity and health insurance costs. However, two important papers have examined the theoretical effect of mandated benefits on wages and employment. Summers (1989) finds that if a benefit

[1]This story may be apocryphal, though: see Sapolsky et al. (1981).

is fully valued by the employees, mandating it does not cause changes in employment, but wages fall by the amount of the benefit. Gruber and Krueger (1991) extend this model, and depending on how much the workers value the benefit, wages will fall, but employment could also fall, especially for those whose wages are near a lower bound, such as the minimum wage. In the case of the skill premium, if all workers value health insurance benefits, then the skill premium should rise with rising health insurance costs: health insurance costs are a smaller percentage of a skilled worker's wage, so if wages fall by the amount of the benefit for both skilled and unskilled workers, skilled wages will fall by a smaller percentage than unskilled wages, raising the skill premium.

2 Model

In order to determine the effect of healthcare costs on the skill premium within the context of capital-skill complementarity, we use a model that can accomodate many types of substitutability and complementarity among the factors of production. The model is an aggregate production function used by Krusell et al. (2004) and Polgreen and Silos (2009). We model a profit-maximizing firm that in each period t produces output (Y_t) using 5 factors of production: structures (k_{st}), equipment (k_{et}), skilled labor (S_t), and unskilled labor (U_t). In the model, equipment and skilled labor are aggregated using a constant elasticity of substitution (CES) function, which in turn is aggregated with unskilled labor in another CES function. This composite aggregation is combined with structures in a Cobb-Douglas production function as follows:

$$Y_t = G\left(k_{st}, k_{et}, S_t, U_t\right) = k_{st}^{\alpha}\left[\mu U_t^{\sigma} + (1-\mu)\left(\gamma k_{et}^{\rho} + (1-\gamma)\, S_t^{\rho}\right)^{\frac{\sigma}{\rho}}\right]^{\frac{(1-\alpha)}{\sigma}} \quad (1)$$

where μ and γ govern the output shares. The elasticities of substitution are governed by σ, ρ, and α. Skilled and unskilled labor inputs are measured in efficiency units with $S_t = \varphi_{st} h_{st}$ and $U_t = \varphi_{ut} h_{ut}$, where φ_{st} and φ_{ut} are the human capital of skilled and unskilled labor respectively, and h_{st} and h_{ut} denote the labor hours of skilled and unskilled workers, respectively. Output is transformed to equipment by technology q_t

such that $c_t + x_{st} + \frac{x_{et}}{q_t} = Y_t$, where c_t is consumption, x_{st} is the investment in structures, and x_{et} is the investment in equipment. Structures and equipment depreciate at rate δ_s and δ_e, respectively.

We assume there is perfect competition in the factor markets. The rates of return on structures and equipment are r_{st} and r_{et}, respectively. Workers are heterogeneous in skill levels and whether they are covered by employer-provided health insurance. The cost of employer-provided health insurance (i_t) is common to all workers.[2] Because each worker's total compensation is comprised of both wages and health insurance benefits, workers with health insurance may receive different wages than those without health insurance. The fraction of labor hours supplied by skilled workers covered by health insurance, denoted by λ_t^s, are paid with wage w_{st}^c and the hours from skilled workers without health insurance are paid at wage w_{st}^{uc}. Similarly, the fraction of labor hours supplied by unskilled workers covered by health insurance, denoted by λ_t^u, are paid at wage w_{ut}^c, and the hours of unskilled workers without health insurance are paid at wage w_{ut}^{uc}. From this model, we develop the firm's profit maximization problem and calculate the first-order conditions, and they are available in the appendix.[3]

With the presence of employee benefits, we highlight the distinction between the conventional measure of the skill premium and the actual skill premium implied by the firm's profit maximization problem. The conventional skill premium is what we regard as the *wage* premium in this context because it only accounts for wage differentials. Specifically, the wage premium (wp_t) implied by the model is

$$wp_t = \frac{\lambda_t^s w_{st}^c + (1 - \lambda_t^s)\, w_{st}^{uc}}{\lambda_t^u w_{ut}^c + (1 - \lambda_t^u)\, w_{ut}^{uc}}. \tag{2}$$

The actual skill premium with employee benefits considered is what we regard as the *compensation* premium. It is the ratio of marginal productivities of skilled and unskilled

[2]This is not an unreasonable assumption: In fact, for self-insured firms, in order for health benefits to be tax-exempt, employers must offer comparable health plans to all workers (Marks 2011). As a robustness check, we also produced the estimates from a model that allows the health insurance cost to differ. Results are similar and available upon request.

[3]The appendix also includes a detailed description of the data and a description of Bayesian estimation procedure used in section 3.

workers. The compensation premium (cp_t) is calculated as

$$cp_t = \frac{G_{h_{st}}(\cdot)}{G_{u_{st}}(\cdot)} = \frac{(w^c_{st} + i_t)\,\lambda^s_t + w^{uc}_{st}\,(1 - \lambda^s_t)}{(w^c_{ut} + i_t)\,\lambda^u_t + w^{uc}_{ut}\,(1 - \lambda^u_t)}, \tag{3}$$

where $G_{h_{st}}$ and $G_{h_{ut}}$ are the partial deriatives of (1) with respect to skilled labor and unskilled labor, respectively. Because the wage rates for workers with health insurance are affected by the health insurance cost, even though the compensation premium remains the same, the wage premium is influenced by the health insurance cost (i_t) and the health insurance coverage rates of skilled and unskilled workers (λ^s_t and λ^u_t).

3 Estimation Method

For econometric estimation of the model, we identify 3 equations that form the non-linear state space model. First, there is a non-arbitrage condition between investment in structures and equipment:

$$\frac{q_t}{q_{t+1}} = \frac{1}{1-\delta_e}\left(1 + r_{s_{t+1}} - \delta_s\right) - q_t r_{e_{t+1}} + \epsilon_{t+1}, \tag{4}$$

where ϵ_{t+1} is the price-forecasting error with $\epsilon_t \sim N(0, \sigma^2_\epsilon)$. We further assume that the human capital (latent) variables φ_{st} and φ_{ut} follow the stochastic process

$$\phi_t = \phi_0 + \nu + t, \tag{5}$$

where $\phi_t = [\log(\varphi_{st}), \log(\varphi_{ut})]'$ and $\nu_t \sim N(0, \Sigma)$. The covariance matrix Σ is diagonal and the two diagonal elements are restricted to be equal to σ^2_φ. Let X_t represent the set of observed independent variables, which include $k_{st}, k_{et}, h_{st}, h_{ut}, i_t, \lambda^s_t$, and λ^u_t. The set of unknown parameters in the model, denoted as θ, is a vector of $(\alpha, \sigma, \mu, \rho, \gamma, \delta_s, \delta_e, \sigma^2_\epsilon)'$. Thus, we can further specify 2 measurement equations as a function of parameters, observed independent variables, and latent variables

$$\frac{G_{h_{st}} h_{st} + G_{h_{ut}} h_{ut}}{Y_t} = f_y(\theta; X_t, \varphi_{st}, \varphi_{ut}, \epsilon_t), \tag{6}$$

$$cp_t = \frac{G_{h_{st}}(\cdot)}{G_{u_{st}}(\cdot)} \quad = \quad f_{cp}(\theta; X_t, \varphi_{st}, \varphi_{ut}, \epsilon_t). \tag{7}$$

Equation (6) is labor's share of output, and equation (7) is the compensation premium. These two equations, together with equation (4), are used to jointly estimate the set of parameters θ with the independent variables X_t. Estimation errors are given by the price-forecast error ϵ_t and latent variables φ_{st} and φ_{ut}.

We use the U.S. data from 1980 to 2004 to estimate the parameters and latent variables via a Bayesian procedure similar to Polgreen and Silos (2009). This period is of particular interest because significant changes in health insurance premiums occurred.Then we sample from the posterior distribution of the parameters repeatedly to generate a set of model generated compensation premiums and wage premiums.

4 Results

To determine the relationship between the skill premium and health insurance costs, we simulated distributions for the skill premium, output, health insurance cost, and the health insurance coverage ratio using the posterior distribution of the parameters. After detrending these series using a Hodrick-Prescott filter and first differencing the data, we computed correlations of interest. The results are reported in Table 1. We find that the compensation premium is negatively correlated with employee health insurance cost, and this result is robust to both de-trending methods as well as using non-detrended data. The compensation premium is also negatively correlated with the ratio of skilled-unskilled health insurance coverage rates, but the correlation is not as strong.

The traditional skill premium is negatively correlated with the the ratio of skilled-unskilled health insurance coverage rates, and this result is also robust to different de-trending methods, but the correlation is much weaker than that of the compensation premium. The correlation between the skill premium and employee health insurance cost is also negative, but less robust: first differencing the data gives a positive, though less significant result.

The weak correlation between the wage premium and health insurance costs implies that wages are not very responsive to changes in health insurance costs. If this is the case, firms must be responding to increasing health insurance costs by adjusting labor inputs. In addition, the negative correlation between the compensation premium and health insurance cost implies a substitution of skilled workers for unskilled workers. As health insurance costs increase, firms hire more skilled workers and fewer unskilled. As a result, the partial derivatives of the production function change: the marginal product of skilled labor decreases and the marginal product of unskilled labor increases, and thus the compensation premium falls. Furthermore, if firms respond to an increase in health insurance cost by using skilled labor more intensely, that would decrease output as the marginal product of skilled labor falls. This would explain the negative correlation estimated between output and health insurance costs.

Table 1: Results from Model Simulation

	H-P	FD	ND
$corr(cp_t, i_t)$	-0.430	-0.235	-0.335
	(0.005)	(0.011)	(0.004)
$corr(cp_t, \mathrm{EHI}_t)$	-0.030	0.138	-0.874
	(0.002)	(0.005)	(0.002)
$corr(Y_t, i_t)$	-0.453	-0.229	0.304
	(0.004)	(0.013)	(0.003)
$corr(Y_t, \mathrm{EHI}_t)$	-0.214	0.032	0.893
	(0.004)	(0.010)	(0.003)
$corr(wp_t, i_t)$	-0.088	0.096	-0.278
	(0.068)	(0.071)	(0.014)
$corr(wp_t, \mathrm{EHI}_t)$	-0.307	-0.089	-0.881
	(0.024)	(0.016)	(0.004)

Note: cp_t, wp_t, Y_t, and i_t are in log values. EHI_t is the log of the ratio of skilled-to-unskilled labor hours covered by employer-provided health insurance $(\lambda_t^s/\lambda_t^u)$. H-P denotes simulation results detrended by the Hendrick-Prescott filter, FD refers to the first difference of the simulation results, and ND refers to the non-detrended simulation results. Standard deviations of the simulation results are shown in parentheses.

5 Conclusion

We explored the relationship between the skill premium and health insurance costs. The skill premium has increased over the past 30 years. Over this same time period, the percentage of employee compensation devoted to health insurance has also increased. A positive correlation between the two series would be expected. Suprisingly, we find that the skill premium is negatively correlated with employer health insurance cost. This negative correlation may be explained by the differing values placed on benefits by skilled and unskilled workers. Referring back to Summers (1989) and Gruber and Krueger (1991), wages fall by the amount of the benefit if the benefit is fully valued by the workers. A larger percentage of skilled workers are covered by health insurance than unskilled workers are. Thus if skilled workers value health insurance benefits more than their unskilled counterparts, when health insurance costs rise, skilled workers are more likely than unskilled workers to take a cut in pay in order to keep their insurance. For unskilled workers, who value health insurance less than skilled workers, losing their health insurance would be preferable to taking a cut in pay.

If the skill premium and health insurance costs are negatively correlated, what will happen if all workers are offered health insurance? An earlier universal health insurance mandate could provide an explanation: Hawaii has required that almost all employers offer health insurance to full-time employees since 1979. A recent paper (Buchmueller, DiNardo and Valletta, 2011) finds that Hawaii's mandate did not affect wages, but it did cause an increase in the amount of part-time work in the lower wage groups; i.e., low-skilled workers were moved to the uncovered category. Given these results and ours, a universal health insurance mandate could actually increase the skill premium. If unskilled wages fall with the increase in health insurance coverage, the skill premium would rise - increasing income disparity. Indeed, another recent paper estimates that in Massachusetts, which mandated health insurance coverage in 2006, wages for covered workers fell by an amount similar to the cost of the insurance (Kolstad and Kowalski, 2012). If more part-time positions are created to avoid the mandate, especially for the unskilled, increasing health coverage will increase income disparities as well. Thus, although universal health coverage may decrease health insurance disparities, it may actually increase wage disparities.

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