The Individual-Specific Impact of Employer-Sponsored Insurance: Evidence from the Affordable Care Act

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Abstract

The Affordable Care Act's employer mandate provides a unique source of exogenous variation allowing for identification of the effects of employer-provided health insurance on wages and hiring. The Act affects firms who do not provide cover more than firms who do provide cover allowing for an examination of how labor market outcomes are affected by variation in health-care costs at the individual level.

Estimates, using data from the 2008-2012 Medical Expenditure Panel Survey (MEPS), suggest that workers who would have higher benefit expenses are less likely to secure employment at affected firms, have lower wages when they do, and work fewer hours if employed at a firm that already provides coverage.

JEL classification: *J31, J32, J38, I12, I13, I18, H51*

1 Introduction

During World War II, employers provided generous health benefits to circumvent wage freezes imposed by the National War Labor Board. Given its origins as a substitute for wages, it is not surprising that Gruber (1993), Sheiner (1999), Bailey (2014), Jensen and Morrisey (2001), and others find that workers still pay for their health-care benefits in the form of reduced wages today.

For example, Gruber's work on mandated maternity benefits shows that beneficiaries, as a group, experience lower wages. Sheiner finds a similar result for elderly workers in high versus low cost regions of the US. Jensen and Morrisey's paper also finds that elderly workers pay for their increased cost of care while Bailey finds that the cost of prostate screening mandates are passed on to males over the age of 50.

What remains unclear in the literature is at which level cost-shifting occurs: is it at the group level or do firms respond to individual variation in employee health-care usage? This paper tackles

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exactly this question by using the implementation of the Affordable Care Act to examine if firms who must provide coverage under the Act respond to individual differences in health-care costs for existing and new employees.

The level at which cost-shifting occurs matters because employer-based insurance creates a cost wedge between workers who are equally productive but who incur different annual health-care expenses potentially introducing a needless distortion in the labor market. The cost wedge is unavoidable because firms who purchase insurance are treated as a single risk pool and pay a premium based on their specific employee demographics and past claims experience. Alternatively firms can self-insure, taking the financial risk of large expenses on themselves. In either case, the firm eventually pays the actual cost of their employee's health-care usage and can only reduce the cost of providing the same level of coverage by cherry-picking employees who will use health insurance less intensively.

Of course, the tailoring of wage and benefits packages at the individual level would seem efficient. If worker A has health-care costs c_A and worker B has costs $c_B > c_A$ but both workers are equally productive then the difference in their wages should be $c_B - c_A$. Moreover, worker B should have no qualms with this outcome.

The potential for inefficiency when bundling health insurance with employment only becomes apparent when we consider that for larger values of c_B, it may be impossible for worker B to be profitably employed at any firm that offers coverage.[1] For workers with high health-care costs, the availability of jobs that *do not* provide health coverage would be crucial to securing employment. If firms consider each worker's actual health-care expenses when making hiring and wage decisions, the impact of a broad mandate on employer-based coverage may be quite harmful for the employment prospects of workers who utilize health-care the most.

Surprisingly, the literature has struggled to determine if labor market outcomes vary with individual health-care usage. As a prime example, Jonathan Gruber doesn't have the data on fertility events that would be needed to test if those who have multiple or complicated births face larger wage reductions as a result of maternity coverage. Similarly, the data sets used by Bailey, Sheiner, and Jensen and Morrisey do not have data on actual health-care usage to determine if two otherwise-identical workers with different health expenses are treated differently by employers.

Authors who leverage individual health-care expenses have struggled to causally relate labor market outcomes to individual-specific variation in benefit expenses. The problem is that we might expect healthier workers to be systematically more productive meaning that attributing success in the labor market to lower benefit costs is extremely difficult. The identification problem is best illustrated by Levy and Feldman (2001) who search for individual-specific cost-shifting but ultimately conclude "[w]e attribute our failure to find useful results to the absence of exogenous variation in health insurance status; those who gain or lose health insurance are almost certainly experiencing other productivity-related changes that render our fixed-effects identification strat-

[1] Research by the Agency for Healthcare Research and Quality found that "health care expenses in the United States rose from $1,106 per person in 1980 ($255 billion overall) to $6,280 per person in 2004 ($1.9 trillion overall)." Available at http://archive.ahrq.gov/research/findings/factsheets/costs/expriach/index.html (accessed March 1, 2015).

egy invalid." Levy and Feldman also note that "exogenous variation in insurance coverage will be necessary in order to test these hypotheses."

The Affordable Care Act provides the necessary exogenous variation. The Act mandates that firms with more than 50 full-time employees;

1. provide affordable coverage for all workers who work more than 29 hours in a usual week and
2. provide coverage that is more generous both in terms of benefits and eligibility than before.[2]

These changes resolve many of the identification problems in the existing literature. The Act's provisions ensure that firms will face an increase in benefit expenses. Importantly, the Act's impact will be greatest where coverage was not previously offered.

The paper focuses on the period after the announcement of the law but before its full implementation. That may seem problematic but while individuals and the media struggled to wrap their heads around the new health-care law, the insurance industry reacted swiftly. By mid-2011 there is ample evidence that insurers had developed reports which advised affected firms of the Act's regulatory changes and how to prepare for them.[3] Underlining the importance of a speedy response to the law, firms were to be experience-rated for 2014 based on their employee pool in 2013.[4]

The cost of not complying with the coverage mandate is significant. From 2014, firms with more than 50 workers were to face a penalty of $2,000 per full-time employee excluding the first 30 employees for not providing coverage. Given the available empirical evidence shows firms can and do pass on the cost of coverage to employees (at least as a group), the penalty represents a significant stick. It would make little sense to pay the penalty when firms could simply offer coverage and reduce real wages to cover its cost.

Because paying the penalty would only make sense as some kind of protest, a firm who did not provide cover before the new health-care law can be expected to have the strongest economic incentives to prepare for the Affordable Care Act by instituting exclusionary hiring practices and reducing wages. The focus of this paper is examining if their reactions to the law successfully targeted individuals who would be the most costly to cover.

Aiding clean identification, the Act gave workers little incentive to alter their behavior until January 2014.[5] At that point, they could obtain coverage on the individual insurance exchanges and whether a firm offers coverage or not would be less relevant to their job search. Of course, workers could decide to change jobs in 2011 or 2012 in anticipation of the law's impact. The type

[2]Due to the law's "Essential Health Benefits" and enhanced coverage for dependents. For details, see Appendix A.

[3]A typical example is the Hudson Institute report for franchise owners in September 2011: http://www.franchise.org/uploadedFiles/HeathCare/The%20Effects%20of%20PPACA%20on%20Franchising-%20Final.pdf

[4]http://www.washingtonpost.com/national/health-science/white-house-delays-health-insurance-mandate-for-medium-sized-employers-until-2016/2014/02/10/ade6b344-9279-11e3-84e1-27626c5ef5fb_story.html

[5]Except for workers under 26, who were allowed to remain on their parents insurance if their own employer did not offer coverage.

of behavior which would render the findings in this paper invalid would require healthy workers joining firms that were not providing coverage *because* of the law. Such a move, if only driven by the expected consequences of the Affordable Care Act, would be risky as there is no guarantee any particular firm would offer insurance when 2014 eventually arrived. To make a fully-informed decision an individual worker would need to know, before joining a no-coverage firm, the number of *full-time* workers employed, existing and future health-care options, and be well-informed about options on the new individual health-care exchanges in case cover was not provided by their employer.[6] This paper rules out such omniscience.

Because the law gave workers no reasons to change their behavior the paper proceeds as if the law affects only firms in the period before its full implementation. The paper then examines if firms' preparations for the law involved lower wages and exclusionary hiring practices for those who would be more expensive to cover. To do so, detailed micro-level survey data on labor market outcomes, employer characteristics, health coverage, and health expenses from the 2008-2012 waves of the Medical Expenditure Panel Survey are used. Note that this data is at the individual level. The explicit assumption here is that if firms are treating higher cost workers differently, we will be able to observe this from micro-survey data on individuals.

The empirical analysis uses difference-in-difference and triple-difference empirical strategy to take advantage of the natural experiment created by the new health-care laws. The mandate affects firms who did not provide coverage much more than those who already did and therefore provides well-defined "treatment" and "control" groups. The high and low cost workers at each type of firm are another "difference" along with the before and after the Act period. More details of this estimation strategy are provided in the body of the paper.

As a preview of the results, firms do appear to consider workers' actual health expenses in employment and compensation decisions even after controlling for demographic characteristics. Those who have higher benefit expenses are significantly less likely to secure employment at firms impacted by the Act and secure lower wages when they do. Unsurprisingly, equilibrium forces result in higher-cost workers shifting towards firms that already provide coverage. However, when they do so, they work fewer hours suggesting they may be employed at a firm that offers coverage but are perhaps ineligible as they are under the Act's 29-hour per week coverage limit.

There is a risk that the empirical work in this paper, focused on determining if employers respond to variation in health coverage costs at the individual level, will be conflated with an analysis of the Affordable Care Act itself. This is not the case. The Affordable Care Act consists of many regulatory changes. This paper uses just one of its changes to identify an effect that has previously been difficult to observe.

At the same time, the paper raises questions about the Act's potential efficacy. In particular, if firms affected by the Affordable Care Act's mandate treat high and low-cost workers differently, it is sensible to think that firms who already provided insurance coverage to their workers were

[6]This is extremely unlikely in the period analyzed in this paper as the website (health-care.gov) detailing coverage options for individuals was barely functioning as late as December 2013.

already behaving this way. The fact that firms can and do pass the individual costs on to their workers suggests that the system of employer-based coverage may lower wages and hamper the choices higher-cost workers have in the labor market. First, this could be considered as a strike against a mandate that makes finding work that does not offer coverage more difficult. Second, it strongly suggests that the bundling of employment and health insurance creates unnecessary and discriminatory distortions in the labor market.

It is also worth noting that the results presented in this paper should be viewed as a lower bound. The estimates are biased towards zero if firms were not convinced the law would ever come into effect or if some firms were unaware of their responsibilities. However, focusing on firm behavior in the pre-implementation period is crucial to cleanly identifying how the employer mandate affects individual workers. This is because once the law is fully implemented identifying the effect of the employer mandate separately from the rest of the Act's provisions will be difficult. The most likely source of confounding variation will be the already-mentioned distortions introduced by the heavily-subsidized coverage available on the Act's individual health-care exchanges.

These exchanges will render clean identification impossible. While employers can be expected to continue to try to avoid the costs of the Act after 2014, labor market survey data will be affected by the coverage available on insurance exchanges. These exchanges will provide affordable individual health coverage plans which could affect incentives to participate in the labor market, alter decisions to retire or to become self employed, remove "job lock" effects, and could reduce the intensity of unemployed workers' job search.

Underlining the importance of studying the pre-implementation period, a naive approach to this question using data from 2012 to 2016 or later may find no "effect" of the employer mandate. From that, the researcher may be tempted to state the incidence of health insurance is not individual-specific. Such a claim would be erroneous because the adjustments occurred before the stated implementation date of the Act. Indeed, many well-known studies of the impact of labor market policies are open to exactly this type of criticism. The most famous is likely Card and Krueger (1994) who study the implementation of a higher minimum wage by surveying selected employers in New Jersey and Pennsylvania the month before a wage increase comes into effect in New Jersey. They then re-survey these employers again 7 to 8 months after the higher minimum wage is in place. Unfortunately, the wage increase the authors study was announced two years before its implementation date.

This paper proceeds with a review of the literature on who pays for employer-provided insurance. The existing literature generally exploits state-level mandated benefits as a source of identifying variation. The review highlights that evidence of *individual-specific* incidence has been elusive to date and illustrates the importance of the identifying variation provided by the Affordable Care Act's employer mandate. The third section provides a theoretical framework to motivate the empirical analysis in section six. The section presents an equilibrium job search model which highlights the expected effects of a mandated benefit which is costlier to provide to some workers versus others. Comparative statics provide testable hypotheses. The empirical section then examines the predictions of the model in difference-in-differences and triple-difference frameworks. The data used for this empirical analysis is described in section four. Section five details the Act's implementation time-line and re-iterates the importance of focusing on the pre-implementation period. The final section concludes.

2 Literature Review

Summers (1989) provides a succinct analysis of the economics of mandated benefits, highlighting the ways in which they are similar to payroll taxes, where they differ, and why that makes them politically popular. Despite being only six pages long, including references, the paper sparked a wave of research into the empirical regularities of mandated benefits. This paper adds to the existing literature by providing clean identification of the individual-specific incidence of a particular type of mandated benefit: employer-based health insurance.

The paper is very closely related to the work of Jonathan Gruber and regular co-authors on the incidence of mandated benefits, such as Gruber and Krueger (1991), Gruber (1993), Baicker and Chandra (2006), Baicker and Levy (2008), and others. Baicker and Levy examine the potential for employer mandates to impact a specific group, low-wage earners, finding that many positions where wages are close to the floor provided by the federal minimum wage may not be economically viable if employers were forced to provide health coverage to these workers, too. While not focused on any actual mandate, Baicker and Chandra find rising health-care premiums reduce employment levels but the effect they find is not group or individual-specific. The authors leverage exogenous variation provided by medical malpractice laws across states. This method circumvents the endogeneity concerns with state-based mandates.

Of particular relevance is Gruber's work on the incidence of mandated maternity benefits. Gruber examines changes in labor market outcomes for affected individuals in states that passed maternity benefit mandates and finds that higher coverage costs are shifted to affected workers. Gruber uses non-affected individuals (those not "at risk" for a covered childbirth event, such as single men and females who are past child-bearing age) in the same state as a comparison group for the first difference. The period before and after mandated changes and the difference between experimental and non-experimental states allow for a triple-difference estimation of the impact of the mandate on the treated group: married females of child-bearing age. Single females and married males were also affected by the law but data limitations lead to them being excluded from the analysis. Gruber finds that wages fall for the affected group by approximately the cost of the new benefit. To construct the cost of the mandated benefit Gruber uses complementary proprietary data on the probability of coverage, the type of coverage, and the price of covered events.

Gruber's paper is the type of empirical work Summers suggested would be valuable. Summers was concerned that mandated benefits could introduce exclusionary hiring practices if wages were not free to adjust for the cost of the benefit which employers were forced to provide. Employers could simply refuse to hire workers for whom the mandated benefit would be costly. If a mandated benefit resulted in such behavior Summers saw value in public provision of the benefit: "publicly provided benefits do not drive a wedge between the marginal costs of hiring different workers and so do not give rise to a distortion of this kind." Gruber's findings suggest that wages are actually free to adjust and workers don't pay more than the actual cost of the benefit. In a world where workers value the benefit they receive at its cost these findings minimize concerns about inefficiencies or labor market discrimination. In addition, the firm is no worse off as they should be indifferent between providing the same total compensation to a worker via reduced wages and increased benefits versus higher wages and lower benefits.

However, Gruber's identification strategy is open to criticism. The mandated benefit Gruber studies changes worker incentives in a way that could also explain many of his paper's findings. In particular, the provision of mandated maternity benefits could alter fertility decisions at the margin with follow-on consequences for labor market outcomes. In particular, Gruber mentions that there is a rise in cesarean rates co-incident with the mandates. This suggests that the *type* of person having a baby after the law may be different, violating the assumptions of the identification strategy employed. Moreover, if the law resulted in marginally more births immediately after the law, Gruber's results may be due to new mothers choosing to 1) reduce their supply of labor or 2) to fore-go available employment advancement opportunities until after fertility plans have been completed. As non-parents are substitutes for the jobs that the treated group are choosing not to pursue, such a mechanism would widen the between-group estimates in both directions simultaneously. The *treated* group in the experimental states "choose" to earn less than those in non-experimental states (i.e., they choose to start or have a larger family with consequences for hours worked, promotions, and wage increases), leaving employment opportunities and promotions open for non-parents. Simultaneously, the non-treated in the non-experimental states face labor market competition from those who would be the treated in experimental states. The systematic correlation between the mandates, fertility decisions, and wages for the treated group plausibly violates Gruber's only identifying assumption.

Due to the confounding effects of employee behavior, it is unclear if the estimates Gruber provides are reliable. It may not be the case wages are affected for the treated group, but that the provided benefit allows many at the margin to substitute towards increased fertility rather than labor. Even if the estimates are reliable, it is not clear what the mechanism that determines outcomes actually is: is it firm or worker behavior? This paper is not subject to the same identification concerns. The Affordable Care Act's employer mandate gave employers a multi-year pre-implementation period in which they can make decisions to adjust the composition of their workforce to minimize the impact of the law. During the same period, the law's effects on individuals (particularly those over 26) are essentially zero.[7] The asymmetrical early impact of the

[7] From 2011 onwards, the Act mandated that young adults up to the age of 26 were allowed to remain on their parents dependent coverage.

employer mandate allows for results to be viewed as causally related to firms' reactions to the law. Any potential effects on workers' labor supply or health care decisions can be safely ignored as workers are free to wait until after the Act's full implementation to adjust their behavior and would be taking a huge risk to do so in advance.

Complementing Gruber's work, Sheiner (1999) uses regional variation in health care costs to try to causally relate wages and benefit expenses for older Americans. Sheiner argues that older individuals in high-cost areas should have relatively lower wages when compared with older workers in lower-cost regions, all else being equal. Her results echo Gruber in showing that employers are able to shift the cost of health insurance onto *groups* who are more expensive to insure but can say nothing about the effects of individual-specific variation within a group.

Thurston (1997) examines the unique experience of Hawaii. Hawaii mandated employer provision of health insurance to full-time workers in 1974. Part time workers were not covered. Thurston estimates that in industries that had mainly full-time employees a 10 percentage point increase in employees who would be covered lead to a 1 percentage point increase in part-time jobs which were not covered by the law. Thurston's findings are confirmed by Buchmueller et al. (2011). However, neither paper explains if, *within* an affected group, individuals with varying costs of coverage are affected differently.

Kolstad and Kowalski (2012) examine the broad effects of Massachusetts 2006 health-care reform. The Massachusetts reform was viewed by many as a precursor to the Affordable Care Act and their design and implementation are quite similar. The authors find that wages at firms who were forced to provide coverage fall by approximately the average cost of coverage compared to firms who already provided coverage. It would be possible to repeat the analysis in this paper using Massachusetts data from the time before and after their reform date except the public use Medical Expenditure Panel Survey (MEPS) data does not identify which state a respondent lives in. Data on state of residence is available in the restricted use files which can be accessed at the AHRQ/Census Research Data Centers. However, the MEPS is not on the same scale as the CPS or ACS and examining a single state would limit the number of usable observations to no more than a few hundred in a given year. Placing even greater demands on this data, identification would have to be based on what happens to workers at firms who did not already provide health insurance. In the MEPS data for the country as a whole, this is less than 15% of all employers likely meaning identification would rely on only a few-dozen observations.

Essentially, the MEPS data contains individual health-care usage and expenses but cannot be effectively used with any paper that relies on variation in a single state as it would slice the data too thinly. Moreover, the MEPS in its current form only stretches back to 1996, long after the state mandates used for identification in the work of Gruber and others. However, data-sets that report wages, insurance coverage, *and* state of residence, such as the CPS, do not collect data on how much health-care services an individual consumes. These data limitations are a major reason why authors have struggled to identify the individual-specific effects of mandated benefits or employer based health insurance.

In an empirical set-up almost identical to Gruber's maternity benefit paper, Bailey (2014) finds that prostate screening mandates are passed on to men over 50, the group most likely to benefit from the improved coverage. Bailey (2013) finds similar results for diabetes mandates. However, neither paper uses individual variation in costs or usage of health-care services to examine if the cost is passed on at the group or individual level.

The effects of individual-specific variation are important because experience-rating ensures that different workers cost firms different amounts to cover. For example, many of the positions that Baicker and Levy suggest would be lost in the advent of an employer mandate may be viable if enough employees with very low health-care expenses could be found for these positions. The positions only appear non-viable because it is supposed that the workers in those positions would have average health-care expenses.

Attempting to address the issue of individual-specific cost-shifting Levy and Feldman (2001) estimate wage change regressions that condition on health insurance coverage, changes in employee premium contributions, health status, and an interaction between health insurance changes and health status. Using data from 1996 Medical Expenditure Panel Survey, they do not find evidence of individual-specific cost-shifting. However, the identification strategy used, examining wages and benefits only for job switchers, introduced severe endogeneity problems.

In addition, Pauly and Herring (1999), using the 1987 National Medical Expenditure Survey, claim to address the question of whether there is individual-specific cost-shifting. They consider measures of predicted medical expenses and age, interacted with health insurance coverage. They find, similarly to Louise Sheiner, that wages rise slower for older workers who have health insurance coverage than for those who do not, suggesting that workers "pay" for their benefits. However, their terminology is confused, this is still a finding of a group offset, not an individual-specific offset.

The model and associated empirical results in this paper largely confirm the predictions of Mitchell (1990) who surveyed the literature on compensating differentials in the workplace to predict the effect of mandated benefits. Mitchell expected a mandated health benefit package to cause wages to fall and for firms to treat workers with higher expenses differently to those with lower expenses.

An additional important avenue for cost-shifting, the employee's contribution to employer-provided benefits, is examined by Levy (1998). Levy finds that worker contributions play an important role in employee sorting and provide employer flexibility to tailor benefit packages to match their workforces' preferences. The role of employee contributions cannot be examined in this paper. Even if that information were provided in the MEPS, the paper's identification relies on examining the pre-implementation period at affected firms where, by definition, no insurance was in place. In addition, while data on worker contributions to coverage is available, it would seem easier for firms to take a wait and see approach with decisions on employee contributions. Data on employee contributions after the mandate comes into effect will not be available until late 2017.

Overall, prior studies of the incidence of mandated benefits have been significantly clouded by data availability and suitability, instances of simultaneity bias, and the inseparable interaction between firm and worker reactions to policy changes. The provisions of the Affordable Care Act, in conjunction with the rich data provided by the Medical Expenditure Panel Survey, solves the identification issues and provides a clearer analysis of the impact of mandated benefits, such as mandated health coverage, on labor market outcomes.

3 Model

This section presents a job search model that builds upon the work of Mortensen (1990) and, particularly, Bowlus and Eckstein (2002). Bowlus and Eckstein develop their model to examine racial discrimination. They focus heavily on the equilibrium predictions and structurally estimate their model's parameters to identify the role Beckerian-style discrimination plays in the black-white wage gap. The job search model in this paper is similar in spirit but presents employers who face a cost of providing coverage to high expense workers that is above the value those workers place on that coverage. The gap between a worker's valuation and the employer's actual cost emerges under the assumption that the firm pays the full cost of coverage, whereas an individual can insulate themselves from the full cost by purchasing private insurance coverage.

The model considers a labor market with just two types of employers and two types of workers. In equilibrium, workers maximize utility by choosing to work at any job that meets their type-specific reservation wage. Workers can search on and off-the-job, and switch if they receive a utility-increasing offer. Employers, only some of whom provide insurance coverage, also maximize utility which is represented by the sum of profits per worker.

Formally, suppose there are a total of M workers, a proportion $(1-\theta)$ of whom are type A and θ are type B. Type A workers are considered "healthy". They have productivity P_A. Type B workers are defined as the unhealthy workers with productivity P_B. Healthier workers are assumed to be more productive so that $P_A \geq P_B$.[8]

Employers maximize utility that depends on profits and preferences over the types of workers. In particular, a fraction γ_d of employers provide health coverage providing them with a disincentive to hire type B workers. These employers are referred to as type d. Those who do not provide coverage are referred to as type n. Excusing the abuse of notation, type d employers face a cost $w_B + d$ when they hire a type B worker where w_B represents the value of wages and health coverage to the Type B worker.[9] Type A workers have no health-care expenses, by assumption. The number of firms is normalized to 1 while θ and γ_d are determined exogenously.

[8]The reader can think of this increased productivity as due to less absenteeism, greater physical ability, stamina, etc.

[9]This means that the firm views the cost of the worker as higher than the worker views their total compensation package. This is mainly because in experience rated or self-insured firms, the firm pays the full cost of a worker's coverage plus a salary. For the worker, if they did not have cover, their expenses would potentially not be as high or they may be able to obtain community rated, low-cost, subsidized, or even free coverage.

Arrival rates are drawn from a Poisson distribution. For a type A worker, offers arrive at a rate λ_1 if employed and λ_0 if unemployed. Unemployed workers are assumed to search more intensively than employed workers so that $\lambda_0 > \lambda_1$. Arrival rates for each type of worker differ by a scaling term k where $0 \leq k \leq 1$. The arrival rate of offers to unemployed (employed) type B workers from type n employers is $\lambda_0(\lambda_1)$ and $k\lambda_0(k\lambda_1)$ from type d employers. This means that if $k = 0$ then employers who offer coverage never hire type B workers. If $k = 1$ offer arrival rates for both workers are the same at both types of employers. If $d = 0$ or if there are no employers who offer health insurance ($\gamma_d = 0$) then $k = 1$ by assumption and a standard model of job search with heterogeneous productivity obtains.

Employers do not condition offers on current employment status. For employed workers, their jobs are destroyed at a rate δ_i for $i = A, B$ where $\delta_A \leq \delta_B$. Job destruction rates are not permitted to vary by worker *and* firm type. Adding firm-specific destruction rates would unnecessarily complicate the model by requiring reservation wage rules that differ for each type of firm.

Employers

Employers consider workers' reservation wages and wage offer distributions as given. Therefore, wage offers are conditioned on worker type but not a worker's current wage and employers can only post one wage offer for each *type* of worker. They set wages to maximize utility. For type n employers utility is the sum of their profit times the number of each type of worker;

$$U_n(w_A, w_B) = (P_A - w_A)l_n^A(w_A) + (P_B - w_B)l_n^B(w_B)$$

where w_i are the wages to each type of worker and $l_n^i(w_i)$ is the stock of of type i workers at wage w_i in the steady state. For type d employers;

$$U_d(w_A, w_B) = (P_A - w_A)l_n^A(w_A) + (P_B - d - w_B)l_n^B(w_B)$$

Note that d is sufficiently small so that the firm receives positive utility from type B workers.

Workers

As in standard job search models, workers choose state-contingent reservation wages to maximize their utility. The reservation wage of an *employed* type A worker is simply their current wage w and they accept any better offer from any firm. The reservation wage while unemployed is solved by equating the value of unemployment and the value of being employed at the reservation wage. The value of unemployment is

$$\begin{aligned}(1 + \beta dt)V_U^A &= bdt + \lambda_0(1 - \gamma_d)dtE_w^n max(V_E^A(w), V_U^A) \\ &\quad + \lambda_0\gamma_d dtE_w^d max(V_E^A(w), V_U^A) + (1 - \lambda_0 dt)V_U^A\end{aligned}$$

where β is the rate of time preference, and b is the value of the time given up when working. The instantaneous value of unemployment is the sum of the value of leisure, the probability of getting a job from a no-coverage firm, the probability of getting an offer from a firm that does provide coverage, plus the probability of remaining unemployed.

The value of being employed is a function of the current wage and all possible transitions. That is, the value of being employed at wage w for a type A worker, is

$$\begin{aligned}(1+\beta dt)V_E^A(w) &= wdt + \lambda_1(1-\gamma_d)dtE^n_{w'}max(V_E^A(w'),V_E^A(w)) \\ &\quad +\lambda_1\gamma_d dtE^d_{w'}max(V_E^A(w'),V_E^A(w)) + \delta_A dtV_U^A \\ &\quad +(1-(\lambda_1+\delta_A)dtV_E^A(w)\end{aligned}$$

which is the sum of the current wage, the probabilities and expected values of job offers from each type of firm, the probability and value of becoming unemployed, plus the probability and value of remaining employed at wage w. The value functions of type B workers are constructed similarly;

$$\begin{aligned}(1+\beta dt)V_U^B &= bdt + \lambda_0(1-\gamma_d)dtE^n_{w}max(V_E^B(w),V_U^B) \\ &\quad +k\lambda_0\gamma_d dtE^d_{w}max(V_E^B(w'),V_U^B) \\ &\quad +(1-(\lambda_0(1-\gamma_d)+k\lambda_0\gamma_d)dt)V_U^B\end{aligned}$$

and

$$\begin{aligned}(1+\beta dt)V_E^B(w) &= wdt + \lambda_1(1-\gamma_d)dtE^n_{w'}max(V_E^B(w'),V_E^B(w)) \\ &\quad +k\lambda_1\gamma_d dtE^d_{w'}max(V_E^B(w'),V_E^B(w)) + \delta_B dtV_U^B \\ &\quad +(1-(\lambda_1(1-\gamma_d)+k\lambda_1\gamma_d+\delta_B)dt)V_E^B(w)\end{aligned}$$

The expressions differ in offer arrival and job destruction rates and, consequently, wage offers.

Let $F_n^i(w)$ and $F_d^i(w)$ be the distribution of wage offers for the two types of employers for type i workers ($i = A, B$). The reservation wage for a worker of type i is the value of r_i that equates the value of employment and unemployment. Setting $V_E^i(r_i) = V_U^i$ and solving for r_A and r_B gives;

$$r_A = b + \int_{r_A}^{\infty} \frac{(\lambda_0-\lambda_1)\left((1-\gamma_d)\left(1-F_n^A(w)\right)+\gamma_d\left(1-F_d^A(w)\right)\right)}{\beta+\delta_A+\lambda_1\left((1-\gamma_d)\left(1-F_n^A(w)\right)+\gamma_d\left(1-F_d^A(w)\right)\right)}dw$$

and

$$r_B = b + \int_{r_B}^{\infty} \frac{(\lambda_0-\lambda_1)\left((1-\gamma_d)\left(1-F_n^B(w)\right)+k\gamma_d\left(1-F_d^B(w)\right)\right)}{\beta+\delta_B+\lambda_1\left((1-\gamma_d)\left(1-F_n^B(w)\right)+k\gamma_d\left(1-F_d^B(w)\right)\right)}dw$$

The reservation wage is composed of the value of time given to labor b, plus an expectation of a random variable which is is increasing with the value of not working (expressed in the numerator in the integrated term) and decreasing with the value of being employed (the denominator in the same term). The numerator is composed of expected wages (the longer term in parentheses) scaled by the difference in arrival rates of offers for unemployed and employed workers. As λ_0 rises, unemployment becomes relatively more attractive, and less attractive if λ_1 rises. The denominator scales the value of unemployment by the rate of time preference (with higher β representing *less* patience), the chance of job destruction (accepting an offer now seems less valuable if the chance of destruction is very high, all else equal) and the likelihood of job offers (and their associated wages) once already employed.

Equilibrium

Standard equilibrium conditions in job search models apply:

1. Reservation wages are set to maximize utility.
2. Flows of workers in and out of employment are equal.
3. The utility of the employers is maximized and equal within each type of firm, given the behavior of other agents.

Importantly, because employers' utility is additive the steady-state flows and wage offer distributions for each type of worker can be solved independently.

For type A workers:

Type A workers are treated the same at each type of firm so $F_n^A(w_A) = F_d^A(w_A) = F^A(w_A)$. The equilibrium wage offer distribution is;

$$F^A(w_A) = \frac{1+\kappa_{1A}}{\kappa_{1A}}\left[1 - \left(\frac{P_A - w_A}{P_A - r_A}\right)^{1/2}\right] \quad r_A \le w_A \le wh_A$$

Where κ is a measure of the ratio of offers to job destruction, $\kappa_{1i} = \lambda_1/\delta_i$ and wh_A is such that $F^A(wh_A) = 1$. Note that because the wage distribution of each worker can be solved independently, type A workers are no different to the job searchers in Mortensen (1990). For the reservation wage;

$$\begin{aligned} r_A &= b + (\kappa_{0A} - \kappa_{1A}) \int_{r_A}^{wh_A} \left[\frac{1 - F^A(w_A)}{1 + \kappa_{1A}(1 - F^A(w_A))}\right] dw_A \\ &= b + (\kappa_{0A} - \kappa_{1A}) \int_{r_A}^{wh_A} \left[\frac{1 - \frac{1+\kappa_{1A}}{\kappa_{1A}}\left[1 - \left(\frac{P_A - w_A}{P_A - r_A}\right)^{1/2}\right]}{1 + \kappa_{1A}(1 - \frac{1+\kappa_{1A}}{\kappa_{1A}}\left[1 - \left(\frac{P_A - w_A}{P_A - r_A}\right)^{1/2}\right])}\right] dw_A \end{aligned}$$

Because $F^A(wh_A) = 1$ then;

$$wh_A = P_A - \left(\frac{1}{1+\kappa_{1A}}\right)^2 (P_A - r_A)$$

and the reservation wage for type A workers is;

$$r_A = \frac{(1+\kappa_{1A})^2 b + (\kappa_{0A} - \kappa_{1A})\kappa_{1A} P_A}{(1+\kappa_{1A})^2 + (\kappa_{0A} - \kappa_{1A})\kappa_{1A}}$$

Using the derived expressions for offers and reservation wages, the earnings distribution $G^A(w_A)$ can then be recovered:

$$G^A(w_A) = \frac{1}{\kappa_{1A}} \left[\left(\frac{P_A - w_A}{P_A - r_A} \right)^{1/2} - 1 \right] \quad r_A \leq w_A \leq wh_A$$

For type B workers:

The wage distribution for type B workers is a mixture of two distinct distributions in which type d employers offer lower wages and type n employers offer higher wages. In particular;

$$l_d^B(w_B) = \frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1 + k\kappa_{1B}\gamma_d(1-F_d^B(w_B)) + \kappa_{1B}(1-\gamma_d)\right)^2} \quad r_B \leq w_B \leq wh_d$$

$$l_n^B(w_B) = \frac{\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1 + \kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2} \quad wh_d \leq w_B \leq wh_B$$

where $l_i^B(w_B)$ represents the stock of B type workers and $0 \leq k \leq 1$ and the wage offer distribution is

$$F^B(w_B) = \begin{cases} \frac{1+\kappa_{1B}^k}{k\kappa_{1B}} - \left(\frac{1+\kappa_{1B}^k}{k\kappa_{1B}}\right)\left(\frac{P_B-d-w_B}{P_B-d-r_B}\right)^{1/2} & r_B \leq w_B \leq wh_d \\ \frac{1+\kappa_{1B}(1-\gamma_d)}{\kappa_{1B}(1-\gamma_d)} - \left(\frac{1+\kappa_{1B}(1-\gamma_d)}{\kappa_{1B}(1-\gamma_d)}\right)\left(\frac{P_B-w_B}{P_B-wh_d}\right)^{1/2} & wh_d \leq w_B \leq wh_B \end{cases}$$

so that the earnings distribution for type B workers is

$$G^B(w_B) = \begin{cases} \frac{\kappa_{0B}}{\kappa_{1B}\kappa_{0B}^k}\left[\left(\frac{P_B-d-w_B}{P_B-d-r_B}\right)^{1/2} - 1\right] & r_B \leq w_B \leq wh_d \\ \frac{\kappa_{0B}}{\kappa_{1B}\kappa_{0B}^k}\left[\frac{1+\kappa_{1B}^k}{1+\kappa_{1B}(1-\gamma_d)}\left(\frac{P_B-wh_d}{P_B-w_B}\right)^{1/2} - 1\right] & wh_d \leq w_B \leq wh_B \end{cases}$$

where wh_B is the highest wage offered to type B workers; wh_d is the highest wage offered to type B workers at the employers who experience a cost d due to hiring them; $\kappa_{iB}^k = \kappa_{iB}(1-\gamma_d) + k\kappa_{iB}\gamma_d$ for $i = 0, 1$; and $F^B(w_B)$ is the market wage offer distribution, the fraction of all employers paying w_B or less to type B workers. Note that $F^B(w_B) = (1-\gamma_d)F_n^B(w_B) + \gamma_d F_d^B(w_B)$. The derivation of these results is presented in the Appendix.

Properties of Equilibrium

It is relatively easy to show that $G^A(w_A) \leq G^B(w_B)$ and $r_B \leq r_A$ (see Bowlus and Eckstein for details) so that type B workers receive and are willing to accept lower wages, as we might expect just from their lower productivity. It is precisely because wage distributions and reservation wages can be expected to be lower for less healthy individuals that identifying the individual-specific incidence of employer-provided health insurance has troubled the literature to date.

Observing that wages are lower for individual high-cost workers at firms that provide health insurance does not explain if the effect is due to productivity differences or individual-specific cost-shifting of insurance expenses.

The Affordable Care Act aids identification by affecting γ_d exogenously. The effects of the Act can be predicted by examining comparative statics for type B workers with respect to γ_d within the model.

1. Expected Earnings

The ratio of earnings between the two types of workers is negatively related to d and γ_d. Consider the mean earnings of type A workers given by Mortensen;

$$E^A(w_A) = \int_{r_A}^{wh_A} w_A dG^A(w_A) = \frac{1}{1+\kappa_{1A}}(P_A\kappa_{1A} + r_A)$$

Notice the expected wage is not a function of d. For type B workers, their mean earnings are found by considering;

$$\begin{aligned}
E^B(w_B) &= \frac{k\gamma_d}{k\gamma_d + 1 - \gamma_d}\int_{r_B}^{wh_d} w_B dG^B(w_B) + \frac{1-\gamma_d}{k\gamma_d + 1 - \gamma_d}\int_{wh_d}^{wh_B} w_B dG^B(w_B) \\
&= (1-\gamma_d)\frac{1+\kappa_{1B}^k}{1-\gamma_d+k\gamma_d}\left[\frac{\kappa_{1B}(1-\gamma_d)P_B}{(1+\kappa_{1B}(1-\gamma_d))^2} + \frac{r_B}{(1+\kappa_{1B}^k)^2}\right] \\
&\quad + \gamma_d\frac{k}{(1-\gamma_d+k\gamma_d)(1+\kappa_{1B}^k)}\left[\frac{k\kappa_{1B}\gamma_d\,(P_B-d)}{1+\kappa_{1B}(1-\gamma_d)} + r_B\right] \\
&\quad + \gamma_d(1-\gamma_d)\frac{k\kappa_{1B}(1+\kappa_{1B}^k)(2+2\kappa_{1B}(1-\gamma_d)+k\kappa_{1B}\gamma_d)}{(1-\gamma_d+k\gamma_d)(1+\kappa_{1B}^k)^2(1+\kappa_{1B}(1-\gamma_d))^2} \\
&\quad \times (P_B - d)
\end{aligned}$$

While this is a complicated expression, $\partial r_B/\partial d < 0$, and therefore $\partial E^B(w_B)/\partial d < 0$. It is also straightforward to show that $\partial E^B(w_B)/\partial \gamma_d < 0$. To see this, note that if $\gamma_d = 1$ then

$$E^B_{\gamma_d=1}(w_B) = \frac{k\kappa_{1B}\,(P_B-d) + r_B}{1+k\kappa_{1B}}$$

and that if $\gamma_d = 0$ then

$$E^B_{\gamma_d=0}(w_B) = \frac{1}{1+\kappa_{1B}}(P_B\kappa_{1B} + r_B)$$

Given that $E^B_{\gamma_d=0}(w_B) > E^B_{\gamma_d=1}(w_B)$ and since $E^B(w_B)$ falls between $E^B_{\gamma_d=0}(w_B)$ and $E^B_{\gamma_d=1}(w_B)$ and approaches $E^B_{\gamma_d=1}(w_B)$ as γ_d increases it must be the case that $\partial E^B(w_B)/\partial\gamma_d < 0$. This prediction provides a testable hypothesis:

> **Hypothesis 1:** as the proportion of employers who provide coverage grows, the wages of type B workers can be expected to fall, *all else equal*.

While the proportion of employers who provide health coverage (γ_d) and the specifics of that coverage (affecting d) certainly changes over time, the pre-implementation period of the Affordable Care Act is as close as a researcher can hope to get to variation in γ_d where all else is equal.

2. Labor Stocks and Segmentation

For a single firm who moves from type n to type d due to legislative changes outside of their control they will move from employing $l^B_n(w^n_B)$ to $l^B_d(w^d_B)$ of type B workers where $w^n_B \neq w^d_B$. Due to utility equalization among firm types, the model cannot provide an unambiguous prediction on the labor stock change at a particular firm. This is because becoming a type d firm decreases the attractiveness of type B workers but type B workers accept lower wages at type d firms. In essence, there are competing income and substitution effects and it is not clear from the model exactly what will happen at any given firm. This ambiguity is described in detail in the Appendix.

However, if a firm was selected randomly and forced to become type d then predictions can be made on the expected labor stock at such a firm. Remember that;

$$l^B_d(w^d_B) = \frac{k\kappa_{0B}(1+\kappa^k_{1B})\theta M}{(1+\kappa^k_{0B})\left(1+k\kappa_{1B}\gamma_d(1-F^B_d(w^d_B))+\kappa_{1B}(1-\gamma_d)\right)^2} \quad r_B \le w_B \le wh_d$$

$$l^B_n(w^n_B) = \frac{\kappa_{0B}(1+\kappa^k_{1B})\theta M}{(1+\kappa^k_{0B})\,(1+\kappa_{1B}(1-\gamma_d)(1-F^B_n(w^n_B)))^2} \quad wh_d \le w_B \le wh_B$$

To simplify the analysis assume a firm keeps its relative position in the wage distribution when moving from type n to type d so that $1 - F^B_d(w_B) = 1 - F^B_n(w_B)) = p$. Then the labor stocks are simply

$$l^B_d(w_B) = \frac{k\kappa_{0B}(1+\kappa^k_{1B})\theta M}{(1+\kappa^k_{0B})\,(1+k\kappa_{1B}\gamma_d(p)+\kappa_{1B}(1-\gamma_d))^2}$$

$$l^B_n(w_B) = \frac{\kappa_{0B}(1+\kappa^k_{1B})\theta M}{(1+\kappa^k_{0B})\,(1+\kappa_{1B}(1-\gamma_d)(p))^2}$$

Which means $l_n^B(w_B^n) > l_d^B(w_B^d)$ if

$$1 + k\kappa_{1B}\gamma_d(p) + \kappa_{1B}(1-\gamma_d) > k^{1/2}\left(1 + \kappa_{1B}(1-\gamma_d)(p)\right)$$

Which is true as k and p are between zero and one. While there is no guarantee a firm would maintain its relative position across the distribution of wage offers, when a large number of firms moves from type n to type d the effect can be expected to hold in the aggregate.[10] This provides a second testable hypothesis:

> **Hypothesis 2a:** Type n firms who become type d will tend to employ fewer type B workers.

Additionally, the solution to the model shows that the distribution of wages for type B is composed of two disjoint distributions indicating that employers will pay strictly lower wages to type B workers after becoming type d employers. This provides another testable hypothesis:

> **Hypothesis 2b:** Type n firms who become type d will then employ type B workers at a reduced wage.

3. Unemployment Rate and Duration

The cost of providing coverage for type B workers introduces unemployment rate and duration effects. To see this note that, in equilibrium, all job offers are accepted and since offers are drawn from a Poisson distribution, expected unemployment durations are

$$\frac{1}{\lambda_0}$$

for type A workers and

$$\frac{1}{\lambda_0(1-\gamma_d(1-k))}$$

for type B workers. So long as $k \neq 1$, *type B workers face longer unemployment spells*. It is easy to see that the duration of unemployment is increasing in γ_d.

Additionally, if $k \neq 0, 1$ and $\delta_A \leq \delta_B$ it can be shown that the rate of unemployment is higher for type B workers.

$$ue_B = \frac{\lambda_0(1-\gamma_d) + k\lambda_0\gamma_d}{\delta_B + \lambda_0(1-\lambda_d) + k\lambda_0\gamma_d} \geq \frac{\lambda_0}{\delta_A + \lambda_0} = ue_A$$

where ue_i is unemployment rate of type i. Note that *the rate of unemployment is increasing in γ_d for type B workers*. These results provide two more testable hypotheses:

> **Hypothesis 3:** After a mandate on coverage is implemented the rate and duration of unemployment for type B workers increases.

[10] Note that a firm becoming type d results in equilibrium effects on $l_n^B(w_B)$ and $l_d^B(w_B)$ through an increase in γ_d. The effects are described in full in the appendix.

Relative separation rates can be higher or lower for Type B workers depending on the values of the model's parameters. Separation rates are presented in the Appendix for completeness.

Gathering Results

While abstracting from certain features of the labor market, the model shows that type B workers can be expected to have "worse" labor market outcomes even before any mandate on coverage is implemented. The model then provides predicted effects from a mandate on health coverage by examining comparative statics with respect to γ_d. After an increase in γ_d type B workers can expect that in aggregate;

1. Their earnings will fall
2. They will face higher unemployment rates
3. They will search for employment longer

These predictions are "equilibrium" results encapsulated in Hypotheses 1, 3*a*, and 3*b*. With the Affordable Care Act acting as natural experiment affecting γ_d exogenously, the hypotheses can be tested empirically using earnings, unemployment rates, and unemployment duration as dependent variables in a difference-in-differences framework.

Drilling down to the micro level, firms who are forced to provide cover (moving from type n to type d) will employ fewer type B workers than before (Hypothesis 2*a*). Additionally, the model indicates (Hypothesis 2*b*) that employers will pay strictly lower wages to type B workers after becoming type d employers. Hypotheses 2*a* and 2*b* are tested empirically by exploiting the variation in health insurance provision at the firm level. By comparing the labor market outcomes of higher cost workers at firms that do and do not provide coverage to lower cost workers at each type of firm, before and after the law, the effect of the Act's employer mandate at the individual-level can be seen. Such a triple-difference estimation allows for identification of the effect the mandate has on workers at affected firms with health expenses that vary at the individual level.

4 Data

The empirical analysis in section six uses data from the Medical Expenditure Panel Survey. The Agency for Health-care Research and Quality describes the MEPS as "a set of large-scale surveys of families and individuals, their medical providers, and employers across the United States. MEPS is the most complete source of data on the cost and use of health-care and health insurance coverage."[11] A new cohort joins the survey each calendar year and respondents participate in five detailed interviews across a two-year period which collect data on health-care usage, out of pocket costs, insurance coverage, along with demographic and employment information at each

[11] http://meps.ahrq.gov/mepsweb/

interview date. The data collected is ideal to examine the effect of the new laws on the labor market outcomes of individuals with higher coverage expenses.

The MEPS panel survey began in 1996 and each year a sub-sample of households participating in the previous year's National Health Interview Survey (NHIS) are selected to participate. The NHIS sampling frame provides a nationally representative sample of the U.S. civilian non-institutionalized population, and reflects an over-sample of minorities. Additional policy relevant subgroups (such as low income households) are over-sampled by the MEPS.

Most importantly, the MEPS provides data on the actual health-care usage of individuals, allowing for a researcher to examine if individual labor market outcomes vary with actual usage. Unfortunately, the MEPS began *after* many state-level mandated benefit programs had been put in place. This means the the data cannot be used to re-visit the impact of mandated maternity benefits or to exploit other state-level variation in insurance mandates. Even if the data covered the period before these mandates were in place the MEPS public-use files do not provide state of residence. The MEPS collects data on the state an individual resides in but it is available only in the restricted-use data-sets available only at Census Data Centers.

The data used in this paper focuses on interview three of five for Panels 13 through 17 of the MEPS covering from the end of 2008 to the end of 2012. The third interview is the first set of year-end observations for Panel 17, and is the most recent data available that is suitable to test the hypotheses presented in section three. As data on health-care expenditures are reported as an annual figure, the analysis cannot meaningfully exploit the quasi-panel nature of the data-set. Instead, the data are treated as a repeated cross-section using only the third interview with each panel as an independent repeated cross-section.

The empirical analysis focuses on working-age adults (ages 27-59) who report that they work at firms with more than 50 employees.[12] Summary statistics for the restricted sample, at firms who do and do not provide cover, are presented in Table 1.

Notice that workers at firms who provide cover tend to be slightly older, have higher wages, are better-educated, are more likely to be white, and have higher annual *actual* health expenses. Notice that employer-provided coverage has fallen from covering 86% of the sample to 82% of the respondents over the period. In addition, the type of worker being hired by these firms seems to be trending towards lower cost workers: younger males. A large body of research has explored why males tend to use less health-care services than females, finding that mens' usage is lower as they tend to be less diligent about making and keeping doctor appointments, filling prescriptions, cannot become pregnant, and live shorter lives (see Mustard et al., 1998 for more on this topic). The summary statistics suggest that employers may be using worker gender and age as a heuristic to aid them in lowering their upcoming Affordable Care Act mandated health-care costs.

[12]Those under age 26 are excluded as they are affected by the Affordable Care Act in the pre-implementation period. Those over age 55 are excluded as labor force participation falls dramatically after this age.

Table 1: Summary Statistics for the MEPS Data (by Panel/Year)

	Employer-Provided Insurance						No Employer-Provided Insurance					
	2008	2009	2010	2011	2012	**Total**	2008	2009	2010	2011	2012	**Total**
Sex												
	%	%	%	%	%	%	%	%	%	%	%	%
Female	49.2	51.4	50.4	50.6	47.7	**49.8**	49.6	48.9	47.5	48.7	46.6	**48.3**
Male	50.8	48.6	49.6	49.4	52.3	**50.2**	50.4	51.1	52.5	51.3	53.4	**51.7**
Total	100	100	100	100	100	**100**	100	100	100	100	100	**100**
Race												
	%	%	%	%	%	%	%	%	%	%	%	%
White	76.6	77.0	75.3	75.9	73.7	**75.7**	66.3	69.1	67.8	69.0	65.2	**67.5**
Black	15.2	14.4	14.4	16.0	15.8	**15.2**	21.5	19.8	20.1	19.8	21.1	**20.5**
Other	8.1	8.6	10.3	8.0	10.5	**9.1**	12.2	11.1	12.2	11.2	13.6	**12.0**
Total	100	100	100	100	100	**100**	100	100	100	100	100	**100**
Education												
	%	%	%	%	%	%	%	%	%	%	%	%
High School	38.9	36.4	36.4	36.8	31.5	**36.1**	66.9	66.1	62.9	64.5	60.5	**64.1**
College	46.5	48.5	48.6	48.7	54.5	**49.2**	28.1	28.7	33.2	30.8	35.9	**31.4**
More than College	14.6	15.1	14.9	14.5	14.1	**14.6**	5.0	5.2	3.9	4.7	3.5	**4.5**
Total	100	100	100	100	100	**100**	100	100	100	100	100	**100**
Age (in years)	42.0	42.7	42.2	42.5	40.5	**42.0**	40.0	40.3	40.0	39.8	38.9	**39.8**
Wage ($Annual)	$46,139	$46,175	$46,280	$46,168	$46,865	**$46,325**	$21,769	$21,363	$21,384	$20,903	$20,659	**$21,215**
Health Expenses ($Annual)	$2,851	$3,023	$2,902	$2,788	$2,445	**$2,802**	$1,646	$2,032	$1,976	$1,458	$1,287	**$1,680**
Percent of Firms	14%	13%	14%	16%	18%	**15%**	86%	87%	86%	84%	82%	**85%**

These summary statistics represent only the 27-59 year-old sub-sample.

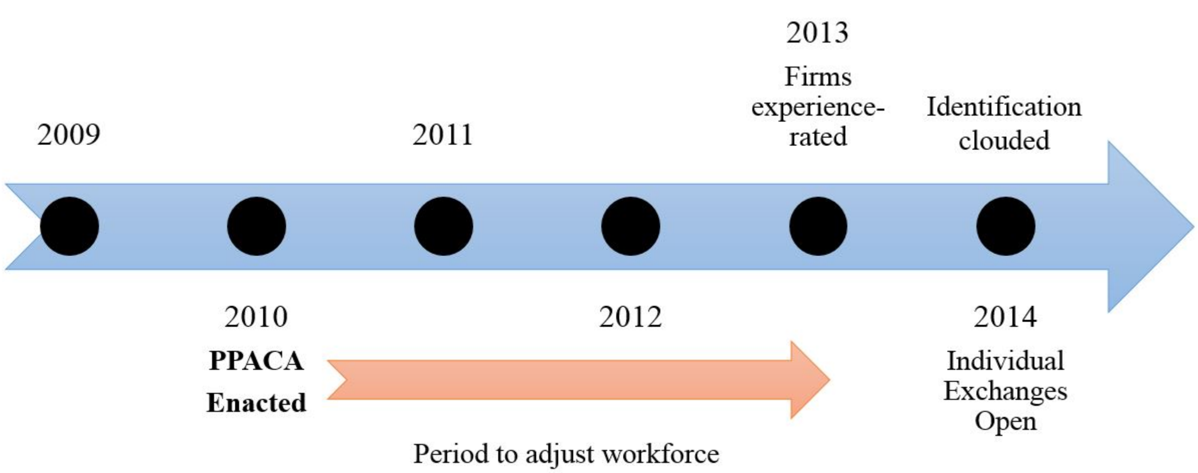
5 ACA Implementation and Identification Strategy

5.1 Implementation

The 2008-2012 waves of the MEPS are ideal for studying the individual-specific effects of employer-provided insurance. When the new health-care law was announced in March of 2010, firms were told they would be subject to an employer mandate as of January 1, 2014. The employer mandate required firms with more than 50 full-time employees to have affordable coverage options in place for employees on that date. The original time-line for the implementation of the employer mandate is illustrated in Figure 1. This time-line was changed in February of 2014 when the IRS was instructed not to enforce the mandate until January 2015. As the data in this analysis only covers up to the end of 2012, 14 months before the decision to delay the implementation, firms should have been behaving as if the mandate would come into effect in January 2014, the original intended implementation date.

Importantly, the cost of coverage to firms in 2014 would be based on the demographic characteristics of the firm's employees in 2013. As part of the underwriting process for employer-based plans, insurance companies collect detailed data on a firm's workforce. The cost of cover offered to the firm in 2014 would be higher if the firm has employees with high expected medical expenses, such as older workers or females who could be expected to have a pregnancy. This means that a firm wishing to minimize its cost of compliance would need to begin making adjustments to their workforce immediately after the details of the mandate were announced.

Figure 1: The Implementation Time-line of the Patient Protection and Affordable Care Act (PPACA)



The time-line for the law's implementation shows why identification will be clouded by other aspects of the Act. A researcher seeking to examine the effect of the employer mandate on labor market outcomes using data collected *after* 2014 would have to account for the changes in worker behavior caused by the availability of affordable individual cover on the Act's exchanges. Failing to account for the effects on individuals would lead to empirical results representing the joint effect of the employer mandate and the individual mandate. Moreover, comparing outcomes from 2014 on-wards to the period immediately before would require an assumption that firms did not prepare for or anticipate the mandate in any way.

Focusing on the pre-implementation period avoids the identification problems that the individual mandate will cause. It also stacks the deck against finding any significant effects in the data as some employers may not be well-informed about the law, they may not be sufficie7ntly forward-looking, or they may be considering paying the mandate's financial penalties rather than providing coverage.

Employers who fail to react to the Act's announcement are essentially not "treated" by the law yet they are considered treated in the analysis presented in section six biasing results towards zero. Because the Act increased the cost of coverage (see details in Appendix A) at firms who provided cover even before the law, the control group is also mildly treated. At these firms, the more generous coverage required by the law adds to incentives to avoid hiring high-cost workers, again biasing results towards zero. As not all firms can be expected to react to the law by providing coverage and given that firms who already provided coverage faced increased costs, too, the results presented in section six can only be viewed as a *lower bound* on the actual effects of the mandate on individual workers at affected firms.

One concern about comparing the period before 2010 to after is how the 2008-2009 recession impacts the analysis. Difference-in-difference and triple-difference strategies tend to ease these kinds of concerns as we focus on differences between the labor market outcomes of individuals who work at firms who do and do not provide before and after the law. If the recession affected all firms essentially equally then there should be no concerns. However, Siemer (2014) finds reduced employment growth in small relative to large firms. This finding is relevant as firms that don't offer coverage tend to be smaller.

Siemer's estimates suggest small firms have between 4.8 and 10.5% slower employment growth during the recession period. This would bias our estimates toward significance if the reduced growth happened to be biased against healthier workers. If so, it is possible the findings in section six would simply be a product of the effects of the recession. While there is no immediately clear reason a recession should induce smaller firms to reduce their hiring of healthier (and therefore expected to be more productive) workers, this potential source of bias will be addressed as a robustness check using MEPS data from 2006-2010.[13]

5.2 Identification and Estimation

Identification relies on difference-in-difference and triple-difference approaches. The triple-difference estimation can only be used when testing for individual-specific effects on wages (Hy-

[13]This is yet to be added to the paper.

pothesis 2a). For Hypotheses 1, 2b, and 3 a simpler difference-in-difference estimation approach is used.

Hypothesis 1 examines what are termed "macro" level labor market effects of the Act, examining labor market outcomes for workers with low and high cost health-care before and after the law. The estimating equation takes the following form

$$\begin{aligned} LaborMarketOutcome_{it} = \beta_0 + \beta_1 HealthExpenses_{it} + \beta_2 PostACA_{it} \\ + \beta_3 HealthExpenses * PostACA_{it} + \Pi X_{it} + \epsilon_{it} \end{aligned}$$

where $LaborMarketOutcome_{it}$ stands for labor market outcomes of interest for person i at time t. While Hypothesis 1 provides only a prediction on wage, the dependent variable could be hourly wages, weekly wages, annual wages, or a log transformation of any of these to aid interpretation. The right hand side of the estimating equation considers the main effect of a continuous measure of health expenses $(HealthExpenses_{it})$, the main effect of the Affordable Care Act $(PostACA_{it})$ which represents a binary variable taking on the value of 1 after the Act is announced. The estimating equation is completed by allowing for a set of controls X_{it} which can include age, sex, education, marital status, race, location, occupation, and industry.

The co-efficient on the interaction term in the estimating equation gives us the measure of the effect of the Act on the labor market outcomes of individuals as a function of their health expenditure per year. A negative co-efficient on this term would suggest that after the Act, individuals with higher health expenses experience worse labor market outcomes than before the Act.

Via Hypothesis 1, the model laid out in section 3 predicts labor market outcomes for workers with higher health-care costs will worsen after the Act. At the same time, the model highlights that the effects are concentrated at firms who move from not providing coverage to providing coverage (essentially, Hypothesis 2a and 2b). To examine this prediction the estimation adds a third difference between firms who do and do not provide insurance. This amounts to isolating the difference between those affected and unaffected by the Act.

The estimating equation takes the following form

$$\begin{aligned} LaborMarketOutcome_{it} = \beta_0 + \beta_1 HealthExpenses_{it} + \beta_2 PostACA_{it} + \\ + \beta_3 HealthExpenses * PostACA_{it} \\ + \beta_4 EmployerOffersInsurance_{it} \\ + \beta_5 HealthExpenses * EmployerOffersInsurance_{it} \\ + \beta_6 PostACA * EmployerOffersInsurance_{it} \\ + \beta_7 PostACA * HealthExpenses * EmployerOffersInsurance_{it} \\ + \Pi X_{it} + \epsilon_{it} \end{aligned}$$

where, again, $LaborMarketOutcome_{it}$ stands for labor market outcomes of interest for person i at time t. In addition to a continuous measure of health expenses ($HealthExpenses_{it}$), the main effect of the Affordable Care Act ($PostACA_{it}$) and the interaction between them, the equation adds a binary indicator if the observed individual works for a firm that offers health insurance ($EmployerOffersInsurance_{it}$).[14] The estimating equation also considers a broad set of potential controls X_{it}.

The co-efficient of interest is β_7 corresponding to the triple difference interaction term. The term represents the effect of the Act on the labor market outcome of interest as a function of health expenses and insurance coverage. If β_7 is positive, it suggests that firms who offer coverage pay higher wages than firms who do not offer coverage to workers with high health-care expenses after the Act. In other words, a positive β_7 suggests the Act worsens labor market outcomes for high cost workers at affected firms even after controlling for demographic factors which explain health insurance costs.

Finally, Hypotheses 3 is tested using a similar estimating equation as Hypothesis 1 except that the dependent variable is now a binary variable indicating employment status for 3a. For Hypothesis 3b, the dependent variable is a count of how many (out of three) MEPS interviews the worker reported being unemployed in that year, a crude but helpful measure of how the Act affects the unemployment duration of workers who would be costlier to insure. The findings produced using the MEPS data and these estimating equations are presented in section six.

6 Estimates

In the terminology of the model in section three the impact of the Act is analogous to an exogenous increase in "type d" firms. Based upon the model's comparative statics, Hypothesis 1 predicted that an increase in type d firms would decrease wages for high-cost type B workers, regardless of the firm they work at. This prediction can be examined in a difference-in-differences framework (as laid out in section 5), comparing the earnings of workers before and after the law change with respect to their annual health-care expenses.

Table 2 reports the results of such an estimation approach but the estimates presented in Table 2 do not show any significant *aggregate* effects after the announcement of the new law. The first three columns consider the log of annual wages, hourly wages and hours regressed against demographic controls (co-efficients not reported), binary indicators for employer-based health coverage, a dummy for the post-Act period, the log of health expenses, and the difference-in-differences interaction term which captures how outcomes have changed with respect to health expenses *after* the Act. The final three columns, presented to aid interpretation, are the same regressions but the dependent variable is not logged.

In the first column, the difference-in-difference interaction term indicates that annual wages

[14]The worker does not have to accept this insurance for this to be equal to 1. Using this as the measure of insurance availability *assumes* firms cannot predict who will take up coverage when offered.

decreased for higher cost workers but not significantly. Moreover, in the linear-log specification in column 4 the sign of the co-efficient is positive. The interaction terms in columns 2 and 3 report the effects on log hourly wages and and log hours worked. None of these estimations provide statistically or economically significant findings.

Table 2: Difference-in-Differences estimation of the PPACA's Aggregate Labor Market Effects

	Log-Log			Linear-Log		
	(1)	(2)	(3)	(4)	(5)	(6)
	Annual Wages	Hourly Wages	Hours Worked	Annual Wages	Hourly Wage	Hours Worked
Offers Health Insurance	1.280***	0.399***	0.320***	20,491***	6.202***	8.835***
	(0.0644)	(0.0142)	(0.0144)	(688.2)	(0.281)	(0.358)
Post PPACA	-0.0282	0.000749	-0.00979	-444.0	-0.977**	-0.531
	(0.0634)	(0.0193)	(0.0129)	(1,059)	(0.420)	(0.385)
Health Expenses	0.00704	0.00426**	-0.00645***	274.3**	0.0843*	-0.196***
	(0.00557)	(0.00201)	(0.00134)	(113.9)	(0.0465)	(0.0399)
PPACA x Health Expenses	-0.00390	0.00131	0.000940	21.38	0.00623	0.0455
	(0.00890)	(0.00289)	(0.00189)	(168.7)	(0.0655)	(0.0569)
Race	Y	Y	Y	Y	Y	Y
Education	Y	Y	Y	Y	Y	Y
Marital Status	Y	Y	Y	Y	Y	Y
Age	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Observations	10,157	10,157	10,031	10,157	10,157	10,031

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Overall, the estimates suggest workers who have higher health care expenses may be no worse off after the Affordable Care Act is announced. However, the number of firms affected by the law is really quite small. As can be seen in the table of summary statistics in section four, an average of 85% of workers in the sample had insurance coverage from their employer across the sample. As the number of workers at affected firms is quite small, detecting any broad empirical effect from changes concentrated in a small group is going to be challenging.

Examining the same changes in labor market outcomes but making use of variation in coverage provision at the firm level tells a much clearer story. Recall Hypothesis 2*a* predicted that firms who are forced to provide coverage would employ fewer type *B* workers while Hypothesis 2*b* predicted a fall in wages for any type *B* worker who did work at a firm who was forced to provide cover by the Act. These hypotheses are examined in a triple-difference estimation as laid out in section 5 and estimates reported in Tables 3 and 4. As a brief reminder, the first difference is between workers with higher and lower health-care expenses. The second difference is between firms who do and do not provide health coverage. The final difference is between the pre- and post-Act periods. The estimation is only possible because workers report their employer characteristics in the MEPS data. Therefore it is possible to determine which workers would be affected by the law via how their employer is affected.

The estimates from this triple-difference are presented in Table 3, where columns 1-3 reflect estimates from a specification where the dependent variables are in log form. Columns 4-6 present the same estimations but labor market outcomes of interest are not converted to logs. This allows the reader to see the effect of a unit change in a predictor in absolute terms. The estimates in Table 3 are very much the focus of this paper. They highlight changes in labor market outcomes for employees at *affected* firms (defined as those who would have to begin providing coverage) after the Act's announcement expressed as a function of individual workers' health expenses. The estimates provide evidence that the incidence of mandated benefits and, in turn, employer provided health coverage, is individual specific rather than merely group-specific.

Table 3: Triple Difference estimation of the ACA's Individual-Specific Effects on Wages and Hours Worked

	Log-Log			Linear Log		
	(1)	(2)	(3)	(4)	(5)	(6)
	Log Wages	Log Hourly Wage	Log Hours Worked	Dollar Wages	Hourly Wage	Hours Worked
Offers Health Insurance	0.682***	0.381***	0.168***	17,371***	5.780***	5.052***
	(0.0457)	(0.0306)	(0.0273)	(1,270)	(0.567)	(0.673)
Post PPACA	0.0553	0.0611	-0.0485	1,762	0.293	-1.499*
	(0.0610)	(0.0373)	(0.0363)	(1,478)	(0.644)	(0.870)
Offer x PPACA	-0.0954	-0.0908**	0.0460	-3,099	-1.953**	1.118
	(0.0681)	(0.0434)	(0.0379)	(1,973)	(0.825)	(0.961)
Health Expenses	-0.0129	0.000106	-0.0335***	-73.72	-0.0276	-0.888***
	(0.00789)	(0.00482)	(0.00484)	(203.4)	(0.0819)	(0.113)
Offer x Health Expenses	0.0214**	0.00442	0.0326***	422.8*	0.121	0.827***
	(0.00836)	(0.00525)	(0.00498)	(240.0)	(0.0975)	(0.120)
PPACA x Health Expenses	-0.0193	-0.0130*	0.0147**	-539.3*	-0.261**	0.419**
	(0.0120)	(0.00678)	(0.00712)	(306.4)	(0.121)	(0.169)
Offer x PPACA x Expenses	0.0233*	0.0196***	-0.0152**	741.0**	0.382***	-0.404**
	(0.0128)	(0.00751)	(0.00731)	(365.0)	(0.143)	(0.179)
Race	Y	Y	Y	Y	Y	Y
Education	Y	Y	Y	Y	Y	Y
Marital Status	Y	Y	Y	Y	Y	Y
Age	Y	Y	Y	Y	Y	Y
Region	Y	Y	Y	Y	Y	Y
Observations	10,390	10,390	10,269	10,390	10,390	10,269

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The first two columns of Table 3 examine wages in log form, first annually and then hourly. Columns 4 and 5 provide the same analysis without taking logs of the dependent variables. The co-efficient of interest is the triple-difference interaction. Compared to before the law, the positive co-efficient indicates that higher-cost workers at firms who do not provide health benefits make significantly less than those at firms who do provide insurance. In particular, looking at column 4, as expenses are measured in logs, for a unit increase in log health expenses, a worker at an affected firm (a firm who did not provide coverage before the law's announcement) can expect to earn around \$741 less per year relative to what they would have in the absence of the law. The effect is statistically significant at the 10% level. Column 5 presents the analogous result for hourly wages, with a unit increase corresponding to a \$0.38 per hour reduction in wages, significant at the 95% level. The stronger statistical significance of the estimates using hourly wages relative to using annual wages highlights that workers could be responding to reduced hourly wages with increased labor supply.

Interestingly, hours worked at firms who *do* provide coverage fall significantly. While it was not possible to incorporate hours worked in the model presented in section 3, the Affordable Care Act only requires firms to offer coverage to workers who are full time ($\geq$ 30 hours per week). The results in columns 3 and 6 suggest that workers who have high benefit expenses are having their hours reduced after 2010 relative to the hours at no-coverage firms. At firms who already provided coverage, higher-cost workers appear to be employed for fewer hours potentially lowering costs for the firm by avoiding the Affordable Care Act's coverage stipulations. Furthermore, if the hours worked dependent variable is changed to a dummy for less than or more than 30 hours (not given in the table), the triple-difference estimator suggests there is a 1.8% increase in the likelihood of working part time for every unit increase in the log of health expenses (approximately equal to a doubling of annual expenses in dollar terms, such as moving from \$2,000 to \$4,000 per year in health-care expenses).

The estimates on hours worked should be viewed in the context provided by Table 4. In Table 4, column 1 presents the difference-in-differences estimates from a probit regression examining employment as a function of health expenses (in log terms) before and after the Act. The dependent variable and outcome of interest is whether a worker is offered employer-based health insurance. The estimates indicate that after the Act, all workers are less likely to have a job where employer-based health insurance is offered, echoing the reduction in cover seen in the summary statistics presented in Table 1. However, the co-efficient on the interaction term suggests that workers with larger health expenses are not getting hired at firms who were forced to provide cover by the Act.

The results reported in Table 4 are raw probit estimates without an easy interpretation. Computing crude marginal effects, a unitary difference in log expenses *before* the Act was associated with a 1.3% higher probability of working at a firm that offered insurance coverage to the worker, and this increased to 1.8% after the Act. The estimates suggest that workers with higher costs are less likely to be employed by firms forced to provide cover due to the employer mandate. However, higher cost workers, as shown in table 3, then appear to be employed for fewer hours at the firms that do offer coverage. Together these results show high cost workers are less likely to be employed at firms most affected by the Act and are employed for fewer hours at the employment they do have.

Column two in Table 4 presents the same estimation but uses a "standardized" measure of health expenses to provide easier interpretation. The co-efficient on the interaction term can then be interpreted as the change in cumulative density due a one standard deviation increase in health expenses. The corresponding marginal effect of a one standard deviation increase in health expenses is a 5.6% decrease in the relative probability of being employed at a firm affected by the new health-care law.

Table 4: Difference-in-Differences Probit Estimation of the ACA's Individual-Specific Effects on Employment

	Log	Standardized
	(1)	(2)
	Offered	Offered
Post PPACA	-0.204***	-0.120***
	(0.0568)	(0.0374)
Health Expenses	0.0636***	0.0125
	(0.00634)	(0.0368)
PPACA x Health Expenses	0.0154*	0.233**
	(0.00921)	(0.107)
Race	Y	Y
Education	Y	Y
Marital Status	Y	Y
Age	Y	Y
Region	Y	Y
Observations	10,157	10,157

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Hypothesis 3 focuses on the unemployment level and duration effects of the Act. Column 1 of Table 5 estimates a probit model on the binary outcome employed or unemployed. The effect of higher health expenses after the Act is positive, indicating increased likelihood of unemployment, but the effect is not statistically significant.

Column 2 examines an extremely *qualitative* measure of unemployment duration. The MEPS does not ask how long a worker has been unemployed so the dependent variable is a simple count of the number of interviews in the year at which a respondent reported that they were unemployed. As all of the analysis in this paper focuses on the year-end interview for each panel in their first year in the MEPS (the third of five interviews), the number can be zero, one, two, or three. The estimates show that the duration of unemployment is higher (expressed as an odds ratio) after the Act for high-cost workers but the co-efficient is not statistically different from 1.

Table 5: Difference-in-Differences estimation of the Affordable Care Act's Unemployment Level and Duration Effects

	Probit	Logit
	(1)	(2)
	Unemployed	Duration
Post PPACA	-3.34e-05	1.021
	(0.0366)	(0.0610)
Health Expenses	0.0273***	1.036***
	(0.00365)	(0.00617)
PPACA x Health Expenses	0.00725	1.011
	(0.00534)	(0.00880)
Race	Y	Y
Education	Y	Y
Marital Status	Y	Y
Age	Y	Y
Region	Y	Y
Observations	20,695	20,463

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As these results do not zero-in on affected firms (by definition, you cannot be both unemployed and offered employer-based coverage), the lack of statistical significance is not surprising. As mentioned earlier the number of firms and employees potentially affected by the law is so small that detecting "macro" level effects would likely require much larger sample sizes.

Overall, the Affordable Care Act's effect appears consistent with the predictions of the job search model presented in section three. The estimates are in the direction predicted by the model but not always statistically significant. The statistically significant results are the effects on higher-cost workers at firms *most* affected by the Act as presented in Table 3 and 4. The findings indicate that firms can and do condition wage and employment offers on the benefit expenses of the individual worker.

6.1 Robustness

As they provide the estimates that are economically and statistically significant, robustness checks will focus on Hypotheses 2a and 2b. There at least four potential concerns with the findings in Tables 3 and 4. The first of these is that comparing firms who do and do not offer insurance ignores other potentially confounding differences between these types of firms. The most striking difference between firms that do and do not offer insurance is their size. For firms with more than 200 employees, virtually all offer health coverage. What that means is that the estimates in Tables 3 and 4 essentially compare small firms who do not offer insurance to small *and* large firms who do. Therefore, the control group is potentially invalid. Table 6 provides estimates of the effects on wages and hours worked but limits the sample to workers at firms who have fewer than 200 employees. The estimates are again produced using the triple-difference estimation strategy detailed in section 5.

Table 6: Triple Difference Estimation of the ACA's Individual-Specific Effects on Wages and Hours Worked (Restricted to Firms with <250 employees)

	(1) Log Wages	(2) Log Hourly Wage	(3) Part Time <30 Hours
Offers Coverage	0.728***	0.466***	-0.124***
	(0.0776)	(0.0810)	(0.0155)
After ACA	0.133	0.115***	0.0414
	(0.0800)	(0.0228)	(0.0579)
Offers Coverage x After ACA	-0.140	-0.114**	-0.0368
	(0.0967)	(0.0351)	(0.0594)
Health Expenses	0.00599	0.0108	0.0402***
	(0.00726)	(0.00673)	(0.00403)
Offers Coverage x Health Expenses	0.00393	-0.00530	-0.0402***
	(0.00935)	(0.00794)	(0.00418)
After ACA x Health Expenses	-0.0403**	-0.0197**	-0.0231***
	(0.0161)	(0.00676)	(0.00623)
Offers Coverage x ACA X Healh Expenses	0.0409**	0.0239**	0.0239***
	(0.0173)	(0.00708)	(0.00623)
Observations	5,225	5,225	5,204
Race	Y	Y	Y
Education	Y	Y	Y
Marital Status	Y	Y	Y
Age	Y	Y	Y
Region	Y	Y	Y

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The findings in Table 6 should be compared to those in Table 3. Considering columns 1 and 2, the effect of the Act when using small firms only as a control group are largely similar to Table 3. Focusing on the co-efficients on the triple difference interaction term suggests a log unit (roughly +100%) difference in health expenses is associated with a 4.1% difference in annual wages between firms who do and do not provide coverage after the Act is announced. The second column focuses on hourly wages where the effect is smaller in size but remains significant. The dollar value interpretation amounts to almost $1000 per year and about $0.40 per hour. In other words, if we consider two workers with annual health expenses of $3,000 and $6,000, the higher cost worker (at an affected firm) will receive about $1,000 less in annual wages than they would have in the absence of the ACA. This is quite a large pass through of expenses given employee health expenses reduce a firms' tax burden at the marginal rate of corporate tax.

Column 3 reports probit estimates where the dependent variable is an indicator that equals 1 if an individual reports working fewer than 30 hours per week. The triple difference estimate again shows firms that offer coverage are more likely to hire higher cost workers for part-time positions. Such employees would be ineligible as they work less than the 30-hour per week requirements for mandated coverage.

Table 7 repeats the analysis of Table 4 using the "smaller firm" sub-sample. Table 4 focused on the likelihood of being employed at a firm that offers coverage as a function of health expenses. Column 1 keeps health-care expenses in log form while column 2 uses a standardized (i.e., a z-score) measure. The estimates suggest that after the Act, individuals with higher health-care expenses are much more likely to work at a firm with health coverage suggesting these workers are now being excluded from the no-coverage firms who are most affected by the Act. Each of these estimations controls for demographics and the "main" effect of having health coverage at all (which unsurprisingly tends to increase health-care expenses).

Table 7: Difference-in-Differences Estimation of Effects on Probability of Employment at Firms Who Offer Coverage (Restricted to Firms with <250 Employees)

	(1) Offers Coverage	(2) Offers Coverage
After ACA	-0.295***	-0.127***
	(0.0895)	(0.0378)
Health Expenses	0.0402***	-0.0503***
	(0.0101)	(0.0163)
After ACA x Health Expenses	0.0365*	0.168***
	(0.0193)	(0.0556)
Observations	5,225	5,225

Robust standard errors in parentheses, usual controls included
*** p<0.01, ** p<0.05, * p<0.1

Together, Table 6 and 7 cement the earlier results. Indeed, as the control group is potentially more appropriate, it may be reasonable to view these estimates as the *main* findings of the paper. Either way, there is no reason to be concerned that the findings in Tables 3 and 4 are driven by an inappropriately selected comparison group.

Secondly, the findings presented all use data after 2010 as the post-treatment period. This is because the Act was announced in March of 2010 and the estimates allow for a short period of time for information to spread. Treating the 2010 MEPS data as "before" the Act also allows for the case where firms decisions on contracts or wage increases for 2010 were already in place before the Act was announced. Therefore, a simple check on the estimates presented would be to consider 2010 as part of the after-treatment time-period. Doing so assumes (as a placebo test) that the Act was announced into effect in 2009. This eliminates most of the economic and statistical significance of the findings indicating that the effects observed crucially rely on the period after 2010. The results are not presented here to economize on space. Underlining the importance of the changes that happened in 2010, dropping the 2010 data from the analysis altogether - essentially comparing 2008/2009 to 2011/2012 - increases the economic and statistical significance of the main results. Again, these results are omitted for space.[15]

Thirdly, a concern with how the recession impacted the before-2010 period. The concern would be that the recession impacted high and low cost employees at firms who offer and do not offer coverage differently, potentially biasing the results. Essentially, this is a concern about pre-trends. To address this, data from the four years before the Act's announcement can be used to examine how the recession affected hiring as a function of health expenses at both types of firms. The intuition driving this robustness check is that we want to ensure that the pre-Act period represents "normality" and that the Act affected normality rather than restoring it. The empirical approach again relies on a similar triple-difference estimation to that used to produce the results seen in Table 3. The estimation compares labor market outcomes of higher and lower cost workers at firms who do and do not offer coverage before and after some key event. In this case, the 2008-2009 recession period is that event. The empirical estimates are presented in Table 8.

Together, the estimates in Table 8 show essentially no differential effects of the recession on the labor market outcomes of higher cost workers at firms who do and do not offer coverage. In particular, the triple-difference estimate in column 1 suggests annual wages decreased slightly for higher cost workers at firms that offer coverage relative to those that do not offer coverage during the recessionary period. However, column 2 suggests hourly wages appear to have gone up slightly. Neither estimate is particularly significant, economically or statistically. In column 3, a small and statistically insignificant negative coefficient suggests little change in the likelihood of higher cost workers obtaining part-time work. These effects should be contrasted to the significant effects observed in Table 3 and again in Table 6 (when the sample was restricted to only "small" firms). In sum, Table 3 and 6 strongly suggest *something* seems to have affected the labor market outcomes of higher cost workers at affected firms after 2010 compared to before 2010. Table 8 eases

[15] Available on request.

concerns that the *something* is the 2008-2009 recession.[16]

Table 8: Difference-in-Differences Estimation of the Effects of the 2008-2009 Recession on Wages and Hours Worked as a Function of Expenses and Health Benefits

	(1) Log Wages	(2) Log Hourly Wage	(3) <30 Hours
Offers Health Insurance	0.574***	0.346***	-0.101***
	(0.0565)	(0.0292)	(0.0123)
Recession	-0.0633*	0.0317	0.0492**
	(0.0318)	(0.0260)	(0.0169)
Offer x Recession	0.0314	-0.00407	-0.0436*
	(0.0454)	(0.0334)	(0.0196)
Health Expenses	-0.0143	-0.00166	0.0283***
	(0.00873)	(0.00462)	(0.00236)
Offer x Health Expenses	0.0270**	0.0130*	-0.0289***
	(0.00953)	(0.00573)	(0.00207)
Recession x Health Expenses	0.00717	-0.00728**	0.000585
	(0.00478)	(0.00300)	(0.00231)
Offer x Recession x Expenses	-0.00647	0.00818*	-0.00125
	(0.00745)	(0.00361)	(0.00271)
Race	Y	Y	Y
Education	Y	Y	Y
Marital Status	Y	Y	Y
Age	Y	Y	Y
Region	Y	Y	Y
Observations	16,049	16,049	15,937

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Lastly, the author has applied to Johns Hopkins University to obtain a license for their ACG Health Insurance Risk Score software. This system takes diagnostic codes (also known as ICD-9 codes; available in the MEPS data) and demographic and geographic information to produce an estimate of an individual's future health care expenses and riskiness. These risk scores will provide another measure of individual-level health risks. The value of the risk scores is that compared to

[16] Even though the period before the Act appears okay - in the sense that firms do not react to the recession by treating workers with varying costs of coverage differently - there is a concern that the 2011/2012 post-recession recovery period may be problematic. The concern would be that firms who don't offer coverage arbitrarily laid off workers but after the recession ended they hired the highest productivity (potentially correlated with health expenses) workers *first*. If, as we may expect, firms kept only the highest productivity workers during the recession this concern would be minimal. However, one way to empirically check this would be to consider the education level of those hired at firms with no coverage compared to those with coverage. Those results will also be added to the paper.

a single years health expenses they keep more "signal" and discard "noise." The downside is that these risk scores do not have an economic interpretation. However, leveragin risk scores will provide a secondary check on how employers are treating high risk (*read:* high cost) employees. In addition, data for 2013 will be released in September of 2015 and will be added to the analysis at that time.

7 Conclusion

The Affordable Care Act's pre-implementation period provides a unique opportunity to identify the causal relationship between health expenses and labor market outcomes in a world with employer-provided health coverage. While prior research on mandated benefits shows groups who receive a mandated benefit appear to pay for the benefit provided there are reasons to be skeptical of their findings. Either the mandates studied affect workers and firms simultaneously, or there is insufficient data to examine individual-level effects, or both. This paper uses the Affordable Care Act's employer mandate to provide evidence of the individual-specific impacts of a particular type of mandated benefit, employer-provided health insurance. After controlling for demographic factors associated with health expenses, estimates show affected firms favor workers with lower health-care expenses and they pay lower wages to workers with higher expenses.

Importantly, these results should not be seen as any indictment of the new health-care law, but instead a criticism of the institution of employer-provided health insurance. The supposed benefit of employer-based coverage is that groups of workers are ideal risk pools because insurers would "screen" out the higher cost workers if each worker had to buy their own coverage. This paper highlights that because firms ultimately pay the health expenses of their employees, they are incentivized to act as the insurer would, lowering the wages of higher cost employees or excluding applicants from employment altogether.

The labor market distortion created by employer provided insurance might be acceptable if it solved risk pooling problems it is supposed to. However, as it does not it is unambiguously inferior to a world without employer-provided insurance. This underscores the point that the Affordable Care Act itself is not what is being analyzed here, it is just the tool which allows for identification of the behavior of employers in response to the incentives provided by employer-based health insurance. At the same time, these results, when combined with the literature on mandated benefits, make the employer mandate in the Affordable Care Act a curious artifact. If individual workers will pay for their care (one way or another) the mandate, at best, seems to arbitrarily restrict workers to a benefits package chosen for them by their employer. At worst, it leaves higher cost workers unemployed.

What is less clear from this paper is how the *process* of cost-shifting works on a practical level. Think about a large decentralized firm; it is not clear why a mid-level team-leader or division manager tasked with hiring a new worker would treat applicants differently based upon their expected or actual health expenses. Why would it affect the manager one way or another? The robustness check focusing on smaller firms seems to suggest the effects are much more pronounced at smaller firms, perhaps where owners are more involved in hiring decisions. However, the mechanism that leads to the outcomes presented in this paper is still something of a black box. Future work will attempt to tackle this question using a correspondence study approach.

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Appendix A - Provisions of the Patient Protection and Affordable Care Act

The Patient Protection and Affordable Care Act (PPACA) is a complex response to issues that originate with the decision to exempt fringe benefits such as health insurance from strict wage controls during the Second World War. Employer-based coverage quickly became the norm as employers substituted health-care coverage for wage increases. With changing household demographics, decreases in labor force participation, and a rise in part-time employment, the PPACA attempts to ensure access to affordable coverage is provided to all, rather than just those who are full time employees at larger firms.

To do so, the new health-care law makes many changes to the health insurance landscape in the US. While many of these changes do not directly impact the labor market, this paper is focused on changes that are forced upon firms, known collectively as the "employer mandate." The cost of not complying with this "employer mandate" may be quite large. Firms with more than 50 workers face a penalty of $2,000 per full-time employee excluding the first 30 employees for not providing coverage. This means that a firm who did not provide cover before the new law must decide between paying costly penalties or providing costly coverage.

However, firms who already provide coverage are also given incentives to adjust their behavior. At firms who already provided some form of health benefits, the PPACA raises costs on the intensive margin by mandating that all health insurance plans provide Essential Health Benefits which include items and services within *at least* the following ten categories;

1. Ambulatory Patient Services
2. Emergency Services
3. Hospitalization
4. Maternity and Newborn Care
5. Mental Health and Substance Use Disorder Services, Including Behavioral Health Treatment
6. Prescription Drugs
7. Rehabilitative and Habilitative Services and Devices
8. Laboratory Services
9. Preventive and Wellness Services and Chronic Disease Management; along with
10. Pediatric Services, Including Oral and Vision Care.[17]

[17] Note that states are given some discretion within these items. See https://www.healthcare.gov/glossary/essential-health-benefits

In addition, plans must provide participants and beneficiaries with a uniform summary of benefits and coverage and must also comply with PPACA's requirement to report the aggregate cost of employer-sponsored group health plan coverage on their employees' end of year summary of compensation (referred to as a W-2 in the US).[18,19] They must also comply with the following provisions:

- If dependent coverage is offered, coverage must be available for dependent children up to age 26
- Preventive health services must be covered without cost-sharing ("grandfathered" plans are exempt[20])
- No rescission (removal) of coverage, except in the case of fraud or intentional misrepresentation of material fact
- No lifetime limits on Essential Health Benefits (see below for explanation) *when* offered (self-insured plans do not have to offer these Essential Health Benefits)
- Improved internal claims and appeals process and minimum requirements for external review (grandfathered plans are again exempt)

It is worth noting that firms who self-insure, under the provisions of the ERISA (1974), are *exempt* from providing the Essential Health Benefits.[21] In addition, self-insured plans are free from Medical Loss Ratio Rules, the Review of Premium Increases regulation, the Annual Insurance Fee, and risk sharing and adjustment charges.

Appendix B

Flow Conditions

If UE^i is the steady state number of type i unemployed workers and $G^i(w_i)$ is the fraction of type $i = A, B$ workers who earn w_i or less, i.e., the *cdf* of earnings for i. In a steady-state, the flows of type A workers into a firm offering wage w_A and flows out of such a firm must be equal:

[18] See https://www.cms.gov/CCIIO/Resources/Files/Downloads/uniform-glossary-final.pdf

[19] http://www.ciswv.com/CIS/media/CISMedia/Documents/Self-Insured-Plans-Under-Health-Care-Reform-070312_1.pdf

[20] Grandfathered plans are those that were in existence on March 23, 2010 and have stayed basically the same. But they can enroll people after that date and still maintain their grandfathered status. In other words, even if you joined a grandfathered plan after March 23, 2010, the plan may still be grandfathered. The status depends on when the plan was created, not when you joined it. Grandfathered plans don't have to: Cover preventive care for free, guarantee the insured's right to appeal, protect the insured's choice of doctors and access to emergency care, or be held accountable through Rate Review for excessive premium increases. See https://www.healthcare.gov/what-if-i-have-a-grandfathered-health-plan/.

These plans have been subject to the recent outcry over President Obama's initial claim that "if you like your plan, you can keep it" - see http://www.usatoday.com/story/news/politics/2013/11/11/fact-check-keeping-your-health-plan/3500187/.

[21] Kaiser Family Foundation website (accessed June 26, 2013) - http://kff.org/interactive/implementation-timeline/

$$\begin{aligned}\lambda_0 UE^A + \lambda_1 G^A(w_A)((1-\theta)M - UE^A) &= \delta_A l^A(w_A) + \lambda_1(1-\gamma_d)(1-F_n^A(w_A))l^A(w_A) \\ &\quad + \lambda_1\gamma_d(1-F_d^A(w_A))l^A(w_A)\end{aligned}$$

with $l^A(w_A) = l_n^A(w_A) = l_d^A(w_A)$ indicating the steady state "number" of type A workers at each type of firm being the same. The flow in is the sum of those who are unemployed and receive an offer plus those who are already working but switch in from another firm. The flow out is the sum of the exogenously given rate of job destruction plus those who move out to each of the types of firm.

For type B workers,

$$\begin{aligned}\lambda_0 UE^B + \lambda_1 G^B(w_B)((\theta M - UE^B) &= \delta_B l_n^B(w_B) + \lambda_1(1-\gamma_d)(1-F_n^B(w_B))l_n^B(w_B) \\ &\quad + k\lambda_1\gamma_d(1-F_d^B(w_B))l_n^B(w_B)\end{aligned}$$

equates the flow in and out of "normal" employers. And for the employers who obtain cost;

$$\begin{aligned}k\lambda_0 UE^B + k\lambda_1 G^B(w_B)((\theta M - UE^B) &= \delta_B l_d^B(w_B) + \lambda_1(1-\gamma_d)(1-F_n^B(w_B))l_d^B(w_B) \\ &\quad + k\lambda_1\gamma_d(1-F_d^B(w_B))l_d^B(w_B)\end{aligned}$$

From these steady state flows, UE^A, UE^B, $G^A(w_A)$, and $G^B(w_B)$ can be recovered. For steady state unemployment stocks for type A workers, let the flows in and out of unemployment equal one another;

$$\lambda_0(1-\gamma_d)(1-F_n^A(r_A))UE^A + \lambda_0\gamma_d(1-F_d^A(r_A))UE^A = \delta_A((1-\theta)M - UE^A)$$

Note that at all times it must be the case that $UE^A + l^A(w_A) = (1-\theta)M$ with a similar condition for type B workers. Type B workers have steady state unemployment stocks of

$$\lambda_0(1-\gamma_d)(1-F_n^B(r_B))UE^B + k\lambda_0\gamma_d(1-F_d^B(r_B))UE^B = \delta_B(\theta M - UE^B)$$

The flow conditions that relate the offer and earnings distributions for Type A workers

$$\begin{aligned}&[\lambda_0(1-\gamma_d)(F_n^A(w_A) - F_n^A(r_A)) \\ &+\lambda_0\gamma_d(F_n^A(w_A) - F_n^A(r_A))]UE^A = \delta_A G^A(w_A)((1-\theta)M - UE^A) \\ &\quad + \left[\lambda_1(1-\gamma_d)(1-F_n^A(w_A)) + \lambda_1\gamma_d(1-F_d^A(w_A))\right] \\ &\quad \times G^A(w_A)((1-\theta)M - UE^A)\end{aligned}$$

and for type B workers

$$\begin{aligned}
&[\lambda_0(1-\gamma_d)(F_n^B(w_B)-F_n^B(r_B)) \\
&+k\lambda_0\gamma_d(F_n^B(w_B)-F_n^B(r_B))]UE^B \quad = \quad \delta_B G^B(w_B)((\theta M-UE^B) \\
&\qquad + \left[\lambda_1(1-\gamma_d)(1-F_n^B(w_B))+k\lambda_1\gamma_d(1-F_d^B(w_B))\right] \\
&\qquad \times G^B(w_B)((\theta M-UE^B)
\end{aligned}$$

The left-hand side of each equation gives the steady-state number of workers who receive acceptable wage offers below w while unemployed, whereas the right-hand side represents the number of workers with wages below w who exit to unemployment plus those who exit to higher paying employers.

Derivation of Equilibrium Wages, Offers, and Steady State Labor Stocks for Type B workers

Let w_B^i be a utility maximizing wage for firm $i=n,d$. As employers are utility maximizers, using the identities for the reservation wages for each type of worker it must be the case

$$(P_B-w_B^n)l_n^B(w_B^n)\geq(P_B-w_B^d)l_n^B(w_B^d)$$

This is because the expression on each side represents profit per worker times the number of workers. The profit from employing type B workers at "normal" employers must be at least as good as mimicking the cost employers. Similarly, at type d employers;

$$(P_B-d-w_B^d)l_d^B(w_B^d)\geq(P_B-d-w_B^n)l_d^B(w_B^n)$$

indicating that they also must be at least as well off under their chosen strategy as they would by mimicking the normal employers. Some algebraic manipulation will show that:

$$X(w_B^n)=(P_B-w_B^n)l_n^B(w_B^n)-(P_B-d-w_B^n)kl_d^B(w_B^n)\geq(P_B-w_B^d)l_n^B(w_B^d)-(P_B-d-w_B^d)kl_d^B(w_B^d)$$

for any w_B^i that is a utility maximizing wage for firm $i=n,d$. Consider that

$$X'(w_B^n)=(P_B-w_B^n)(1-k)l_n'^B(w_B^n)+kdl_n'^B(w_B^n)l_n'^B(w_B^n)-(1-k)l_n^B(w_B^n)>0$$

This expression is *strictly* positive as $(P_B-w_B^n)(1-k)l_n'^B(w_B^n)=(1-k)l_n^B(w_B^n)$. This is because $\pi=(P_B-w_B^n)l_n^B(w_B^n)$ and $\frac{\partial\pi}{\partial w_B^n}=((P_B-w_B^n)l_n'^B(w_B^n)\times 1)-l_n^B(w_B^n)$ which is zero at a maximum.

Consider $w_B^d\in(\underline{w}_B^n,\overline{w}_B^n)$ where the boundary terms represent the upper and lower limit of the wage offer distribution from type n employers. Given $X'(w_B^n)>0$ then it must be the case that;

$$(P_B-\underline{w}_B^n)l_n^B(\underline{w}_B^n)-(P_B-d-\underline{w}_B^n)l_d^B(\underline{w}_B^n)<(P_B-w_B^d)l_n^B(w_B^d)-(P_B-d-w_B^d)l_d^B(w_B^d)$$

for $w_B^d > \underline{w}_B^n$. However, this suggests that a profitable deviation from an employer's optimal strategy exists. As this cannot be the case it means $w_B^d \notin (\underline{w}_B^n, \overline{w}_B^n)$ which ensures that the distributions of wage offers from type d and n employers are disjoint and the wage offer distribution takes the form;

$$\begin{aligned}
F_d^B(w_B) &= F_n^B(w_B) = 0 \qquad w_B \leq r_B \\
F_d^B(w_B) &> 0;\ F_n^B(w_B) = 0 \quad r_B < w_B \leq wh_d \\
F_d^B(w_B) &= 1;\ F_n^B(w_B) > 0 \quad wh_d \leq w_B \leq wh_B \\
F_d^B(w_B) &= F_n^B(w_B) = 1 \qquad w_B \geq wh_B
\end{aligned}$$

where wh_B is the highest possible wage to type B workers and $wh_d < wh_B$ represents the max from cost employers. While symbolically complicated, the wage distribution is such that no offers are made below reservation wage (indicating that any job offer that is made will actually be accepted), all type B workers obtain a wage from type d employers in the region $w_B \in [r_B, wh_d]$. Type B workers will receive a wage $w_B \in [wh_d, wh_B]$ at type n firms. Lastly, No type B worker gets more than wh_B.

Gathering results gives

$$l_d^B(w_B) = \frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1 + k\kappa_{1B}\gamma_d(1-F_d^B(w_B)) + \kappa_{1B}(1-\gamma_d)\right)^2} \quad r_B \leq w_B \leq wh_B$$

where $\kappa_{iB}^k = \kappa_{1B}(1-\gamma_d) + k\kappa_{iB}\gamma_d$ for $i = 0, 1$. This result is found algebraically by using the fact that $F_d^B(w_B) > 0;\ F_n^B(w_B) = 0\ \forall w_B \in (r_B, wh_d]$ in conjunction with the three equations which represent the steady state flows in and out of employment at cost employers;

$$\begin{aligned}
k\lambda_0 UE^B + k\lambda_1 G^B(w_B)((\theta M - UE^B) &= \delta_B l_d^B(w_B) + \lambda_1(1-\gamma_d)(1-F_n^B(w_B))l_d^B(w_B) \\
&\quad + k\lambda_1\gamma_d(1-F_d^B(w_B))l_d^B(w_B)
\end{aligned}$$

in and out of unemployment;

$$\lambda_0(1-\gamma_d)(1-F_n^B(r_B))UE^B + k\lambda_0\gamma_d(1-F_d^B(r_B))UE^B = \delta_B(\theta M - UE^B)$$

and the relationship between offers and earning which underpins the equilibrium solution;

$$\begin{aligned}
[\lambda_0(1-\gamma_d)(F_n^B(w_B)-F_n^B(r_B)) & \\
+k\lambda_0\gamma_d(F_n^B(w_B)-F_n^B(r_B))]UE^B &= \delta_B G^B(w_B)((\theta M-UE^B) \\
&+\left[\lambda_1(1-\gamma_d)(1-F_n^B(w_B))+k\lambda_1\gamma_d(1-F_d^B(w_B))\right] \\
&\times G^B(w_B)((\theta M-UE^B)
\end{aligned}$$

While the algebra is omitted to economize on space, the solution proceeds by solving for UE^B in the unemployment equation, substituting the resultant expression into the remaining conditions and then solving for the earnings distribution G. Similarly, it can be shown that;

$$l_n^B(w_B)=\frac{\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2}\quad wh_d\leq w_B\leq wh_B$$

To solve for the *offer* distributions consider that employers of a single type must equalize utility at wage offers that satisfy $w_B\in[r_B,wh_d]$. That is, no type d firm should be able to increase profits by mimicking another type d firm. Thus;

$$(P_B-d-r_B)l_d^B(r_B)=(P_B-d-w_B)l_d^B(w_B)$$

Similarly, for type n employers;

$$(P_B-wh_d)l_n^B(wh_d)=(P_B-w_B)l_n^B(w_B)$$

which means that

$$l_d^B(w_B)=\frac{(P_B-d-r_B)l_d^B(r_B)}{(P_B-d-w_B)}=\frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2}$$

and

$$l_n^B(w_B)=\frac{(P_B-wh_d)l_n^B(wh_d)}{(P_B-w_B)}=\frac{\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2}$$

implying;

$$F_d^B(w_B)=\frac{1+\kappa_{1B}^k}{k\kappa_{1B}\gamma_d}-\left(\frac{1+\kappa_{1B}^k}{k\kappa_{1B}\gamma_d}\right)\left(\frac{P_B-d-w_B}{P_B-d-r_B}\right)^{1/2}\quad r_B\leq w_B\leq wh_d$$

because

$$\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2 = \frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)l_n^B(wh_d)}\left(\frac{P_B-d-w_B}{P_B-d-r_B}\right)$$

$$\Rightarrow F_d^B(w_B)) = \frac{1+k\kappa_{1B}\gamma_d+\kappa_{1B}(1-\gamma_d)}{k\kappa_{1B}\gamma_d} - \frac{1}{k\kappa_{1B}\gamma_d}\left(\frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)l_n^B(wh_d)}\left(\frac{P_B-d-w_B}{P_B-d-r_B}\right)\right)^{1/2}$$

$$\Rightarrow F_d^B(w_B)) = \frac{1+\kappa_{1B}^k}{k\kappa_{1B}\gamma_d} - \frac{1}{k\kappa_{1B}\gamma_d}\times\left(\frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)(1+k\kappa_{1B}\gamma_d+\kappa_{1B}(1-\gamma_d))^2}}\right)^{1/2}\left(\frac{P_B-d-w_B}{P_B-d-r_B}\right)^{1/2}$$

$$\Rightarrow F_d^B(w_B)) = \frac{1+\kappa_{1B}^k}{k\kappa_{1B}\gamma_d} - \frac{1+k\kappa_{1B}\gamma_d+\kappa_{1B}(1-\gamma_d)}{k\kappa_{1B}\gamma_d}\left(\frac{P_B-d-w_B}{P_B-d-r_B}\right)^{1/2}$$

where

$$l_n^B(r_B) = \frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(r_B))+\kappa_{1B}(1-\gamma_d)\right)^2} = \frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d+\kappa_{1B}(1-\gamma_d)\right)^2}$$

.

Similarly, it can be shown that

$$F_n^B(w_B) = \frac{1+\kappa_{1B}(1-\gamma_d)}{\kappa_{1B}(1-\gamma_d)} - \left(\frac{1+\kappa_{1B}(1-\gamma_d)}{\kappa_{1B}(1-\gamma_d)}\right)\left(\frac{P_B-w_B}{P_B-wh_d}\right)^{1/2} \quad wh_d \le w_B \le wh_B$$

The wage *earnings* distributions can be solved using a similar process of substitution and using the conditions that $F_d^B(wh_d) = 1$ and $F_n^B(wh_B) = 1$. In particular, these conditions give rise to the following two maximum wages at each type of firm

$$wh_d = P_B - d - \left(\frac{1+\kappa_{1B}(1-\gamma_d)}{1+\kappa_{1B}^k}\right)^2(P_B-d-r_B)$$

and

$$wh_B = P_B - \left(\frac{1}{1+\kappa_{1B}(1-\gamma_d)}\right)^2(P_B-wh_d)$$

These wages are, as we might expect, functions of productivity, the relative frequency of offers and job destruction, the proportion and max wages of type d employers, and reservation wages. The reservation wage can be solved by taking the reservation wage expression and substituting in the appropriate offer distributions $F_n^B(w_B)$ and $F_d^B(w_B)$;

$$r_B = b + \int_{r_B}^{\infty}\frac{(\lambda_0-\lambda_1)\left((1-\gamma_d)\left(1-F_n^B(w)\right)+k\gamma_d\left(1-F_d^B(w)\right)\right)}{\beta+\delta_B+\lambda_1\left((1-\gamma_d)\left(1-F_n^B(w)\right)+k\gamma_d\left(1-F_d^B(w)\right)\right)}dw$$

The resulting expression for the reservation wage for type B workers is;

$$
\begin{aligned}
r_B &= \frac{(1+\kappa_{1B}^k)^2 b + \kappa_{1B}(\kappa_{0B}-\kappa_{1B})(1-\gamma_d+k\gamma_d)^2 P_B}{1+\kappa_{1B}^k+\kappa_{1B}(\kappa_{0B}-\kappa_{1B})(1-\gamma_d+k\gamma_d)^2} \\
&\quad - \frac{\kappa_{1B}(\kappa_{0B}-\kappa_{1B})\left((1-\gamma_d+k\gamma_d)^2(1+\kappa_{1B}(1-\gamma_d))^2-(1-\gamma_d)^2(1+\kappa_{1B}^k)^2\right)d}{\left(1+\kappa_{1B}^k+\kappa_{1B}(\kappa_{0B}-\kappa_{1B})(1-\gamma_d+k\gamma_d)^2\right)\left(1+\kappa_{1B}(1-\gamma_d)\right)^2}
\end{aligned}
$$

Armed with an analytical expression for the reservation wage, wh_d, and wh_B along with expressions for $F_n^B(w_B)$, $F_d^B(w_B)$, and knowing that the flow in and out of unemployment is represented by;

$$
\begin{aligned}
&[\lambda_0(1-\gamma_d)(F_n^B(w_B)-F_n^B(r_B)) \\
&+k\lambda_0\gamma_d(F_n^B(w_B)-F_n^B(r_B))]UE^B = \delta_B G^B(w_B)((\theta M - UE^B) \\
&\qquad + \left[\lambda_1(1-\gamma_d)(1-F_n^B(w_B))+k\lambda_1\gamma_d(1-F_d^B(w_B))\right] \\
&\qquad \times G^B(w_B)((\theta M - UE^B)
\end{aligned}
$$

with some substitutions we can recover that

$$
G^B(w_B) = \begin{cases} \frac{\kappa_{0B}}{\kappa_{1B}\kappa_{0B}^k}\left[\left(\frac{P_B-d-w_B}{P_B-d-r_B}\right)^{1/2}-1\right] & r_B \le w_B \le wh_B \\ \frac{\kappa_{0B}}{\kappa_{1B}\kappa_{0B}^k}\left[\frac{1+\kappa_{1B}^k}{1+\kappa_{1B}(1-\gamma_d)}\left(\frac{P_B-wh_d}{P_B-w_B}\right)^{1/2}-1\right] & wh_d \le w_B \le wh_B \end{cases}
$$

Note that $\frac{1+\kappa_{1B}^k}{1+\kappa_{1B}(1-\gamma_d)} = \frac{1+k\kappa_{1B}\gamma_d+\kappa_{1B}(1-\gamma_d)}{1+\kappa_{1B}(1-\gamma_d)} > 1$ just acts as a scaling factor. This completes the derivation of the labor stocks in steady state, along with equilibrium wages and offer distributions.

Equilibrium Effects of changes in γ_d

1. The labor stock change at a specific firm who moves from type n to type d.

A firm who becomes type d moves from employing $l_n^B(w_B^n)$ to $l_d^B(w_B^d)$ of type B workers where $w_B^n \neq w_B^d$. Remember that;

$$
l_n^B(w_B^n) = \frac{\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B^n))\right)^2}
$$

$$
l_d^B(w_B^d) = \frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B^d))+\kappa_{1B}(1-\gamma_d)\right)^2}
$$

It follows that it is only the case that $l_n^B(w_B^n) > l_d^B(w_B^d)$ if

$$
1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B^d))+\kappa_{1B}(1-\gamma_d) > k^{1/2}\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B^n))\right)
$$

Given $F^B_d(w^d_B) = \frac{1+\kappa^k_{1B}}{k\kappa_{1B}} - \left(\frac{1+\kappa^k_{1B}}{k\kappa_{1B}}\right)\left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2}$ and $F^B_n(w^n_B) = \frac{1+\kappa_{1B}(1-\gamma_d)}{\kappa_{1B}(1-\gamma_d)} - \left(\frac{1+\kappa_{1B}(1-\gamma_d)}{\kappa_{1B}(1-\gamma_d)}\right)\left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2}$ then

$$1 + k\kappa_{1B}\gamma_d(1 - F^B_d(w^d_B)) + \kappa_{1B}(1-\gamma_d)$$

$$= 1 + k\kappa_{1B}\gamma_d(1 - \frac{1+\kappa^k_{1B}}{k\kappa_{1B}} + \left(\frac{1+\kappa^k_{1B}}{k\kappa_{1B}}\right)\left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2}) + \kappa_{1B}(1-\gamma_d)$$

$$= 1 + k\kappa_{1B}\gamma_d - \gamma_d(1+\kappa^k_{1B}) + \gamma_d\left(1+\kappa^k_{1B}\right)\left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2} + \kappa_{1B}(1-\gamma_d)$$

$$= 1 + \kappa^k_{1B} - \gamma_d(1+\kappa^k_{1B})\left[1 - \left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2}\right]$$

$$= (1+\kappa^k_{1B})\left(1 - \gamma_d\left[1 - \left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2}\right]\right)$$

and similarly,

$$k^{1/2}\left(1 + \kappa_{1B}(1-\gamma_d)(1 - F^B_n(w^n_B))\right) = k^{1/2}\left((1+\kappa_{1B}(1-\gamma_d))\left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2}\right)$$

Therefore $l^B_n(w^n_B) > l^B_d(w^d_B)$ if

$$(1+\kappa^k_{1B})\left(1 - \gamma_d + \gamma_d\left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2}\right) > k^{1/2}\left((1+\kappa_{1B}(1-\gamma_d))\left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2}\right)$$

Since $(1+\kappa^k_{1B}) = 1 + \kappa_{1B}(1-\gamma_d) + k\kappa_{1B}\gamma_d$ then $(1+\kappa^k_{1B}) > 1 + \kappa_{1B}(1-\gamma_d)$. Note that for

$$1 - \gamma_d + \gamma_d\left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2} > \left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2}$$

a *sufficient* but not *necessary* condition is for $\left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2} > \left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2}$ because $\left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2} = (1-\gamma_d)\left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2} + \gamma_d\left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2}$. For some values of parameters, $l^B_n(w^n_B) > l^B_d(w^d_B)$ even when $\left(\frac{P_B-d-w^d_B}{P_B-d-r_B}\right)^{1/2} < \left(\frac{P_B-w^n_B}{P_B-wh_d}\right)^{1/2}$. That is, it is an empirical question whether or not type a specific firms hires fewer workers if they become type d exogenously.

2. The equilibrium effects on labor stocks

A change in γ_d affects $l^B_i(w_B)$ for $i = d, n$. With labor stocks;

$$l_d^B(w_B) = \frac{k\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2} \quad r_B \leq w_B \leq wh_B$$

and

$$l_n^B(w_B) = \frac{\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2} \quad wh_d \leq w_B \leq wh_B$$

then

$$\frac{\partial l_d^B(w_B)}{\partial \gamma_d} = (\Lambda - \Omega) \times \Delta < 0$$

where

$$\Lambda = (1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2 \frac{\partial}{\partial \gamma_d}\left[k\kappa_{0B}(1+\kappa_{1B}^k)\theta M\right]$$

$$\Omega = k\kappa_{0B}(1+\kappa_{1B}^k)\theta M \frac{\partial}{\partial \gamma_d}\left[(1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2\right]$$

and

$$\Delta = 1/\left((1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2\right)^2 > 0$$

However, because $k\kappa_{0B}(1+\kappa_{1B}^k)\theta M = k\kappa_{0B}(1+\kappa_{1B}(1-\gamma_d)+k\kappa_{1B}\gamma_d)\theta M$ we have that

$$\frac{\partial}{\partial \gamma_d}\left[k\kappa_{0B}(1+\kappa_{1B}^k)\theta M\right] = k\kappa_{0B}\theta M(-\kappa_{1B}+k\kappa_{1B}) < 0$$

which implies $\Lambda < 0$. For Ω;

$$\frac{\partial}{\partial \gamma_d}\left[(1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2\right]$$

$$= (1+\kappa_{0B}(1-\gamma_d)+k\kappa_{0B}\gamma_d) \times 2\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)(k\kappa_{1B}(1-F_d^B(w_B))-\kappa_{1B})$$
$$+\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2(k\kappa_{0B}-\kappa_{0B})$$

so we have that

$$\frac{\partial}{\partial \gamma_d}\left[(1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2\right] < 0$$

which implies $\Omega < 0$. However, it is still the case that $\frac{\partial l_d^B(w_B)}{\partial \gamma_d} < 0$ because $|\Lambda| > |\Omega|$;[22]

$$\begin{aligned}
\Lambda - \Omega \quad = \quad & (1+\kappa_{0B}^k)\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2 k\kappa_{0B}\theta M(-\kappa_{1B}+k\kappa_{1B}) \\
& -k\kappa_{0B}(1+\kappa_{1B}^k)\theta M \\
& \times[(1+\kappa_{0B}(1-\gamma_d)+k\kappa_{0B}\gamma_d) \\
& \times 2\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)(k\kappa_{1B}(1-F_d^B(w_B))-\kappa_{1B}) \\
& +\left(1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)\right)^2(k\kappa_{0B}-\kappa_{0B})]
\end{aligned}$$

This expression is positive if

$$(1+\kappa_{0B}^k)(k\kappa_{1B}-\kappa_{1B})+(1+\kappa_{1B}^k)(k\kappa_{0B}-\kappa_{0B})) < \frac{2(1+\kappa_{0B}(1-\gamma_d)+k\kappa_{0B}\gamma_d)(k\kappa_{1B}(1-F_d^B(w_B))-\kappa_{1B})}{1+k\kappa_{1B}\gamma_d(1-F_d^B(w_B))+\kappa_{1B}(1-\gamma_d)}$$

which is true as $(k\kappa_{iB}-\kappa_{iB}) < 0$ for $i = 0, 1$ and all other terms are positive. For the type n firms;

$$l_n^B(w_B) = \frac{\kappa_{0B}(1+\kappa_{1B}^k)\theta M}{(1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2}$$

so that

$$\frac{\partial l_n^B(w_B)}{\partial \gamma_d} = (\Gamma - \Psi) \times \Xi > 0$$

$$\Gamma = (1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2 \frac{\partial}{\partial \gamma_d}\left[\kappa_{0B}(1+\kappa_{1B}^k)\theta M\right] < 0$$

because

$$\frac{\partial}{\partial \gamma_d}\left[\kappa_{0B}(1+\kappa_{1B}^k)\theta M\right] = \kappa_{0B}\theta M(k\kappa_{1B}-\kappa_{1B}) < 0$$

and

$$\Psi = \kappa_{0B}(1+\kappa_{1B}^k)\theta M \frac{\partial}{\partial \gamma_d}\left[(1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2\right] < 0$$

because

$$\frac{\partial}{\partial \gamma_d}\left[(1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2\right]$$

$$\begin{aligned}
& = (1+\kappa_{0B}(1-\gamma_d)+k\kappa_{0B}\gamma_d) \times 2\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)(-\kappa_{1B}(1-F_n^B(w_B))) \\
& + \left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2(k\kappa_{0B}-\kappa_{0B}) \\
& < 0
\end{aligned}$$

[22] That is, the expression represented by Λ is sufficiently negative to overcome the effect of subtracting a smaller negative number similarly to the following arithmetic $-5-(-4)) < 0$.

and

$$\Xi = 1/\left[(1+\kappa_{0B}^k)\left(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B))\right)^2\right]^2 > 0$$

For $\frac{\partial l_n^B(w_B)}{\partial \gamma_d} > 0$ it must be that

$$(1+\kappa_{0B}^k)(k\kappa_{1B}-\kappa_{1B}) - (1+\kappa_{1B}^k)\left[\frac{(1+\kappa_{0B}(1-\gamma_d)+k\kappa_{0B}\gamma_d)}{(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B)))}2(-\kappa_{1B}(1-F_n^B(w_B)))\right]$$
$$-(1+\kappa_{1B}^k)(k\kappa_{0B}-\kappa_{0B}) > 0$$

Given $(1+\kappa_{1B}^k)\left[\frac{(1+\kappa_{0B}(1-\gamma_d)+k\kappa_{0B}\gamma_d)}{(1+\kappa_{1B}(1-\gamma_d)(1-F_n^B(w_B)))}2(-\kappa_{1B}(1-F_n^B(w_B)))\right] < 0$ this means that for $\frac{\partial l_n^B(w_B)}{\partial \gamma_d} > 0$ it must be the case that

$$(1+\kappa_{0B}(1-\gamma_d)+k\kappa_{0B}\gamma_d)\lambda_1 > \lambda_0(1+\kappa_{1B}(1-\gamma_d)+k\kappa_{1B}\gamma_d)$$

$$\lambda_1 + \frac{\lambda_0}{\delta_B}(1-\gamma_d)\lambda_1 + k\frac{\lambda_0}{\delta_B}\gamma_d\lambda_1 - \lambda_0 - \lambda_0\frac{\lambda_1}{\delta_B}(1-\gamma_d) - \lambda_0 k\frac{\lambda_1}{\delta_B}\gamma_d > 0$$

Since $\frac{\lambda_0}{\delta_B}(1-\gamma_d)\lambda_1 = \lambda_0\frac{\lambda_1}{\delta_B}(1-\gamma_d)$ and $\lambda_0 k\frac{\lambda_1}{\delta_B}\gamma_d = k\frac{\lambda_0}{\delta_B}\gamma_d\lambda_1$ this simplifies down to

$$\frac{\partial l_n^B(w_B)}{\partial \gamma_d} > 0 \; if \; \lambda_1 > \lambda_0$$

which is the case by assumption. Therefore

$$\begin{aligned}\frac{\partial l_d^B(w_B)}{\partial \gamma_d} &< 0 \\ \frac{\partial l_n^B(w_B)}{\partial \gamma_d} &> 0\end{aligned}$$

Note that these are the equilibrium effects on single firm labor stocks at a *given* wage. That is, if there are more type d employers and a firm keeps the same wage, it hires fewer type d workers with the opposite being true for type n employers.

Separation Rates

Firm-worker separation rates are

$$\int_{r_A}^{wh_A}(\delta_A + \lambda_1(1-F^A(w_A)))dG^A(w_A) = \frac{\delta_A(1+\kappa_{1A})}{\kappa_{1A}}ln(1+\kappa_{1A})$$

where

$$F^A(w_A) = \frac{1+\kappa_{1A}}{\kappa_{1A}} - \left(\frac{1+\kappa_{1A}}{\kappa_{1A}}\right)\left(\frac{P_A - w_A}{P_A - r_A}\right)^{1/2} \quad r \le w_A \le wh_A$$

. and

$$\int_{r_B}^{wh_B} \left(\delta_B + \lambda_1(1-\gamma_d)(1-F_n^B(w_B))\right) + k\lambda_1\gamma_d(1-F_d^B(w_B))dG^B(w_B) = \frac{\delta_B(1+\kappa_{1B}^k)}{\kappa_{1B}^k} ln(1+\kappa_{1B}^k)$$

When $\delta_A \leq \delta_B$ it is possible that separation rates for type B workers to be higher. If $\delta_A = \delta_B$, separation rates for type A workers are strictly higher.