Alternatives to Mitigate the Economic Impacts of the McCain-Lieberman Bill

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SYNOPSIS

The Climate Policy Center (CPC) engaged Charles River Associates (CRA) to develop a version of CRA's Multi-Region National (MRN) model that would estimate transitional job impacts as well as long-run equilibrium job impacts. CPC also engaged CRA to use this enhanced version of the model to contrast the economic impacts of the proposed McCain-Lieberman Bill to those of several alternative policy options.

Previous CRA analyses have shown the McCain-Lieberman Bill to be quite costly, even when considering only the one-phase version of the Bill that was introduced to the Senate as S.A. 2028. This bill, however, does not include a couple of interesting possible policy provisions that have the potential to help manage the costs of a carbon policy. Specifically, (1) the McCain-Lieberman Bill has no provision for a "safety valve" to cap carbon permit prices,[1] and (2) it does not provide for any permit auction proceeds to offset erosion of government tax revenues. CRA used the enhanced model to explore how these types of provisions could affect the projected economic impacts of the Bill.

Our analysis demonstrates that:

- A safety valve provision can dramatically lower the cost to consumers of a policy.
- A safety valve provision also can greatly reduce the policy's jobs impacts.
- Even without a safety valve, the cost of the carbon policy can be mitigated significantly by using a portion of carbon permit sales revenues to offset shortfalls in government tax revenues that will be caused by the policy.

ANALYSIS ASSUMPTIONS AND SUMMARY OF QUANTITATIVE RESULTS

The analysis consisted of four scenarios. One scenario was a basic representation of the McCain-Lieberman Bill (S.A. 2028) exactly as written. The other three scenarios were identical to the base scenario, except that each one added some combination of provision for a safety valve (SV) and/or use of carbon permit revenues to just offset government tax

[1] A "safety valve" is a government-guaranteed ceiling on the price of carbon permits under a cap-and-trade system. It is implemented by the government agreeing to sell as many permits at the stated safety valve price that companies may wish to buy. If the marginal cost of meeting the cap in a given year is less than that year's safety valve price, none will be demanded and the cap will be met. If the marginal cost of meeting the cap in a given year exceeds the safety valve price, then the cap will not be met in that year, but economic impacts will be held within pre-established limits.

erosion effects.[2] The specific modifications considered in these three scenarios were, respectively:

1. A SV price is implemented, set in 2010 at \$15/tonne carbon (\$4.10/tonne CO_2) in 2010, and rising by 1% real per year. A sufficient number of the non-SV permits are also auctioned each year to just offset estimated tax erosion effects.

2. A SV price is implemented, set in 2010 at \$20/tonne carbon (\$5.45/tonne CO_2), and rising by 3% real per year. A sufficient number of the non-SV permits are also auctioned each year to just offset estimated tax erosion effects.

3. No SV is implemented, but a sufficient number of the capped permits are auctioned each year to just offset estimated tax erosion effects.

All four of the scenarios were simulated using the same basic assumptions about cap levels, sectors covered by the cap, future expectations of cap levels, and future technology costs. The latter assumptions were identical to those of CRA's "low estimate" of the impacts of the McCain-Lieberman Bill reported in CRA (2004b).[3] Comparison of the results of the base McCain-Lieberman policy scenario to those of CRA (2004b) thus also indicates the implications of having added involuntary unemployment to the simulation.

In the following, all prices and cost estimates are stated in 1999 constant dollars.

Permit Prices. For the two scenarios without a SV, permit prices in 2010 are about \$45/tonne carbon (\$12.27/tonne CO_2), and they rise to about \$120/tonne carbon (\$32.73/tonne CO_2) by 2030. The high prices reflect incentives to bank emissions against yet higher costs in later years, and so emissions are below the cap in the early years.

In both SV cases, the price in 2010 is about \$9/tonne carbon (\$2.45/tonne CO_2). This is the marginal cost to just meet the actual cap in 2010, without any banking, which is not

[2] We did not consider any scenarios where imposition of a carbon cap would be combined with tax reform policies that would generate *an incremental* source of government revenue that could be used to reduce existing income or other taxes. Rather, we have only considered policies that retain just enough of the carbon revenues to "just offset tax-base erosion" (JOTE), thus eliminating the need for the government to have to increase the existing tax rates in order to maintain current levels of services without raising the size of the debt.

[3] Specifically, the cap is applied to CO_2 emissions from all U.S. sectors except agriculture, households, and the non-government portions of the commercial and services sector. The cap is set equal to the year 2000 CO_2 emissions from the covered sectors. This cap is then increased by 15%, which assumes that for the 15% of the McCain-Lieberman cap that may be met through offsets, such offsets may be found for free from uncovered or international sources. The backstop technology costs \$300/tonne carbon (\$81.82/tonne CO_2). Non-CO_2 greenhouse gas emissions are primarily in the non-covered sectors, and these are part of the 15% "free offsets". The small fraction of non-CO_2 greenhouse gas emissions that are in covered sectors are assumed to offset all their projected growth for free. The cap is held constant through all future years. (MRN explicitly simulates the years through 2070, and estimates impacts on an infinite horizon after 2070.)

allowed under a SV policy. In all later years, the SV permits are in demand, and the SV price sets the equilibrium permit price. It thus rises by 2030 to $18/tonne carbon ($4.91/tonne CO_2) in the low SV case, and to $36/tonne carbon ($9.82/tonne CO_2) in the high SV case. With a few complexities that will be noted, the relative magnitudes of these marginal control cost estimates are a fairly good indicator of the relative size of all the other key economic impact metrics that are summarized below.

Fraction of Permit Revenues Needed to Just Offset Tax-base Erosion (JOTE). Each of the three alternative modifications to the McCain-Lieberman Bill entails reserving a portion of the permit pool for auction, for the sole purpose of raising sufficient new government revenues to offset lost revenues from existing tax sources. In the case of no SV, we estimate that about 44% of the permits must be sold through this auction. In the case of the lower SV, about 46% of the capped permits must be auctioned, and about 50% in the higher SV case.[4]

Job Losses. Table 1 and Figure 1 present the total employment impacts for each of the four scenarios, which now directly simulate transitional job losses. (Transitional job losses are explained in a later section of this paper.) Each of the three alternative policies has substantially lower job impacts than the McCain-Lieberman Bill, particularly as time passes.[5] After an initial increase, job impacts level off in the SV cases, whereas they continue to increase under both of the non-SV cases. This reflects the fact that there are larger continuing "shocks" under the non-SV cases as the permit prices escalate more rapidly.

The job impacts estimated for the McCain-Lieberman Bill case (row 4 of Table 1) can be compared to those in CRA (2004b) to see how much the earlier estimates were understated because the model used then did not capture transitional job losses. The model used here estimates 179,000 jobs lost in 2010, and 550,000 jobs lost in 2020. In contrast, the comparable scenario in CRA (2004b) estimated job losses of only 39,000 and 190,000, respectively.

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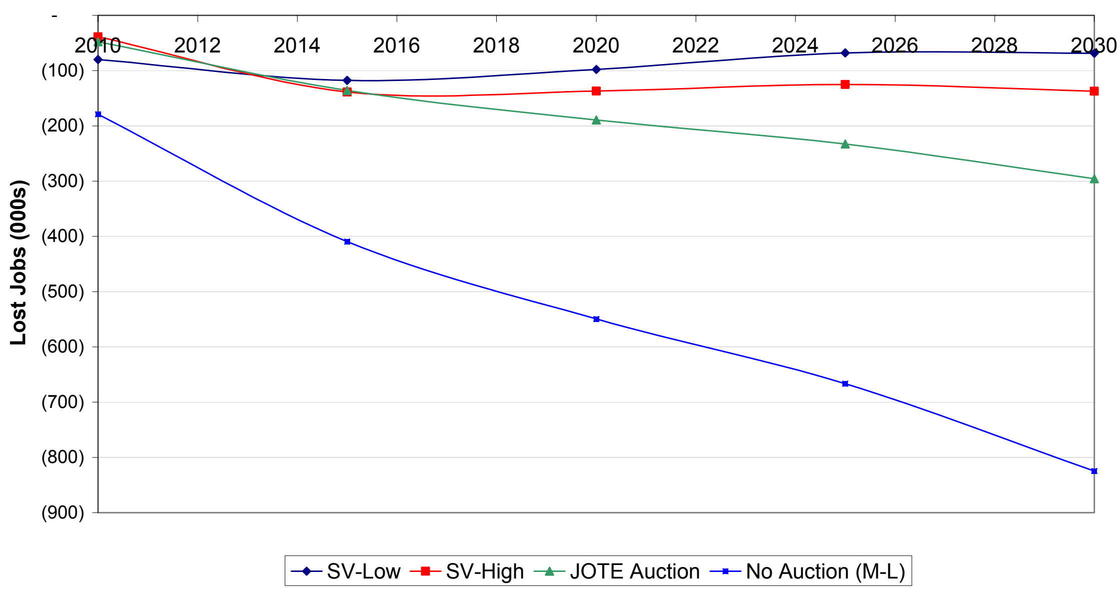
[4] These estimates are based on an equalization of the present value of carbon revenues from the auction to the present value of lost tax revenues, for the years 2010-2049, using a discount rate of 7%. We assume that the fraction of permits auctioned would be the same in each of the years in this time period, rather than attempting to make such equalization occur in each year. If equalization were calculated over the entire model horizon through 2070, the percent necessary to auction would be larger for the no-SV case (54%) and lower for both SV cases (41% and 45% for the lower and higher, respectively).

[5] An exception to this statement is visible in Table 1: the lowest cost case (the lower SV case) has larger job losses in the first year of the policy (2010) than either of the higher cost alternative scenarios. This reflects intertemporal smoothing that consumers make when the costs of a policy will be increasing over time. If costs will be increasing in the future, and real wages falling over time, consumers will be motivated to work harder in the near term in order to save more to maintain higher spending needs in the future. This incentive to work more in the near term implies somewhat less reduction in voluntary employment in the near term for a given reduction in the real wage rate in those years. This effect partially offsets the downward pressure on jobs in the first years of the policy. The lower SV case imposes very little increase in costs over time and little further decrease in real wage rates over time; it thus entails the very little of this offsetting incentive to work more in the initial years of the policy. The net effect is that the loss of jobs is more apparent in the first years of that policy than in the others, but this is reversed later in time.

Table 1. Reduction in Employment (Number of Jobs Lost)

	2010	2015	2020	2025	2030
Cap with Lower Safety Valve	80,000	118,000	98,000	68,000	69,000
Cap with Higher Safety Valve	39,000	139,000	137,000	125,000	138,000
Cap/Auction to Just Offset Tax Erosion	48,000	136,000	190,000	233,000	296,000
Cap/No Auction (M-L Bill)	179,000	409,000	550,000	667,000	825,000

Figure 1. Change in Employment



Consumer Impacts. Another key impact estimate, one that is usually considered the "bottom line" cost of a policy, is the consumer welfare impact. Estimates of this impact are presented in Table 2 and Figure 2. The McCain-Lieberman Bill is about 5 to 10 times more costly than the SV cases. A good part of this cost is traceable to the permit allocation mechanisms in the McCain-Lieberman Bill. The third alternative policy ("Cap/Auction to Just Offset Tax Erosion") would mitigate the tax interaction effects of the Bill by using an auction to raise government revenues in an amount just sufficient to offset the projected present value of tax erosion. Doing so would nearly halve the cost of the McCain-Lieberman Bill as written. Nevertheless, a SV provision provides a much larger cost reduction still.

Changes in consumer welfare are based on changes in consumption plus a monetized estimate of the value of changes in leisure. Thus, the consumer welfare impact treats some of the unemployment (the voluntary component) as a benefit of the policy. The actual financial impact to spending that would be observed in the economy, however, would not include this welfare-enhancing leisure component. For this reason, it is also interesting to understand the impact to consumer spending, or consumption, in each year. Table 3 provides those results.

Table 2. Change in Consumer Welfare ($/household per year)

	2010	2015	2020	2025	2030
Cap with Lower Safety Valve	$ (17)	$ (34)	$ (53)	$ (71)	$ (76)
Cap with Higher Safety Valve	$ (43)	$ (62)	$ (93)	$ (121)	$ (138)
Cap/Auction to Just Offset Tax Erosion	$ (129)	$ (193)	$ (258)	$ (333)	$ (403)
Cap/No Auction (M-L Bill)	$ (240)	$ (331)	$ (422)	$ (522)	$ (616)

Figure 2. Change in Consumer Welfare ($/household per year)

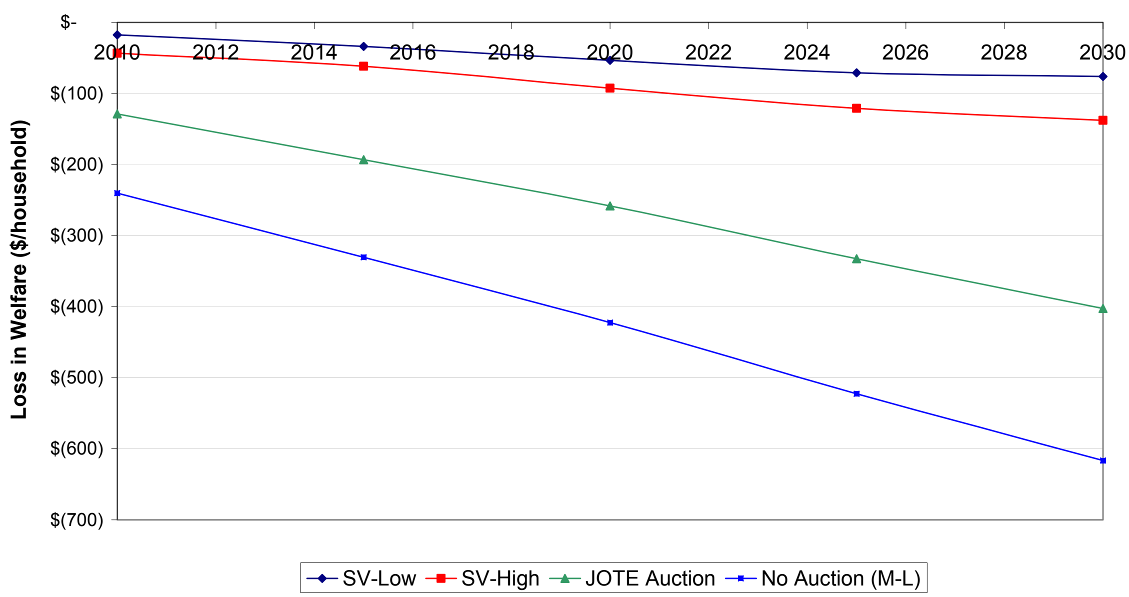


Table 3. Changes in Consumer Spending ($/household per year)

	2010	2015	2020	2025	2030
Cap with Lower Safety Valve	$ (37)	$ (70)	$ (96)	$ (114)	$ (123)
Cap with Higher Safety Valve	$ (64)	$ (111)	$ (158)	$ (197)	$ (228)
Cap/Auction to Just Offset Tax Erosion	$ (177)	$ (284)	$ (389)	$ (507)	$ (628)
Cap/No Auction (M-L Bill)	$ (347)	$ (523)	$ (697)	$ (885)	$(1,084)

GDP. GDP is an impact measure of significant interest to policy makers. Impacts to GDP can be confusing, however, and it is not a robust indicator of costs to the economy. This is because GDP includes not just changes in consumption (i.e., consumer spending), but also adds in changes in investment. Regardless of whether a dollar invested will enhance economic outcomes in future years, it is a "cost" to the consumer during the year that it is invested. Nevertheless, that dollar of investment has a positive effect on GDP in the year that it is invested. Thus, the estimate of GDP in any one year will not reflect the "belt tightening" felt by the consumer, especially if there is a significant investment in that year (i.e., less consumption). Nevertheless, many models (such as EIA's) only produce GDP impact estimates, and not the direct measure of consumption loss. Thus, we also provide estimates of GDP impacts in Table 4.

An anomalous result appears in Table 4, where the two higher cost scenarios (the cases with no SV) are projected to have increased GDP in the first years of the policy. This seemingly counterintuitive result is caused by the fact that these two cases require a large spike of investments in 2010, which must be made in order to make a substantial sudden emissions reduction when the cap is first introduced. As noted above, investment is a "positive" in the GDP formula, and in these two scenarios it is large enough in 2010 to offset the large reductions in consumer spending that were apparent for those same cases in Table 3. After the initial spike to adjust carbon emissions to a suddenly lower level in 2010, the remaining investment increases are spread out more evenly over time, and the underlying losses in consumption become apparent as decreases in GDP from 2015 onwards. The SV cases have a smaller and more gradual impact on emissions, and so they entail far less of a spike in investment in 2010. Thus, even though the SV cases have a much smaller impact on consumption in 2010, those consumption reductions dominate the direction of the GDP impact even in 2010.

Table 4. GDP Impacts (as a percent relative to no GHG policy)

	2010	2015	2020	2025	2030
Cap with Lower Safety Valve	-0.07%	-0.12%	-0.14%	-0.13%	-0.12%
Cap with Higher Safety Valve	-0.05%	-0.15%	-0.20%	-0.23%	-0.24%
Cap/Auction to Just Offset Tax Erosion	0.07%	-0.11%	-0.26%	-0.38%	-0.47%
Cap/No Auction (M-L Bill)	0.02%	-0.27%	-0.48%	-0.67%	-0.82%

Carbon Emissions. One implication of a SV policy is that emissions may not come down to the level of the cap. In these scenarios, cumulative emissions through 2070 are 153 billion metric tonnes of carbon in the lower SV case, 138 billion metric tonnes of carbon in the higher SV case, and 115 billion metric tonnes of carbon in to two cases without a SV.

DISCUSSION OF CONTEXT AND MOTIVATION FOR THIS ANALYSIS

The McCain-Lieberman Bill (S.139) was first proposed in February 2003 as a cap-and-trade program to start to reduce U.S. greenhouse gas emissions. In its initial form it had two phases, with the first phase of the cap, from 2010-2015, being set at 2000 levels. In the second phase, starting in 2016, the cap was to be reduced to 1990 emissions levels. Cost analyses of this initial version of the Bill were prepared by CRA using its MRN model. Like other analyses by EIA (2003) and MIT (2003), the MRN model projected substantial impacts to the economy and to consumers.

In October 2003, Sens. McCain and Lieberman introduced an amendment to S.139, S.A. 2028, that eliminated the second phase of the cap, although their expressed intention was that the cap would eventually be reduced through later legislation. In other words, the cap under S.A. 2028 was intended as just a "first step" towards deeper emissions cuts, although the Senate was being asked to vote on only on the level and timing of the initial introduction of a cap-and-trade.

CRA released a report on the estimated economic impacts of the original two-phase and of the amended one-phase version of legislation (CRA, 2003), again based on the MRN model. CRA (2003) explained how expectations of the future evolution of the cap and of future technology outcomes, could dramatically alter even the near-term impacts of a greenhouse gas cap.[6] CRA's report provided a range of impact estimates based on multiple scenarios that reflected alternative realistic assumptions about how affected parties might anticipate the cap to evolve after an enactment of Phase I. The scenarios also reflected a range of assumptions about the degree to which enactment of Phase I might induce improvement in the costs of technologies that can reduce greenhouse gas emissions. (In June 2004, CRA released updated estimates of the impacts of the McCain-Lieberman Bill (CRA, 2004b). The national level impacts in this analysis were substantially the same as those in CRA (2003), and its main new contribution was that it estimated economic impacts for individual states.[7])

[6] At the time, the only other analysis of the costs of a Phase I only version of the Bill were in MIT (2003). MIT's cost estimates were much lower than even the low-end of CRA's cost range. CRA explained that MIT's much lower estimates could be traced to two key limitations of MIT's EPPA model: its recursive formulation (which meant that the model could not capture the impact of different expectations about the future evolution of the cap beyond 2020), and its lack of representation of policy interactions with and distortions from income and other taxes.

[7] The MRN model used in CRA (2004b) had also been updated by recalibrating it to the 2004 energy price and demand forecasts of EIA, known as the *Annual Energy Outlook* ("AEO 2004"). The 2003 impacts estimates had been based on a model calibrated to "AEO 2001". Additionally, CRA had altered the MRN model's labor supply logic to allow for time-variation in labor supply elasticity. The purpose of this was to approximate transitional unemployment impacts, which were not represented at all in the 2003 version of the model. The current analysis funded by CPC drops the time-varying labor supply elasticities in favor of a direct simulation of involuntary unemployment. It does, however, use the same scenario specifications for the "low estimate" of S.A. 2028 reported in CRA (2004b), which estimated 39,000 jobs lost nationally in 2010, and 190,000 jobs lost in 2020.

Throughout the period when the McCain-Lieberman Bill was being discussed, various groups were advocating the use of a safety valve. Sponsored by the Climate Policy Center, CRA also prepared estimates of how a SV provision would affect the economic impacts of the McCain-Lieberman Bill (CRA, 2004a). In all other ways, the analysis methods and model were identical to those of CRA (2003). Two alternative SV price assumptions were analyzed, including one that allowed gradual escalation of the SV price, and one where the SV price was held constant (both starting at $15/tonne C). This analysis showed that the costs of the McCain-Lieberman Bill (i.e., without any SV) were substantially greater than those estimated for either SV case.

The MRN model that was used for all the preceding analyses captured only long-term or equilibrium job impacts. That is, the MRN model only estimated the voluntary decisions of workers to supply labor in response to the equilibrium real wage rate.[8] In the real world, job impacts in the near-term can be much larger than those associated with the new equilibrium level that is created by a policy. Most of the job losses (or gains) that are observed in response to a new policy or other type of economic shock are of the near-term sort, and are associated with the transition between the old and new equilibria. These transitional job losses are created as the economy shifts its focus of economic activity from one type of productive activity to a new one. For example, in the case of a carbon cap, there will be large reductions in jobs associated with production processes that generate large amounts of carbon emissions, and there will be largely offsetting increases in jobs associated with production that is less carbon-intensive.

Thus, the net effect of a new policy on total jobs may be small, but the total jobs that must be shed and filled may be very large. During the initial phase of the policy, there may be many involuntarily laid-off workers who are seeking but have not yet found one of the new positions, which may exist in a different sector or region of the country. Sometimes workers will need to be retrained before they may be able to be matched with one of the new job openings. Once the transition period is over, there will be a permanent change in the number of jobs in the market place, but these changes tend to be much smaller and less observable. The permanent change will also reflect primarily voluntary labor supply choices, and thus have less implication for lost consumer welfare. The transition period can take up to several years if the types of new jobs require substantially different skills than those of the jobs that are being eliminated as a result of the policy.

As noted, the economic impacts estimated by CRA (2003, 2004a, 2004b) included only the permanent and voluntary forms of employment impacts. However, policy makers

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[8] The choice of how much to work in such general equilibrium models is based on maximization of personal utility. In MRN, individuals obtain utility from consumption (which is enabled by working more and hence earning more) and also from leisure (i.e., time spent not working). The equilibrium amount of labor supplied reflects a balancing of the marginal benefit from somewhat more consumption against the marginal benefit from somewhat more leisure time. If the real wage rate falls, then workers will gain less benefit from each hour of extra work. Since the value of leisure will not be affected by the change in the real wage rate, there will be a voluntary reduction in the number of hours worked, in order to move to the new point of balance in this "labor-leisure tradeoff." The parameters of this utility function are calibrated to reflect observed labor supply responses in U.S. jobs market.

tend to be far more concerned with the magnitude of a policy's transitional, involuntary employment impacts. For this reason, CPC funded CRA to incorporate logic into the MRN model that would estimate transitional/involuntary as well as permanent/voluntary unemployment impacts, and to prepare an updated comparison of the economic impacts of the McCain-Lieberman Bill versus alternative SV measures. The results presented above include both types of job losses. The remaining section of this paper documents the method used to simulate transitional unemployment in the enhanced MRN model.

METHODOLOGY FOR ESTIMATING INVOLUNTARY UNEMPLOYMENT IMPACTS

The effort to incorporate simulation of involuntary unemployment into MRN started with the national version of MRN that was used in CRA (2003) and CRA (2004a). Into this basic model, we added logic that reflects the dynamics of "job matching", which is one way to capture the transitional job losses associated with a mass shift of jobs to reach a new equilibrium with a smaller *net* job change. The *net* job change in the new equilibrium is the new level of voluntary unemployment, while the transitional unemployment is the involuntary unemployment.

Balistreri (2002) described a formal method for operationalizing a representation of the transitional aspects of job losses within the standard computable general equilibrium framework of MRN. The method is based on a formal theory of equilibrium unemployment originally developed by Pissarides (1990). Fundamentally, the method starts with recognition that finding a job has a cost due, for example, to search time before a job seeker can be "matched" with an appropriate vacancy. Further, the more people who are looking for a job at the same time, for a fixed number of available vacancies, the greater the average cost of the search for each individual. This latter effect (called an "externality") causes labor demand to contract when a greater number of people are searching for work at the same time.

Balistreri showed analytically and numerically that when real world phenomena are added to the formulation, such as the fact that some workers hold onto their jobs while others must search, and that there are dynamic adjustments of capital investments to policy shocks, then transitional unemployment can be quite large relative to the new equilibrium that will ultimately be achieved. These larger-than-equilibrium swings in short-term unemployment levels are consistent with empirical observations of business cycle employment patterns.

Balistreri also demonstrated an application of this formulation of involuntary unemployment to climate change policy impacts using an earlier version of the MRN model. The equations used, as well as sensitivity to parameterization, were documented in the paper. In this effort, CRA incorporated the same equations into the more up-to-date version of MRN that had already been used for analyses of the McCain-Lieberman Bill, which stretches its horizon to 2070, and includes distortions from existing taxes and associated tax interaction effects.

The current effort made one additional enhancement to the original formulation of Balistreri (2002). In terms of the objective function of MRN, voluntary job losses provide a welfare benefit in the form of increased leisure that partially (but not completely) offsets lost welfare due to reduced spending power. However, in the present implementation, the new component of employment loss, or the *involuntary* unemployment, provides no welfare benefit. One might argue that involuntary unemployment would have a negative impact on utility, due to its implications for stress and emotional distress. However, lacking an obvious method for monetizing the disutility of being laid off, and of being out of work when one would prefer to be working, we treated involuntary unemployment as having neutral welfare impact.[9] We deemed this preferable to treating such employment disruptions as if they were welfare-increasing leisure time.

In summary, the economic costs produced by the enhanced MRN model used for the current analysis do not include any welfare disbenefits to reflect the personal stress and distress of being suddenly and involuntarily unemployed. The only way that the newly added estimates of transitional job losses affect the other economic impacts and costs of a scenario is that overall economic output is reduced when there are fewer people employed.

Balistreri's paper demonstrated that while the patterns of transitional unemployment are qualitatively robust, specific numerical estimates are sensitive to choices of several parameters. Table 5 shows the range of values assessed by Balistreri, and the specific values used in the current analysis. Our parameters were selected to adhere as much as possible to the ranges considered in the original paper. The single parameter setting that is outside of the ranges explored by Balistreri is leisure's share of utility. A lower setting was necessary to obtain a solution to the dynamic optimization of the model.

Table 5. Involuntary Unemployment Parameters Used in Analysis

Parameter	**Range in Balistreri (2002)**	**Value Used in This Analysis**
Leisure's share of utility for a given time period	25%-75%	16.9%
Elasticity of substitution between leisure and consumption	.25 – 1.5	.7
Elasticity of employment in externality	.30- .90	.85
Elasticity of unemployment in externality	.01 - .10	.01
Initial share of matched workers	0% - 100%	95%
Turnover rate of matched workers	2% - 10%	2%

[9] This is equivalent to assuming that the time spent in job search that is equivalent to labor, and is not leisure time.

Clearly alternative parameter values could generate different specific numerical values for the estimates of involuntary unemployment. However, it is important to acknowledge Balistreri's conclusion that implementation of a theoretically-based estimation of involuntary unemployment in dynamic computable general equilibrium models (which typically only assess the long-run equilibrium employment impacts) is far more appealing than the traditional use of an econometrically-based forecasting model. "The credibility of a study that quantifies transitional unemployment is improved if the results are readily traceable to particular assumptions."[10] The current analysis reported here provides the elements for such enhanced credibility in its estimates of transitional job loss.

[10] Balistreri (2002), p. 364.

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