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Welfare Impacts and Labor Market Effects of Environmental Regulations

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Abstract

The welfare impacts of labor market changes induced by regulations are multi-faceted, include both private and social components, and are difficult to identify and measure empirically. There is an ongoing debate on whether the costs and benefits of labor market changes induced by regulations should be included with welfare measures in benefit-cost analysis (BCA), or analyzed separately as economic impacts. Cass Sunstein has called this a "frontiers question". Whether included directly or not, the monetized value of these labor market changes may be of value to policy makers when assessing regulatory options. However, there are theoretic disagreements and significant difficulties in practice, in terms of monetizing labor market changes, which the available literature has yet to address.

This paper first reviews the literature and arguments in the current debate about incorporating potential welfare impacts of labor market changes in applied benefit-cost analysis of environmental policies. Next, we consider two practical dimensions that should inform this discussion but are often neglected: (i) estimating employment impacts, in terms of numbers of workers and jobs affected, is empirically difficult due to methodology and data challenges, and (ii) a nascent empirical literature suggests a variety of methods to monetize welfare effects of labor market changes. We carefully consider their applicability, data requirements, and degrees of uncertainty with regards to analyzing national level environmental policies. This review provides grounds to inform the debate about the incorporation of labor market impacts into benefit-cost analysis by highlighting the open theoretic questions, significant analytic difficulties, and potential information available relative to the resources required to develop credible valuation estimates.

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1 Introduction

The welfare impacts of labor market changes induced by regulations are multi-faceted, include both private and social components, and are difficult to identify and measure empirically. While a growing body of literature estimates employment impacts of environmental policies (e.g., Berman and Bui, 2001; Greenstone 2002; Morgenstern et al., 2002; Walker, 2011 and 2013; Ferris et al. 2014) and finds either no effect or relatively modest effects on employment (Coglianese and Carrigan (2014)), very few papers consider the valuation of those impacts within benefit-cost analysis. There is an ongoing debate on which impacts of labor market changes induced by environmental regulations should be included directly within applied benefit cost analysis, or analyzed separately as economic impacts. The Economist magazine, in 2011, stated that "the economics of incorporating employment considerations into regulatory policy is in its infancy" and Cass Sunstein, while he was Administrator of the White House Office of Information and Regulatory Affairs, called this a "frontiers question".[3]

In the presence of a pollution externality the economy, absent intervention, will likely over-produce pollution as a result of inefficiently allocating too few resources towards abatement and/or too many resources towards the production of the underlying good associated with the pollution. In either case there may be a potential Pareto improvement associated with relocating resources, including labor, towards abatement and/or away from production of the underlying good. Therefore, a reallocation of labor across the economy is an inherent part of the solution to improving social efficiency through addressing the pollution externality. Some components of the benefits and costs of this reallocation of labor are well understood theoretically and applied commonly in practice. For example, labor required to reduce the emissions of a pollutant through abatement represent an opportunity costs to society, as those labor resources can no longer be used to produce other goods and services valued by society. These increases in labor demand for compliance purposes are understood to be social costs of a policy and are routinely included in applied benefit cost analyses.

[3] The Economist, "Clause and Effect: The Business Cycle Matters When Assessing the Cost of New Regulations", Oct. 29, 2011

Often what is stated to be of greater concern to decision makers and stakeholders, is not the reallocation of labor into the directly regulated, or abatement related, sectors for the purposes of compliance, but any potential reallocation of labor from the directly regulated sectors into other sectors. Under assumptions of complete and perfect markets, including labor markets, the value to society of the second best use of this labor resource will be nearly equivalent to its pre-policy use. That is, the value to society of the output produced by the labor resource in its original use was equivalent to the wage rate it received under the aforementioned assumptions. If the wage paid to the resource in its second best use, to which it is allocated after the policy is put into place, is negligibly close to its original wage, which would be the expectation under the assumption of complete markets, then the value society places on its new output is relatively equivalent to the value of the original output. As such, society is essentially indifferent (outside of the reduction in the pollution externality) to the allocation of the labor resource before and after the policy, such that this reallocation itself is neither a benefit nor a cost of the policy. This has been the traditional approach taken in applied benefit cost analysis of environmental policy.

However, the economics literature has begun to question the implications of the assumptions regarding perfect and complete markets for the purposes of accounting for labor reallocation out of the directly regulated sector in applied benefit cost analysis. Labor markets in practice are not perfect, and these issues are well known even outside the economics profession. For example, wages are not perfectly flexible and schedules may have similar rigidities (e.g., 40 hour work week), job search is costly, and it takes time for firms and workers to find mutually-acceptable matches. These types of imperfections may lead to transition costs associated with reallocating labor across sectors. Additional costs of reallocation may arise from the lack of complete markets, which may not allow society to full capitalize on the human capital associated with the labor resource being reallocated out of the directly regulated sector. This lack of completeness may occur due to discreetness between sectors or spatial heterogeneity in where sectors are located.

The question at hand is whether the socially efficient reallocation of resources, or the net social efficiency of reallocating resources, is conditional upon imperfections and

contemporaneous conditions within the labor market? Or to reframe the question, should applied benefit-cost analysis incorporate the reallocation of labor resources, in addition to the pre- to post-policy equilibrium welfare change? Hicks (1941) in proposing what would later be termed, for benefit-cost analysis the Kaldor-Hicks approach to Pareto efficiency, emphasized that measurement of potential improvements to society from new policies, where potential gainers could, in theory, compensate the losers, should consider the benefits of a policy over a sufficiently long time horizon. That is, even if there are transition costs associated with reallocating resources, they should be compared to present value of the stream of benefits that accrue to society while it remains in a more efficient equilibrium. Measuring potential improvements to social welfare with a benefit-cost analysis of a policy follows well-known best practices [cite textbooks? OMB?], but transition or adjustment costs for labor reallocation have, to our knowledge so far, not been as well-described.

The development of environmental policy may benefit from detailed information on potential labor market impacts and careful consideration of how to best incorporate that information into the policy development process. Whether labor market impacts are included directly into benefit-cost measures or not, the monetized value of these labor market impacts may be of value to policy makers when assessing regulatory options. However, when considering how to approach measuring the welfare impacts of labor market changes there are open theoretic questions and significant analytic difficulties in practice, which the literature has yet to address.

This paper first reviews the literature and arguments in the current debate about incorporating potential welfare impacts of labor market changes in applied benefit-cost analysis of environmental policies. Next, we consider two practical dimensions that should inform this discussion but are often neglected: (i) estimating employment impacts, in terms of numbers of workers and jobs affected, is empirically difficult due to methodology and data challenges, and (ii) a nascent empirical literature suggests a variety of methods to monetize welfare effects of labor market changes. We carefully consider their applicability, data requirements, and degrees of uncertainty with regards to analyzing national level environmental policies. This review provides grounds to inform the debate about the incorporation of labor market impacts into

benefit-cost analysis by highlighting the open theoretic questions, significant analytic difficulties, and potential information available relative to the resources required to develop credible valuation estimates.

2 The Theoretical Rationale for Inclusion

The previous literature has considered the role of policy-induced labor market changes in benefit cost analysis from both a theoretical and a practical perspective (Arrow et. al., 1996, Ferris and McGartland, 2014, Haveman and Krutilla, 1968, Mishan, 1994, Boardman et. al. 2010). In light of the empirical evidence that the net employment impacts of environmental regulations is likely minimal and the serious practical challenges associated with identifying those impacts and the potential social welfare consequences, it is worth revisiting the theoretical underpinnings of employment in applied welfare analysis.

In a recent study Shimer (2013) provides insight into the first part of that question by examining the socially optimal pollution tax in the presence of transition costs within the labor market. Specifically, Shimer models a two sector economy (one sector which pollutes, one which does not) with heterogeneous agents who have stochastic sector specific human capital, which exhibits persistence for the sector in which the agent is currently employed. If an agent attempts to switch sectors there is a non-zero probability of failure which leaves them attached to their previous sector and results in unemployment during the period the transition was attempted. Shimer demonstrates that in this setting the optimal pollution tax remains the Pigouvian tax based on the marginal benefits of mitigation and is not a function of the expected length of the unemployment spell or the potential loss of returns to sector specific human capital. This result presents a strong case that the stringency of a first best policy should not be determined by any potential reallocation of labor across the economy, with one major caveat. The study assumes that all employment transitions between the sectors will be voluntary. This result is in line with the standard practice in applied welfare analysis of not incorporating labor market transition costs under the assumption of full employment.

Under the assumption of perfect labor markets with only voluntary employment, workers that transition from the polluting sector under the policy to the non-polluting sector are those that are indifferent between the positions, conditional on their sector specific human capital,

expected time spent unemployed, and the relative wages. There remain distributional consequences of the pollution tax, such that some agents may be willing to pay to avoid the implementation of the policy as the benefits they receive through lower levels of pollution may be exceeded by the private costs associated with lower lifetime earnings, independent of whether they reallocate to the non-polluting sector. The key is that they only reallocate to the non-polluting sector if they find it in their best interest to do so. Therefore, the worker would be at least as well off after switching jobs as remaining in their original position after the policy was implemented. This means that the aggregate costs of the pollution tax on society will be independent of the size of any transition costs in the labor market, under the case of perfect labor markets.

However, in reality there are many imperfections in labor markets that allow them to remain out of equilibrium for extended periods of time and externalities that lead to effects beyond those experienced by the agents reallocating across the labor market, for example wage rigidities, skill mismatch, etc. &&& If there was a non-trivial probability that the labor market will be in notable disequilibrium at the time the regulation was implemented (not promulgated) then the result of Shimer (2013) may not hold. In these cases the pollution tax may result in involuntary unemployment where some agents are forcibly unattached from the polluting sector even though the change in their expected life time earnings from attempting to switch to the non-polluting may be negative. Therefore, for some workers involuntarily unemployed by the pollution tax, their consumption equivalent costs associated with the policy may be greater under than in the case of perfect labor markets. The transition costs in the labor market would be an upper bound on any potential costs associated with involuntary unemployment from the policy in the case of imperfect labor markets

The work by Shimer (2013) also highlights the role of policy design in determining how labor market conditions may affect a benefits cost analysis. This previous work was focused on the case of a Pigouvian tax on the pollution externality. This first best policy allows the economy to endogenously smooth the impacts of reallocating labor to the non-polluting sector based on conditions in the labor market. If, in general, the workers currently in the polluting sector have relatively low human capital in the non-polluting sector compared to polluting sector, the private

costs they would bare from transitioning between sectors would be higher, all else equal. In this case, when the labor market transition costs are relatively high only a relatively small amount of labor may be reallocated across the sectors in response to the pollution tax. In turn, emissions of the pollutant will also be relatively higher. When labor market conditions change, in the model of Shimer as a result of the stochastic process for individual and sector-specific human capital, and the transition costs become relatively lower, then the economy will experience a larger reallocation of labor from the polluting to non-polluting sector. Therefore, while the level of the socially optimal pollution tax is not conditional on the transition costs the socially optimal level of emissions in any period is a function of the labor market conditions, even in the case of a perfect labor market, as well as a function of the relative size of the polluting sector. Specifically, if the polluting sector is initially suboptimally large and labor transition costs are significant, optimal quantity regulation depends on these two factors and will only gradually reduce emissions (Shimer, 2013). This suggests that in the case of second-best policy designs that do not have the ability for the market to endogenously determine the socially optimal rate of transition in terms of labor, production of the polluting good, and emissions, there may be additional social costs associated with the policy instrument.

Therefore, we see two cases where it may be theoretically appropriate to consider labor market changes induced by pollution abatement policy beyond the costs of labor required directly for compliance. These include the cases of imperfect labor markets and second-best policy designs. While Shimer (2013) provides a solid first step, we have much to learn about theoretical implications and approaches for inclusion of labor reallocation and transition costs in benefit-cost analysis. The empirical work in this area has largely been developed absent of an underlying theoretic context of labor market equilibrium, transitions, and household behavior, which is a disadvantage in this context. More research on the economic theory of labor reallocation and transition costs within the context of benefit cost analysis is required to ensure an internally consistent and appropriate treatment, as has been pointed out by Smith (2012, 2015) and Ferris and McGartland (2014).

3 Social Opportunity Cost of Labor

In economic theory in general, and benefit cost analyses of policy interventions in particular, the opportunity cost of resources is a key concept. As commonly defined in textbooks, "[t]he opportunity cost of using an input to implement a policy is its value in its best alternative use." (Boardman et al 2011 p. 29). In benefit-cost analysis, the cost to society of undertaking a public policy are represented by the opportunity costs of utilizing some of society's scarce resources to obtain the outcome of the policy instead of in their current use. If markets are complete and perfect, market prices will represent the social opportunity cost of these resources on the margin.

Typically, in a benefit-cost analysis of a policy the estimates of social cost include the opportunity cost of labor required in the regulated industry or closely connected abatement industries for the purpose of compliance. The social opportunity cost of this labor is measured by its market price (i.e. wages) as representing its value to society in its next best use. (Harberger 1971, Haveman and Farrow 2011, Mishan 1994, Boardman et al 2011, Haveman and Weimer 2015). Other employment impacts are typically regarded as distributional in applied benefit-cost analysis, and therefore, not included as a benefit or cost (Mishan 1994, OMB Circular A-4 2003). This assumption is consistent with assuming complete and frictionless markets, such that if the increased marginal cost of production in the regulated sector leads to a reallocation of labor outside of that required for compliance the value of any reallocated labor in its alternative use is approximately equivalent to the value in its current use.

This typical approach and the assumption of perfect and complete labor markets is currently being reexamined, with consideration being paid to adjustments that might be appropriate to account for the role of unemployment. While the discussion in the preceding section highlighted the potential role of unemployment associated with reallocation of labor, there is also the case that labor currently in an unemployed state may be utilized for compliance purposes. These two concepts are closely related, and we start by considering that latter for exposition of the issue.

The literature on employment effects and valuation within benefit-cost analysis derives from the work of Haveman and Krutilla (1967), which focused on estimating the social cost of

previously unemployed labor utilized for public works projects (Haveman and Krutilla, 1967a, 1967b, 1968, 1971, Haveman, 1976, Haveman, 1983). While economic theory indicates that the best measure of the market value of employed workers is their wage, there continues to be disagreement over estimating the social cost of unemployed labor. Haveman and Krutilla's approach to analyzing public expenditure projects suggests using input-output matrices to adjust nominal factor prices for unemployment and idle capacity in the industry (Haveman and Krutilla, 1968, Epp, 1979).

For example, widely-used applied welfare textbooks consider only portions of this issue, and illustrate some of these different conceptual frameworks and their analytic difficulties in practice. For example, Boardman et. al. (2006) considers two examples: for a public project: they suggest five alternative measures for estimating the opportunity cost of unemployment. Haveman and Farrow (2011) suggest three measures for public projects and also suggest only undertaking this approach during periods of high unemployment. In another example, Boardman et al (2006) consider valuing the social costs of potentially laid-off workers from a public project only when the labor market is significantly distorted, e.g. high unemployment, monopoly. Haveman and Weimar (2015) expand on this approach and consider additional adjustments for social welfare, for potentially laid-off workers. Just, Hueth, and Schmitz (2004) have a small section on "labor supplier welfare measurement" and describe welfare changes as those given by changes in labor supplier surplus associated with the proposed policy. EPA's *Land Handbook* (2011) suggests that hiring previously unemployed workers can potentially lower the social costs of a cleanup or reuse project, however, in labor markets without long-term unemployment, social costs should not be adjusted.

If some of the labor used for the purpose of compliance with the policy being examined may be drawn from currently unemployed labor resources then social opportunity cost of that labor may not be equivalent to the market wage. The literature seems to be in agreement that the social opportunity cost of this unemployed labor has an opportunity cost that is likely greater than zero but less than the market wage. The difficulty (beyond forecasting the proportion of labor that might be drawn from the pool of unemployed resources years into the future when

the policy is implemented)[4] is that unemployed workers' opportunity costs are unobserved and will likely exhibit significant heterogeneity across individuals, making it challenging to estimate a shadow price of unemployed labor.

While not directly observable, there have been a number of attempts to estimate the distribution of reservation wages, or at least the first moment, for varying levels of industrial and/or geographic specificity. Recently these efforts have been associated with the development and calibration of structural macroeconomic models that may be used to describe the dynamics of labor markets in the economy. The goal for this line of research has been to develop a model based on theoretical principles, that when calibrated correctly, will simulate labor market dynamics in a relatively accurate fashion. Clearly the reservation wage of workers will play an important part in determining the behavior of the labor market. Therefore when the parameters of such structural models are calibrated to match empirical observations, one is provided with some information regarding the average reservation wage.

Many of the models in this line of research are derived from the Mortensen-Pissarides search and matching model (Mortensen and Pissarides, 1994) and are calibrated to match empirical observations for the dynamics of unemployment and job vacancies (see Hagedorn and Moanovskii (2008) for a detailed review). Researchers using this approach have reported a wide range of estimates for the average opportunity cost of labor. For example Shimer (2005), Hall (2006), and Hagedorn and Manovskii (2008) are representative of the results and provide

[4] Haveman and Krutilla (1967) initially and later Haveman, Krutilla, and Steinberg (1968) and Haveman and Margolis (1983) provide a framework for determining the probability of drawing from an idle pool of labor based on the characteristics of the job being created. The method is based on using occupation specific labor response functions which relate the current level of unemployment in the market to the probability that a new job created will be filled by a currently unemployed worker. In order to generate a labor response function they calibrated either a linear or semi-logarithmic function such that at the natural rate of unemployment the probability of hiring any currently unemployed worker is zero, whereas at an unemployment rate of 25% the probability is unity.

However, the general applicability of this approach has yet to be fully established, as a case study by Epp (1979) has found that the Haveman-Krutilla labor response functions may substantially over estimate the number of unemployed workers that will be hired. Epp studied a large public project in an area of high structural unemployment where, from a previous study, it was known that the unemployed workforce had the required skills to perform the new jobs created. Using the Haveman-Krutilla labor response function it was expected that 10-12% of the hires should come from the idle labor pool; however it was estimated that only 2% of the workers were previously unemployed. Further research into the development of accurate labor response functions is an important area of research that is crucial to correctly accounting for the social cost of labor in chronically depressed labor markets.

estimates of 0.48, 0.74, and 0.97 times the market wage, respectively. However, in these models both workers and jobs are assumed to be homogeneous and therefore the model may be seen as studying only a particular type of individual and not the labor market in general (Hall, 2006). Even if heterogeneity was considered (as in Chang and Kim (2006)) these modeling exercises are primarily concerned with short-term frictional and cyclical unemployment and in turn tend to only measure the distribution's shape around the marginal worker (Gourio and Noual, 2006). Therefore these estimates of the reservation wage may be seen as the average only around the marginal worker.

Heterogeneity amongst workers will lead to differences in individuals' value of leisure and non-market production (Blanchard and Katz, 1997). For example, the value of non-market production will encompass activities such as caring for children, household repairs, etc. and will therefore differ among individuals (see Gronau (1973) and Nakamura and Nakamura (1994) for examples). Furthermore, one's reservation wage will be dependent upon one's current level of wealth and spousal earnings, which will also vary greatly across unemployed workers (see Kiefer and Neumann (1979) and Bloemen and Stancanelli (2001) for examples). To address these concerns some of the research has focused on the use of micro level survey data that directly ask individuals about their reservation wages. Most of the early literature in this area developed estimates ranging from 0.85 to nearly 1.0 times the respondents market wage (e.g., Kasper, 1967; Warner et al., 1980; Feldstein and Poterba, 1984; Barnes, 1975; and Jones, 1988). However, concerns about omitted variable bias and potential non-stationarity of the reservation wage distribution plague many of the estimates in this literature.

If appropriate and robust estimates of the reservation wage were available, along with defensible estimates of the amount of labor used for compliance purposes is drawn from the pool of unemployed resources at the time a policy is implemented, one might be able to adjust the opportunity of labor in the social cost estimates. Though, another confounding factor is that the adjustment should be reflective of the counter-factual based on expectations about the remaining length those labor resources would have remained unemployed in the absence of the policy. In cases where labor market transitions are relatively quick, a notable amount of the reservation wage distributions' mass is relatively close to the market wage, and/or the amount

of labor resources drawn from the pool of unemployed resources is relatively small, the size of the adjustment may be of second order importance relative to other social costs and benefits associated with the policy. This is the typical assumption employed in benefit cost analysis and returns us to the standard treatment outlined above.

4 New Research on the Social Transition Costs of Labor Reallocation due to Public Policies

The previous literature on the effect of unemployment on the opportunity cost of labor in benefit cost analysis has concentrated primarily on public projects financed by public expenditures and the possibility that they might employ labor resources that were previously idle. Only recently have researchers begun to consider the role of unemployment in the analysis of more general public policies, such as environmental regulations. In these cases, the literature has focused on the transition costs associated the reallocation of labor across the economy as induced by the public policy implemented to address a market failure. Notably, Arrow et al (1996), discussing principles of benefit cost analysis, state that while individual environmental regulations typically affect the distribution of employment across industries rather than the employment level, the appropriate measure for benefit-cost analysis is the transition costs of employees forced to switch jobs because of the regulation (p.8). Though a somewhat different focus than the previous literature on unemployment and benefit cost analysis, many of the same core concepts are relevant in the current context as the transition costs associated with the reallocation of labor (outside of that which is used for compliance) is in part a converse of the previous story. The portion of the transition costs associated with labor resources spending time in an unemployed state during the reallocation, is in part, based on the difference between the value of the resource to society in its original state, and its value in the unemployed state during the transition.

However, the recent revitalization of this literature has further refined Haveman and Krutilla's earlier contributions by introducing alternative measures of unemployed labor's social cost that expand the concept to incorporate additional social impacts associated with the reallocation of labor, such as impacts other family members (Haveman and Weimar, 2015). This recent literature has also focused on under what conditions such transition costs might be of first

order importance for a benefit cost analysis, such as only under conditions of high unemployment (Haveman and Farrow, 2011), land revitalization and reuse projects (EPA 2011).

Recent work suggests revisiting the standard approach, and the most recent papers focus on suggestions for how to implement adjustments. Haveman and Farrow (2011), in the wake of the Great Recession, suggest adjustments for social cost accounting, in terms of hiring previously unemployed workers, during periods of high unemployment. Masur and Posner (2012) cite as motivation new empirical evidence on the cost of job loss for displaced workers. This new evidence may indicate that there are social costs of labor market distortions and transition costs that perhaps may be large enough to not be considered *de minimus* within benefit-cost analysis. (Haveman and Weimer 2015, Bartik 2015, Smith 2015, Haveman and Farrow 2011, Kuminoff, Schoellman, Timmins 2015). Recent studies indicate that job search, transition costs, and long-term earnings loss may be larger than previously thought (Davis and von Wachter, etc). In addition, these recent papers take different approaches to adjusting the social opportunity cost of labor beyond considering unemployment and focus on many different externalities, market distortions, or spillover to adjust for.

Table 1 provides a summary overview of this recent literature. We provide a categorization of whether or not the papers indicate that social cost should be adjusted within benefit cost analysis to account for labor impacts. The literature diverges on when to implement this adjustment within a benefit-cost analysis. Some studies suggest making additional social cost adjustments for unemployment as standard practice, even under full-employment (Haveman and Weimer 2015) and others suggest only during periods of high-unemployment (Haveman & Farrow 2011, Bartik 2015, Smith 2012, 2015). However, while the approach taken in Table 1 quickly summarizes the literature's perspective on including this adjustment in periods of high unemployment, or not, there are important, and broad, differences in approach that are summarized in the "caveats" column.

Haveman and Farrow (2011) mark the start of this recent line of research, in a short paper that illustrates how benefit cost analysts could adjust the social opportunity cost of hiring unemployed labor during periods of high-unemployment. Their focus, as in past work, is on analysis of public works projects, so they focus on hiring labor for the project. They present

different approaches to calculating and presenting information on the social opportunity cost of hiring unemployed labor. U.S EPA (2011), in the specific context of land re-use and clean-up projects, also suggests that there may be social benefits of hiring unemployed labor in local areas facing long-term, or high, unemployment.

The next set of papers to appear in the literature are a good example of the range of approaches taken, on this question of valuing social costs of labor. Smith (2012) identified that environmental economics, as a field, could learn much from techniques and approaches used in macroeconomics. Smith (2012) suggests that, on the topic of valuing employment impacts of environmental regulations within benefit cost analysis during periods of high-unemployment, economists go back and start to address this question using first-principles of economic theory. In contrast to this call for a theoretic framework and basis, Masur and Posner (2012) approach the question and use an *ad hoc*, rule of thumb approach to valuing employment impacts of environmental regulation – they do not include a theoretic model or framework. They focus only on job loss and argue that empirical estimates of earnings impacts, mortality risk, and subjective well-being impacts can be taken from the labor literature and used to adjust the social cost of labor within benefit cost analysis. In contrast, Bartik (2012) focuses only on job gains, and presents an approach that also uses *ad hoc* adjustments, and some initial thoughts on a framework approach for social benefit adjustment.

The most recent set of papers, mostly in 2015, also show a wide range of varied approaches, and focus on different aspects of the question. As previously discussed, Shimer (2013) builds a theory model that indicates labor adjustment costs may be important for the optimal quantity-based policy, but only when job search is significantly costly and the polluting sector is initially suboptimally large. Haveman and Weimar (2015) present an approach that addresses valuation of both job losses and job gains (suggested adjustments are not symmetric), for the standard approach (full-employment) and also under high-unemployment. Smith (2015)'s introduction to a special journal issue overviews the three included papers and suggests that the research effort informs the exploration of including adjustment costs within benefit cost analysis. Specifically, Smith (2015) points out that standard benefit cost analysis looks only at equilibria before and after the policy, but he argues, needs to expand to consider the transition path as

well. Bartik (2015) presents a method to adjust social opportunity costs of labor for both job losses and job gains, and suggests benefit cost analysts focus on times of high national unemployment and focus on adjustments for local areas that have relatively high unemployment. Finally, Kuminoff, Schoellman, and Timmins (2015) use a regional sorting model to consider the margin of adjustment for both job and housing choices, jointly, and present their findings for all phases of the business cycle.

Interestingly, most of these papers use and *ad hoc* approach, listing aspects of labor transitions that may have social welfare components and then using rules of thumb from the labor literature to assign values to each component.

Table 2a shows estimates of the social cost adjustment for labor, for a few papers, by cases: job losses and job gains, using the standard approach (assuming full-employment) and with high unemployment, with and without social cost adjustments. Table 2a provides estimates for these suggested adjustments, by the percent of annual earnings. We have tried to standardize into a common metric -- percent adjustments to average annual earnings, for individual workers – for comparison across studies. Table 2b is the same, but reporting level adjustments (dollar amounts). Haveman and Farrow (2011) include only a very simple example to illustrate their approach to adjusting social cost downward for hiring previously unemployed workers during periods of high-unemployment. Masur and Posner (2012), when applying their social cost adjustment to benefit cost information from environmental policies, use a range of $35,000 to $100,000 of lifetime impacts – which they then divide by 30 for comparisons with the annualized benefits and costs reported in the regulatory impact analyses. Instead, we annualize the two lifetime values using a timeframe of 30 years and assuming a discount rate of 3%. As a percentage of the average annual earnings assumed by Masur and Posner (2012), $50,000, these annualized values range from 3% to 10% (up to 25% if we use their maximum lifetime value of $260,000). Haveman and Weimer (2015) differ from the other papers listed in the table, in that they assume the standard approach would include the average annual earnings of the individual worker within benefit cost analysis as a social cost (job gain) or social benefit (job loss). However, all other papers assume the standard approach we outlined earlier: include only direct compliance employment (or public project employment) within benefit cost analysis and carefully consider

whether or not some fraction of the social cost of other labor may be included, exclusive of earnings (Bartik, 2015). Therefore we subtract (for job gains, or add, for job losses) the average annual earnings assumed by Haveman & Weimer (2015) to establish a zero amount, and find their suggestions for social costs of job loss then range from 1% to 173% of annual earnings, with a 1% adjustment for job loss during full-employment (e.g. increase in social cost of $400 per individual), however, during high-unemployment periods, they suggest a very large (even large for this literature) adjustment of including 173% of annual earnings as a social cost for job loss (e.g. the social costs would be $69,200 under high-unemployment, rather than zero). This estimate in particular stands out in relation to the rest of the literature, which claims that social cost is a smaller fraction than individual earnings. For example, the second highest estimates are about 25% of annual earnings (Masur & Poser (2012)'s max value, and Bartik (2015) value for high initial unemployment and a 7% discount rate).

In comparison, to the previous approaches which use rule-of-thumb estimates gathered from the labor literature, Bartik (2015) and Kuminoff, Shcoellman, and Timmins (2015) use econometric approaches to estimate social cost adjustments for labor impacts. Bartik (2015) uses a model of local labor market shocks to estimate social cost adjustments based on one-time job growth shocks. Kuminoff, Schoellmann, and Timmins (2015) use a regional sorting model to incorporate both labor market and housing decisions, and simulate job layoffs for a sample of ever previously-unemployed workers. Bartik (2015) suggests that adjustments for job loss and job gain are symmetric, and would be higher during periods of high unemployment. Specifically, Bartik focuses on unemployment in local labor markets, suggesting that social cost adjustments could vary based on initial local unemployment rates (low, medium, high) and could take into account a measure of job reallocation by comparing local unemployment rates versus the national average.[5] Bartik includes estimates conditional on net employment changes due to a policy, which range from 9.6 to 24.7% of the present value of earnings. Bartik also estimates adjustments if there are net zero employment changes, with only job reallocation, and estimates range from 5.2% to 6.1%. Kuminoff, Schoellman, and Timmins (2015) focus only on job losses, and using a utility-maximization framework, estimate impacts on welfare for affected workers,

[5] See Bartik (2015) Table 2.

when induced by a policy to shift jobs, shift housing locations, or both. Kuminoff, Schoellman, and Timmins (2015) report welfare impacts measured as equivalent variation, for different business cycle conditions (recession, normal, expansion). [6] Assuming an average income of $50,000, we calculate that those welfare impacts represent a range of 2.5 to 16% of average annual earnings.

Table 2b repeats the estimates in Table 2a, but for levels (dollars), rather than percent adjustments. Across these studies, average annual earnings are assumed to range from $40,000 to $61,000. Some studies suggest different values for job losses versus job gains, and some studies focus only one of the two types of impacts. Over the range of studies, social cost adjustments for labor impacts have lower values conditional on full-employment: ranging from $400 to $7,000, and higher values conditional on high-unemployment, ranging from $2,500 to $69,000.

Table 3 shows listings of the different components of social cost adjustments suggested by the papers, disaggregated by individual adjustments and social adjustments. The wide range of proposed components of social cost adjustments and the small degree of overlap, particularly for social aspects rather than individual costs, show how wide-ranging the approaches and focus are in this most recent literature. While the studies generally incorporate expected components for social costs of labor impacts, such as changes in individual earnings, job search costs, changes in health and well-being associated with unemployment spells, they differ greatly with regards to proposed adjustments for externalities and spillovers, rather than costs directly related to individual workers. For example, Masur and Posner (2012) list possible social adjustments such as unemployment insurance and job-training programs, that others regard as transfers, from a benefit-cost approach. Haveman and Weimer (2015) and Bartik (2015) list adjustments, based on related literatures, for spillover effects on worker's families, including impacts on spousal mental health, children's educational attainment and long-run earnings. However, Bartik (2015) does not include these adjustments in his empirical approach. Other social impacts include the effect of policy-induced employment impacts on local unemployment rates and labor force participation (Bartik, 2015) and the local housing market (Kuminoff, Schoellmann and Timmins,

[6] See Kuminoff, Schoellman, and Timmins (2015) Table 1.

2015). Masur and Posner (2012) and Kuminoff, Schoellman, and Timmins (2015) emphasize that industry characteristics, particularly in terms of economic growth, should matter for estimating welfare changes. Finally, the studies mention, and a few emphasize, how heterogeneity in labor plays an important role in estimating welfare impacts. The labor studies cited for the rule-of-thumb estimates also show how demographics, including age, gender, region of employment, education and experience can impact individual costs of job transition and also welfare measures of the social component of those transitions.

5 Lessons Learned from New Research on Labor Market Transition Costs

At this point it is useful to reconsider the context and question at hand: what is the appropriate treatment of transition costs associated with labor market reallocation in applied benefit cost analyses of public policies? While in theory these transition costs might be social costs (e.g., Shimer, 2013, Arrow et al., 1996), that does not necessarily imply that the limited time and resources available for benefit cost analyses of public policies under consideration are best devoted to estimating the social costs associated with the potential reallocation of labor as a result of the policies. Some of the new research on this topic has posited that these transition costs would clearly be first order effects, but in some cases the perspective for this conclusions, such as focusing on the individual worker, may be misguided. The impact on an individual who is forced to reallocate to a new job as the result of a policy might be non-trivial for that individual. This is the reason that information about labor market changes induced by policies are relevant for decision makers, as they speak to the incidence of a policy. But the fact that the impact on the individual is of first order importance for them, does not imply that the effect is of first order importance in the context of the national social benefits and costs of the policy, such that time and resources are well spent attempting to monetize the transition costs associated labor market changes. Whether such effort is warranted is a question of how much value this new information would add to analyzing the relative economic efficiency of multiple policy options.

The impact of information on transition costs of labor market shifts in a benefit cost analysis, will depend on the magnitude of the induced labor resource reallocation and the transition cost per unit of labor reallocated relative to the magnitude of the other expected social benefits and

costs of the policy. Labor demand theory and the empirical literature recognize that there can be both positive and negative impacts on employment due to environmental policy, as labor is reallocated to more socially-efficient uses. Jobs are both created to supply pollution abatement equipment and services and also potentially lost as regulated industry faces compliance costs (Berman and Bui (2001), Morgenstern, Pizer, and Shih (2002), Coglienese (2014), Deschenes (2014), Pestel (2014)). The growing body of literature that has estimated employment impacts of environmental policies has found either no effect or relatively modest effects on employment (e.g., Berman and Bui, 2001; Greenstone 2002; Morgenstern et al., 2002; Walker, 2011 and 2013; Ferris et al. 2014; Coglianese and Carrigan, 2014). However, this work has focused on the net impact and while the net impact (job creation minus job destruction) may be small, what is relevant for our case is the magnitude of the gross reallocation. While the net impacts are sometimes more statistically discernable, the literature on net employment impacts of environmental regulations has so far ruled out large negative impacts and generally finds small, or statistically insignificant effects. A result which calls into question the likelihood that the transition would be of first order importance unless the transition cost per unit of labor reallocated were exceptionally large given that the expected net benefits of recent large environmental regulations, for example the Clean Power Plan, range from $26 to $45 billion dollars in 2030.[7]

In practice, there are cautions that should be kept in mind when considering application within a benefit-cost analysis framework:

(1) **Secondary effects** – guidance on benefit cost analysis suggests focus on first-order, or direct effects, first. Then, there may be important secondary effects which are unrelated to the purpose of the policy. Secondary effects may also be estimated, but care must be taken to avoid "highly speculative or minor consequences [that] may not be worth further formal analysis".[8] Secondary effects that may be important enough to potentially change the ordering of policy alternatives would take analytic priority. Here, in terms of labor market impacts, because environmental policy focuses first on reducing pollution,

[7] U.S. EPA Clean Power Plan Regulatory Impact Analysis, p. ES-21; http://www.epa.gov/airquality/cpp/cpp-final-rule-ria.pdf

[8] U.S. Office of Management and Budget, Circular A-4.

protecting human health and the environment, in this framework, these would be considered secondary effects. Bartik (2015) uses his adjusted social cost measures for labor impacts and uses them to adjust cost estimates for a sample of recent environmental regulations, and finds that including these adjustments does not change the net benefit estimates.

(2) **Transfers** – properly identifying transfers, as separate from social cost and social benefits, is an important component of benefit cost analysis and can pose difficulties. For example, unemployment benefits are considered a transfer within a benefit-cost analysis. The unemployment insurance system transfers funds from currently employed workers and even past payments of unemployed workers when they were previously employed to those currently unemployed. Mishan (1994) includes a number of examples showing that unemployment benefit payments and even earnings (transfers from purchasers of goods and services to the firms employing the workers in the form of worker's earnings) are considered to be transfers within a benefit-cost analysis. Masur and Posner (2012), for example, instead suggest that unemployment benefits should be considered a social cost, which may be due to their perspective from an individual worker (see point 1 above).

(3) **Double-counting** – when taking an approach in a benefit-cost analysis that builds up from individual effects and valuations, it can be easy to potentially double-count social costs and social benefits (OMB 2003, etc). Mishan (1994) starts with an example using land, then considers the potential for double-counting when considering labor. If the new project benefits local business and increases local property values, you'd risk double-counting these social benefits by including the increase in rents (profits) and also including the increased valuations (property-values) for those businesses. The present net value of social benefits should not include both benefit streams; that would be double-counting. Boardman et al (2011) show this by categorizing net benefits of projects: one approach focuses on the inputs for production, important for the policy, and relies on estimates of the opportunity cost of those inputs. The other category of approach attempts to measure values for productive outputs, created by the same inputs in the opportunity cost approach, valued by willingness to pay for the policy. Taking care to avoid double-

counting is important even within social cost estimation, alone, because there may be overlap between willingness to pay-based estimates and opportunity cost-based estimates that should be accounted for.

6 Search Models of Labor Market Equilibrium

One potential approach to bringing structure to the estimation of transition costs associated with reallocating labor as a result of a public policy would be to directly estimate the willingness to pay of economic agents to avoid an increased risk of entering an unemployed state within a calibrated structural model of labor markets. This approach would ensure an internally consistent estimate of the transition costs that avoid double counting and other consistency concerns. To illustrate the basic concept we identify the components of a simple partial labor search model (Cahuc and Zylberberg, 2004). While simple, it provides the basic intuition behind the approach and can be expanded using the well-developed literature on such models.

Consider an agent who at any point in time may be either employed, e, or unemployed, u. We assume that the agent's preferences are well represented by the utility function $v(\cdot)$ and that the agent does not have access to financial markets, such that there is no savings of investment. The flow of utility is therefore defined by $v(w)$ if the agent is employed, where w is the wage rate. The agent will continue to earn this wage unless their current job is destroyed, which occurs at the rate q. r is the consumption discount rate, V_u is the agent's expected discounted utility if they were in an unemployed state, and V_e is expected discounted utility if employed. If the agent is in the unemployed state they will be searching for an opportunity to shift into the employed state. The rate at which the agent in the unemployed state is presented with opportunities is λ_u. We can identify x, as the ``reservation wage'' for the agent, and z represents the net opportunity cost of labor for the agent. The opportunity cost of labor for the agent is intended as a comprehensive consumption equivalent net measure including the value of leisure, non-market services (e.g., childcare), pain and suffering, and unemployment insurance payments. The willingness to pay (WTP) of an agent currently in an employed state to avoid shifting to an unemployed state, with certainty, can be defined as the permanent fraction of their wage (as long as they have the job) that the agent would be willing to forgo to avoid a certain

shift to the unemployed state. This value is the one that equates the expected discounted utility in the employed state at the reduced wage with discounted expected utility in the unemployed state,

Of course, the preceding stylistic model would be highly simplified. However, there is a robust literature extending the basic search model to include on-the-job search, heterogeneous agents, and endogenous non-degenerate wage distributions. This literature has also worked to calibrate such models to replicate observed labor market conditions. These more complex and carefully calibrated structural models of labor markets provide one avenues for estimating theoretically and internally consistent WTP values for small changes in the risk of involuntarily entering an unemployed state.

7 Non-market valuation

Can we consider applying standard environmental approaches for non-market benefits valuation to the issue of valuing labor market changes within benefit cost analysis?

A key, known problem in using benefit cost analysis to evaluate environmental policies is that markets do not exist for many of the expected benefits of the policies, for example, improvements in human health and environmental quality. The field of environmental economics has, over time, developed well-established techniques that are commonly used today to value these non-market benefits. For example, EPA's Regulatory Impact Analysis for the Clean Power Plan (EPA 2015) includes estimates of social benefits from reduced incidence of premature mortality and morbidity from exposure to PM2.5 (using revealed preference approaches, including hedonic analysis), among a number of other health and environmental benefits.

EPA's *Guidelines for Preparing Economic Analyses* (EPA 2014) is a reference for analysts conducting benefit cost analysis of environmental policies. The *Guidelines* devotes a large section to valuation of non-market benefits (ch. 7), which describes theoretically preferred measures, reviews relevant literatures, and provides recommendations for best practices in benefit costs analysis for valuing non-market benefits of environmental policy. In measuring benefits, the theoretically preferred measure of social welfare is the sum of all individuals' willingness to pay (WTP) for the policy (or willingnesss to accept), where willingness to pay is the maximum amount an individual would voluntarily pay for the policy to be enacted. In cases where markets do not

exist, willingness to pay for the policy can often be inferred from choices people make in related markets. WTP is a valid measure of "economic value" because it is directly useful for applying the potential Pareto improvement compensation test.

As previously described, two of the difficulties in evaluating labor impacts within a benefit cost analysis framework could be described as "non-market" issues: (1) we cannot observe market wages for unemployed workers, and (2) no market exists for unemployment insurance to fully compensate employed workers for involuntary job loss; the public unemployment insurance system provides temporary, partial income replacement only. There is a literature on the reservation wage, the wage at which unemployed workers would just be willing to accept new employment, (cite old version of Appendix C references), so there is information available in the literature on that measure of opportunity cost for individual unemployed workers. There is also a literature (reviewed above) that attempts to adjust this opportunity cost for individual unemployed workers to reflect social factors potentially relevant for benefit cost analysis, such as externalities, market failures, non-pecuniary effects (health, well-being), and spillovers (effects on family members and local labor markets). Another labor economics literature evaluates the U.S. unemployment insurance system (e.g. Chetty et al, etc) and provides empirical evidence for why there is a missing market for full unemployment insurance (Henden 2015), as well as an estimate of a compensation measure for the cost of unemployment (Hurd 1980).

One area where non-market valuation techniques have been used, directly related to labor markets, is to develop an estimate of the value of a statistical life (VSL), which estimates a monetary value based on small changes in the probability of death for many people. The value of a statistical life used by EPA, currently $7.9 million (in 2008) dollars, is based on a distribution of 26 published VSL estimates (EPA 2014). These studies rely on hedonic models that use variation in wages to estimate a value for a particular characteristic of a job: mortality risk, i.e. risk of death on the job. This approach relies on individual's willingness to accept higher wages in exchange for an increased risk of accidental death. Individual values for risk reductions are then aggregated by the number of potentially affected individuals, leading to a value for the benefit of mortality risk reduction for the proposed policy. Hedonic wage studies have been frequently used in benefit assessments within benefit cost analyses to value fatal risk reductions.

There are a few key assumptions that should be met, for this hedonic approach to work well: (1) mortality risk of jobs should be observed and vary sufficiently in measurable ways, and (2) workers must be able to perceive these differences in mortality risk. Some other cautions are to consider if unobservable factors may affect job choice and risk trade-offs, the sources of risks – jobs may have increased risk of both accidental death and serious, but nonfatal injuries. Another caution is to be careful to avoid double-counting of effects. If a local environmental benefit, e.g. improved air quality, is already reflected in workers' wages, then it can both bias the hedonic estimate of the wage-risk premia as well as be double counted within the benefit cost analysis, if that particular environmental benefit is also estimated directly, using a different valuation technique, e.g. averting behaviors.

Let's consider the possibility of using a similar approach to value labor market impacts within benefit cost analysis. If workers potentially affected by an environmental policy face different probabilities of involuntary job loss due (or job gain, if previously unemployed) to the regulation, could we design hedonic wage studies that might be able to estimate a value for that increase (or decrease, if policy leads to hiring previously unemployed workers) in risk for involuntary job loss? We'd first have to look to the hedonic wage literature and see what components of wage premia have previously been studied, e.g. location premia, risk of on-the-job accidents, and account for all those. In addition, we'd need information that's observable to the workers on risk of involuntary job loss by industry, and possibly by occupation, tenure, education, and other important differences for wages. Given the important heterogeneity of labor, as described in the hedonic wage risk studies as well as this recent literature on the social cost of labor, we'd need detailed information that varies by local labor market, over time, by industry, and worker characteristics, e.g. age, education, skills, etc. We'd have to control for the underlying, baseline rates of involuntary job loss for those categories, as well as specify the incremental change in those probabilities due to the policy. If we're able to estimate those marginal changes in risk, we'd then need to aggregate the individual estimates to the number of workers anticipated to be potentially affected by the policy. Such an approach would, theoretically, provide us with a measure of willingness to pay to avoid a statistical unemployment spell, which could then be included in the benefits portion of a benefit cost analysis.

8 Concluding Remarks

In this paper, we have described and reviewed both the existing, older literature on benefit cost analysis and social transition costs of labor impacts, as well as a new, recent literature re-examining previous work and suggesting new directions and approaches. Importantly, much of this literature relies on empirical approaches, with very little discussion of economic theory and theoretic bases for address welfare measures of these labor impacts within benefit cost analysis of environmental policies. We describe the few theory studies, both on employment impacts of environmental regulation and on labor reallocation and transition within a benefit cost analysis framework, and we consider what they may imply for applied analysis. While in theory, addressing transition and adjustment costs for labor impacts may be important, particularly during periods of high-unemployment, in practice, based on available empirical evidence, it is unclear if the size of those impacts, once valued as social costs or benefits, may be large enough to be considered within benefit cost analysis. The recent empirical literature on social costs of labor impacts focuses on costs for individual workers, which while they can be large in terms of individual earnings, may not be significant costs when aggregated and compared to overall costs of a national, environmental regulation, particularly when the literature has found that overall employment impacts are generally small, in terms of number of affected workers. Additionally, the most recent literature shows a divergence in approaches, ranging from *ad hoc*, rule-of-thumb approaches based on applicable literatures, to econometric estimates, and ranges of estimates for welfare impacts. Some studies focus only on job losses or job gains, not both.

In light of the current state of the literature, we propose two potential approaches, based on established theoretic approaches and empirical work related to benefit cost analysis and labor economics. First, we consider the possibility of adapting labor search models, for unemployment, to address willingness to pay to avoid statistical spells of unemployment, rather than willingness to accept job offers. We find, adapting a simple version of a standard job search model, that the range of implied willingness to pay is similar to the range of estimates for social cost adjustments suggested by the recent literature. Second, we consider the possibility of approaching this

question of valuing employment impacts using a similar approach to that is used for estimating the value of a statistical life. This would be a revealed preference approach, and entail hedonic estimation of a trade-off between earnings and risk of involuntary job loss (or job gain, if previously unemployed). If this approach could account for other components of wage-risk premia, and this job loss risk associated with a policy can be observed, then this approach would measure willingness to pay to avoid that risk, relying on econometric evaluation of detailed labor market information to measure a value, or distribution of values.

Cass Sunstein has called this effort to consider welfare measures of labor market impacts within benefit cost analysis as "frontiers question", which provides a framework to view our initial work on this issue. How useful and compelling might these two potential approaches be, in light of our focus in benefit cost analysis on first-order effects of policies? In future hindsight, we may learn that welfare estimates of labor impacts were actually of second-order importance, implying that developing these approaches may have been unneeded. A similar question and resulting empirical literature may provide a cautionary note: the double-dividend literature hypothesized welfare-improving tax policies that would reduce both tax burdens and environmental pollution at the same time (Just et al, 2004). While the start of the literature reflected somewhat polarized opinions: there would be large welfare gains or none, the resulting empirical work eventually indicated that, overall, there was not much, in terms of welfare gains.

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Table 1 – Literature on Social Cost of Labor

	Include social cost of labor in BCA?	Include only when high unemployment?	Caveats
Standard Approach	No		Assume labor reallocates costlessly w/ full-employment
Haveman & Farrow (2011)	Yes	Yes	But only during periods of high-unemployment (considers only public projects)
EPA's Land Handbook (2011)	Yes	Yes	But only for clean-up or re-use projects that hire previously-unemployed workers in local areas with long-term unemployment
Masur & Posner (2012)	Yes		
Smith, V. Kerry (2012)	Yes	Yes	But need to develop macroeconomic framework to account for business cycles
Bartik (2012)	Yes		Larger net efficiency gains from increased employment in labor markets with involuntary unemployment
Shimer (2013 wp)	Yes	Yes	But only for quantity-based policy instruments (not price-based) and when job search is significantly costly or polluting sector is initially suboptimally large
Haveman & Weimer (2015)	Yes		Even at full-employment, include opportunity cost = earnings, and include search costs
Smith, V. Kerry (2015)	Yes	Yes	BCA normally looks only at equilibria before and after the policy, but needs to expand to consider the transition path
Bartik (2015)	Yes	Yes	Focus on times of high national unemployment and estimate costs in local areas with high unemployment.
Kuminoff, Schoellman, Timmins (2015)	Yes		Also consider margin of adjustment for housing choices. Difficult to model.

Table 2a – Benefit-Cost Analysis standard approach: labor is a social cost

Social Cost – proposed adjustments (individual worker, % of annual earnings)	**Haveman & Farrow (2011)**	**Masur & Posner (2012)**	**Haveman & Weimer (2015)**	**Bartik (2015)**	**Kuminoff, Schoellman & Timmins (2015)**
Avg. annual earnings:	$100	$50,000	$40,000	$60,892	n.a. (assume $50,000)
Job loss					
• **w/ full-employment**					
○ **social cost adjustment**		3% to 10% (max 25%)	1%	5.2% to 9.6%	2.5% to 14%
• **w/ high unemployment**					
○ **social cost adjustment**			173%	19%	5% to 16%
Job gain					
• **w/ full-employment**					
○ **social cost adjustment**	none		14%	5.2% to 9.6%	
• **w/ high unemployment**					
○ **social cost adjustment**	-20%		-75%	19%	

Notes:

- *Masur & Posner:* lifetime costs of unemployment: $35,000, $100,000, or max $260,000. Annual value: divide by 30 years.
- *Haveman & Farrow*: social cost of labor is $80 rather than market wage of $100, based on a single example in the text to illustrate approach.
- *Haveman & Weimer*: calculations based on estimates in Table 4: job loss is counted in BCA as a negative social cost (i.e. social benefit). For example, from Table 4, w/ avg. earnings of $40,000, if full-employment, social cost = $45,600 to hire the previously unemployed worker. If high unemployment, social costs is lower: $9,800 to hire the same worker. Likewise for job loss: w/full-employment, social cost = -$39,600 (a social benefit) if worker becomes unemployed. If high unemployment, social cost is much higher: $29,200 if worker becomes unemployed.
- *Bartik*: Table 2. 3% discount rate, low and high employment values -- range reflects a low estimate based on job reallocation and a high estimate on permanent unemployment. PV for permanent job loss or gain: $129,000 to $328,000; PV for reallocation (even if zero job change nationally): $57,000 $110,000. Reports standard errors.
- *Kuminoff, Schoellman, & Timmins*: avg. annual earnings not reported, but their sample is from the CPS, ages 16+ if ever unemployed between Jan 2002 and Feb 2012. Reports standard errors.

Table 2b – Benefit-Cost Analysis standard approach: labor is a social cost

Social Cost – proposed amounts (individual worker, annual $)	**Haveman & Farrow (2011)**	**Masur & Posner (2012)**	**Haveman & Weimer (2015)**	**Bartik (2015)**	**Kuminoff, Schoellman & Timmins (2015)**
Avg. annual earnings:	$100	$50,000	$40,000	$60,892	n.a. (assume $50,000)
Job loss					
• **w/ full-employment**					
○ **w/ social cost adjustment**		$35,000 to $100,000 (lifetime; $260,000 max) $1,700 to $4,850 (annualized; $12,600 max)	$400 (annual)	$57,000 to $129,000 (PV) $2,700 to $6,200 (annualized)	$1,231 to $7,000 (expected E.V.)
• **w/ high unemployment**			$20,000 (annual)		
○ **w/ social cost adjustment**			$69,200 (annual)	$110,000 to $328,000 (PV) $5,300 to $15,900 (annualized)	$2,492 to $7,949 (expected E.V.)
Job gain					
• **w/ full-employment**					
○ **w/ social cost adjustment**	$100		$5,600 (annual)	Symmetric w/ job loss	
• **w/ high unemployment**			-$20,000 (annual)		
○ **w/ social cost adjustment**	$80		-$30,200 (annual)	Symmetric w/ job loss	

Notes:

- *Masur & Posner:* lifetime costs of unemployment: $35,000, $100,000, or max $260,000. Calculated annualized value: 30 years at a 3% discount rate.
- *Haveman & Farrow*: social cost of labor is $80 rather than market wage of $100, based on a single example in the text to illustrate approach.
- *Haveman & Weimer*: Value of annual compensation, set to be zero w/full-employment, for direct comparisons with other studies. Calculations based on estimates in Table 4: job loss is counted in BCA as a negative social cost (i.e. social benefit). For example, from Table 4, w/ avg. earnings of $40,000, if full-employment, social cost = $45,600 to hire the previously unemployed worker. If high unemployment, social costs is lower: $9,800 to hire the same worker. Likewise for job loss: w/full-employment, social cost = -$39,600 (a social benefit) if worker becomes unemployed. If high unemployment, social cost is much higher: $29,200 if worker becomes unemployed.
- *Bartik*: Table 2. Range: 3% or 7% discount rates. Low value is for job reallocation, high value is for permanent unemployment. Reports standard errors. Calculated annualized value: 30 years at a 3% discount rate.
- *Kuminoff, Schoellman, & Timmins*: expected equivalent variation -- the annual payment to workers to compensate them for their loss. avg. annual earnings not reported, but their sample is from the CPS, ages 16+ if ever unemployed between Jan 2002 and Feb 2012. Reports standard errors.

Table 3 – List of proposed social cost of labor adjustments

Welfare components (Social Costs)	Haveman & Farrow (2011)	Masur & Posner (2012)	Bartik (2012)	Haveman & Weimer (2015)	Bartik (2015)	Kuminoff, Schoellman & Timmins (2015)
Individual / private						
• **Employed → Unemployed**						
Change in value of leisure		√		√	√	
Change in earnings		-$100,000		√	√ (earnings changes are social benefits, but wage changes are transfers)	√
Costs of working		√		√		√
Job search costs		√		√		√
Change in future earnings (scarring effects)		√		√	√	√
Change in mortality risk		-$100,000				
Change in physical & mental health				√	√	
Change in homeownership		√				√
Change in health insurance		√				
Subjective well-being		-$60,000		√	√	
Intrinsic benefits from working		√		√		
• **Unemployed → Employed**				√	√	
Change in value of leisure	√		√	√	√	
Change in earnings			√	√	√	
Costs of working						
Job search costs				√		

Welfare components (Social Costs)	Haveman & Farrow (2011)	Masur & Posner (2012)	Bartik (2012)	Haveman & Weimer (2015)	Bartik (2015)	Kuminoff, Schoellman & Timmins (2015)
Change in future earnings						
Intrinsic benefits from working						
• **Employed → Employed**						
Change in earnings						
Job search costs						
Change in future earnings						
Social						
Unemployment insurance		√				
Job training programs		√				
Make-work programs		√				
Monetary policy		√				
Social opportunity cost = worker's reservation wage	√					
Spillovers to worker's family:				√	√	
- Reducing mental health of spouse				√	√	
- Reducing children's educational attainment				√	√	
- Reducing children's long-run earnings				√	√	
Effect on local unemployment			√		√	
Effect on local labor force participation			√		√	
Heterogeneity						
Demographics (age, sex, region of employment, education and experience)		√				
Layoff type (mass or individual)		√		√		
Industry characteristics (declining vs. booming		√				√
Local labor market unemp > national avg.					√	