Chapter 7. The role of the consumption-leisure tradeoff in simulation outcomes

Many of the models currently employed in climate change analysis focus on maximizing household welfare as a driving force underlying the time path of consumption and labor supply. In IGEM household welfare depends on "full consumption" which comprises goods, services *and* leisure. Welfare is specified in a manner that allows the substitution of goods and services for leisure and generates labor supply (see also, Goulder (1994)). An equally common specification is a narrower household welfare measure that depends only on the consumption of goods and services (for example, Nordhaus (1994) and Babiker et al. (2001)).

As demonstrated in our Pew Center report on substitution (Jorgenson et al., 2000), the parameter governing the allocation of full consumption between the demand for goods and services and the demand for leisure is an important factor in model outcomes. We showed that making the consumption-leisure choice less elastic substantially reduced the economic costs of mitigation policy. The GDP and investment effects were more than halved and the impacts on household welfare, consumption and leisure were all but eliminated. In addition, rigidity in the desired consumption-leisure tradeoff removed any possibility of a "double dividend" from the more economically beneficial recycling of permit revenues.

That this parameter plays so dominant a role is not surprising. Since there is a fixed amount of discretionary time to allocate between work and leisure, household choices concerning leisure demand simultaneously determine labor supply and, hence, labor income. In IGEM, as in most CGE models, labor supply is the complement of leisure demand and there is no unemployment gap between the hours offered by households and those demanded by employers. Also, for a given national income, decisions on how much to consume determine the household and business saving that funds private investment. Investment adds to the capital stock which, in turn, is the source of capital income. From these considerations, it is evident that this single decision influences the entire supply side of the economy.

The practice of adopting parameters from the empirical literature is the norm in constructing CGE models (e.g., Ross et al., 2008). For labor supply, this poses a significant aggregation problem (Fullerton and Metcalf, 2001). Many studies focus their attention on the labor supply decisions of various demographic cohorts (defined by sex, age, race, occupation, industry, etc.) who already are employed. The goal here is to ascertain a willingness to supply

additional hours in response to changes in real wages. Unfortunately, these studies do not simultaneously consider labor force participation, a topic with an equally broad and diverse literature.

Developing a single parameter for a representative household requires aggregating both within and across two very distinct sets of literature. RTI and Fullerton and Metcalf reference Russek (1996), who attempts just such an aggregation. Piecing together the details of the Russek article, Fullerton and Metcalf reveal a possible range of 0.1 to 0.6 for the compensated elasticity of labor supply. A consumption-leisure parameter leading to a labor supply elasticity that falls within this range is common among CGE models. For example, the ADAGE model of RTI uses 0.35 as its estimate of the compensated labor supply elasticity (Ross et al., 2008).

The consumption-leisure parameter is part of IGEM's comprehensive model of household behavior and is estimated econometrically from long-run historical data. Over various vintages of the model, estimation has yielded higher elasticity figures than those obtained from aggregation schemes. The disparities between IGEM and other top-down estimates of labor's responsiveness and those from bottom-up aggregations have yet to be reconciled in the literature. More relevant to this effort is the fact that IGEM's more elastic labor-leisure response is a driving force underlying the economic costs of GHG abatement.

The time-varying compensated elasticities of labor supply computed in IGEM simulations typically range from just over 0.8 to just under 1.0. This is more elastic than the bottom-up estimates adopted for other models but is still inelastic. To see the impact of this parameter, three additional simulations are performed for the analysis of Chapter 5. First, the parameter affecting the consumption-leisure tradeoff is set to yield a compensated elasticity of labor supply that averages around 0.3 over the period of simulation. A new base case then is created and proportionally identical policy runs are analyzed for the two cases involving 15% limits on offsets.

Not unexpectedly, making consumption and leisure less elastic, leading to decreases in the responsiveness of labor supply from 0.8 to 0.3, substantially reduces the economic costs associated with cap-and-trade policies. Figure 7.1 compares the impacts on GDP of more and less responsiveness. Table 7.1 also compares the impacts on consumption, capital formation, labor supply and leisure demand. In each case, the consequences for the economy are

substantially smaller when household substitutions between consumption and leisure are reduced. With less elastic consumption-leisure substitution, the longer run impacts on GDP and capital are only 70 to 75% as large as with more elastic demands. Labor and leisure effects are just over 50% as large and the consumption impact is less than 30% as large.

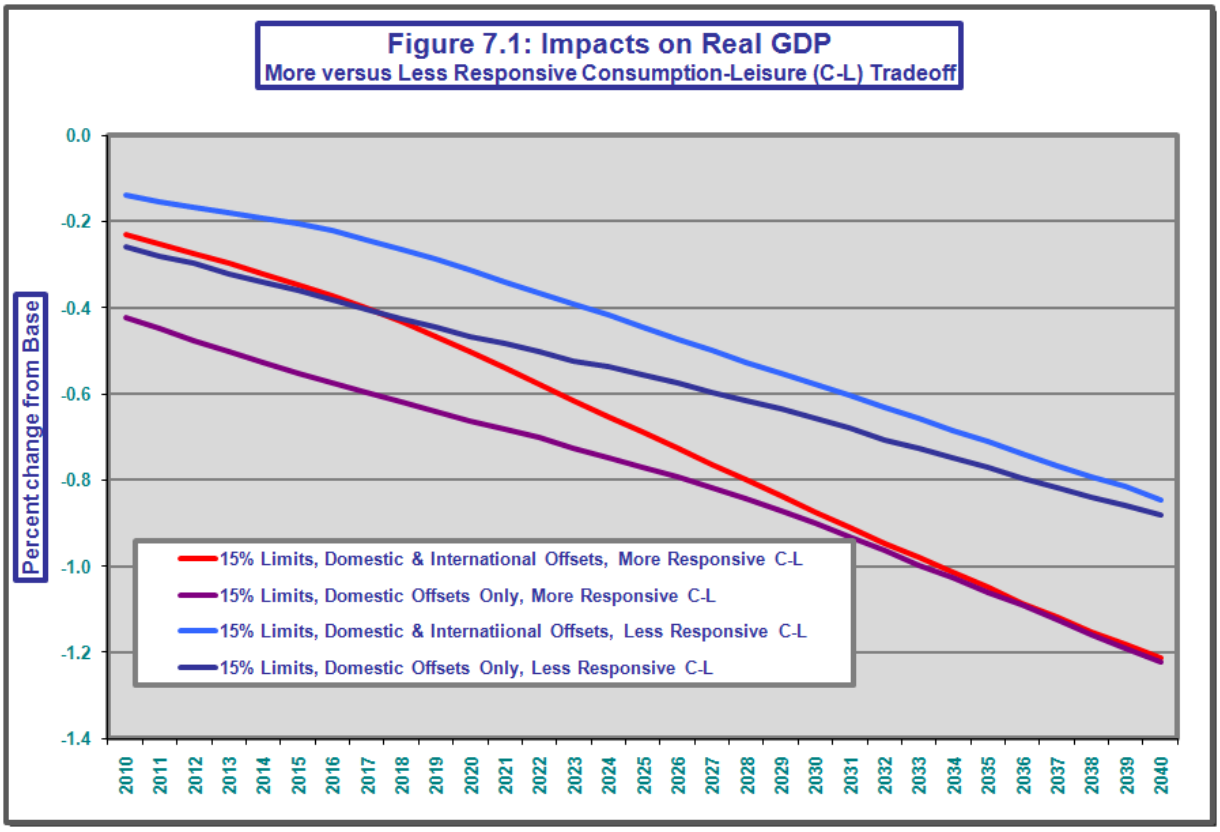

Table 7.1: Price Responsiveness in Household Consumption-Leisure Decisions 15% Limit on Alternative Compliance Options				
	More Responsive (IGEM as estimated)		Less Responsive (IGEM constrained)	
	With International	Domestic Only	With International	Domestic Only
Real Consumption				
2010-2025	-0.10%	-0.19%	0.00%	-0.02%
2025-2040	-0.36%	-0.40%	-0.07%	-0.12%
Capital Stock				
2010-2025	-0.47%	-0.67%	-0.30%	-0.47%
2025-2040	-1.10%	-1.15%	-0.78%	-0.90%
Labor Demand (Labor Supply)				
2010-2025	-0.36%	-0.46%	-0.20%	-0.30%
2025-2040	-0.67%	-0.67%	-0.38%	-0.35%
Leisure Demand				
2010-2025	0.12%	0.15%	0.06%	0.09%
2025-2040	0.22%	0.22%	0.12%	0.11%

An identical experiment with more recent estimates for household behavior and a more timely and aggressive policy initiative yields similar results. We generated two additional scenarios in our analysis of the Lieberman-Warner Climate Security Act of 2008 (S.3036). The first of these was a new base case in which the consumption-leisure trade-off was adjusted to achieve a reduction of approximately 50% (1.03 to 0.48) in the average compensated elasticity of labor supply, 2007-2050. We then introduced the S.3036 core assumptions into IGEM creating a constrained S.3036 policy case.

The macroeconomic consequences of S.3036 from IGEM as estimated and constrained are shown in Table 7.2. The striking feature of these results is that this parametric change has significant differential impacts on consumption, leisure demand and labor supply – virtually halving them – but yields generally much smaller differences in real GDP and the other components of final demand.

Table 7.2: S.3036 Core Analysis							
Percent change from Base							
Consumption-leisure tradeoff as estimated							
Average compensated labor supply elasticity, 2007-2050 = 1.03							
	2007	**2010**	**2012**	**2020**	**2030**	**2040**	**2050**
Quantities							
Real GDP	-0.20%	-0.37%	-0.61%	-0.94%	-1.40%	-2.01%	-2.77%
Consumption	0.20%	0.15%	0.10%	-0.22%	-0.50%	-0.71%	-1.05%
Investment	-1.09%	-1.64%	-1.70%	-2.02%	-2.55%	-3.53%	-4.60%
Government	0.05%	0.05%	-0.15%	-0.28%	-0.46%	-0.68%	-1.00%
Exports	-0.51%	-0.72%	-2.02%	-2.31%	-2.91%	-3.98%	-5.22%
Imports	0.16%	0.14%	0.22%	-0.12%	-0.27%	-0.32%	-0.44%
Capital Stock	0.00%	-0.22%	-0.40%	-0.95%	-1.55%	-2.19%	-3.08%
Labor Demand (=Supply)	-0.30%	-0.41%	-0.63%	-0.65%	-0.74%	-0.95%	-1.20%
Leisure Demand	0.10%	0.13%	0.20%	0.21%	0.25%	0.32%	0.41%
Full Consumption	0.13%	0.14%	0.17%	0.07%	0.01%	-0.01%	-0.06%
Composite of Consumption & Leisure							
Prices							
Consumption	-0.10%	-0.01%	0.11%	0.44%	0.77%	1.06%	1.52%
Investment	-0.14%	-0.14%	-0.07%	0.13%	0.33%	0.51%	0.83%
Consumption-leisure tradeoff constrained							
Average compensated labor supply elasticity, 2007-2050 = 0.48							
	2007	**2010**	**2012**	**2020**	**2030**	**2040**	**2050**
Quantities							
Real GDP	-0.16%	-0.30%	-0.51%	-0.73%	-1.11%	-1.62%	-2.23%
Consumption	0.14%	0.12%	0.11%	-0.09%	-0.23%	-0.35%	-0.53%
Investment	-0.88%	-1.37%	-1.48%	-1.64%	-2.19%	-2.98%	-3.78%
Government	0.03%	0.03%	-0.18%	-0.33%	-0.52%	-0.76%	-1.10%
Exports	-0.41%	-0.57%	-1.78%	-2.03%	-2.65%	-3.66%	-4.84%
Imports	0.08%	0.07%	0.11%	-0.13%	-0.22%	-0.21%	-0.22%
Capital Stock	0.00%	-0.19%	-0.34%	-0.81%	-1.29%	-1.83%	-2.54%
Labor Demand (=Supply)	-0.25%	-0.32%	-0.49%	-0.41%	-0.44%	-0.53%	-0.59%
Leisure Demand	0.10%	0.12%	0.18%	0.14%	0.14%	0.16%	0.17%
Full Consumption	0.12%	0.12%	0.16%	0.06%	0.02%	0.00%	-0.04%
Composite of Consumption & Leisure							
Prices							
Consumption	-0.09%	0.00%	0.15%	0.51%	0.84%	1.17%	1.68%
Investment	-0.11%	-0.10%	0.00%	0.20%	0.39%	0.58%	0.91%

While changes in the trade-off between consumption and leisure have strong macroeconomic implications, they do not materially alter the effectiveness of climate change policy. Table 7.3 shows the impacts on industry prices and quantities from S.3036 in a representative year, 2030. In comparing IGEM as estimated and constrained, there are only minor differences in the changes for the key emissions-generating sectors – coal, oil and gas, electricity, chemicals, and primary metals – and for the other industries as well. The benefits and costs of climate policy thus appear to be separable. The benefits are dominated by the within-period substitutions and restructuring while the costs are dominated by supply-side forces related to capital and labor availability and, to a lesser extent, endogenous technical change. The policy benefit-cost proposition changes not because emissions reductions and avoided damages change but because we altered by assumption the magnitude of their macroeconomic consequences.

Table 7.3: S.3036 Core Analysis					
Percent change from Base					
Consumption-leisure tradeoff:	**As estimated**			**Constrained**	
2030	**Industry Price**	**Industry Output**		**Industry Price**	**Industry Output**
Agriculture, forestry, fisheries	-0.28%	2.68%		-0.23%	2.97%
Metal mining	0.48%	-3.65%		0.54%	-3.33%
Coal mining	100.20%	-41.87%		100.09%	-41.66%
Crude oil and gas extraction	-3.25%	-4.73%		-3.11%	-4.65%
Non-metallic mineral mining	2.84%	-3.74%		2.89%	-3.47%
Construction	0.48%	-1.78%		0.51%	-1.51%
Food and kindred products	0.44%	2.85%		0.47%	3.14%
Tobacco manufactures	0.40%	4.65%		0.46%	4.89%
Textile mill products	0.89%	-3.22%		0.93%	-2.85%
Apparel and other textile products	0.43%	-1.27%		0.47%	-0.95%
Lumber and wood products	0.61%	-3.10%		0.66%	-2.82%
Furniture and fixtures	0.48%	-2.22%		0.52%	-1.94%
Paper and allied products	1.18%	-2.42%		1.21%	-2.09%
Printing and publishing	0.37%	-1.07%		0.39%	-0.72%
Chemicals and allied products	1.36%	-3.65%		1.42%	-3.35%
Petroleum refining	8.72%	-10.30%		8.91%	-10.22%
Rubber and plastic products	1.00%	-3.05%		1.05%	-2.68%
Leather and leather products	0.16%	-1.69%		0.22%	-1.32%
Stone, clay and glass products	0.08%	-2.09%		0.13%	-1.80%
Primary metals	1.92%	-5.16%		2.00%	-4.83%
Fabricated metal products	0.64%	-3.16%		0.68%	-2.85%
Non-electrical machinery	0.24%	-2.94%		0.29%	-2.61%
Electrical machinery	0.29%	-2.77%		0.35%	-2.45%
Motor vehicles	0.33%	-2.72%		0.39%	-2.37%
Other transportation equipment	0.28%	-1.71%		0.32%	-1.53%
Instruments	0.15%	-1.64%		0.17%	-1.32%
Miscellaneous manufacturing	0.45%	-1.81%		0.52%	-1.45%
Transportation and warehousing	0.96%	-2.22%		0.99%	-1.96%
Communications	0.19%	-0.16%		0.24%	0.18%
Electric utilities (services)	9.36%	-8.78%		9.39%	-8.65%
Gas utilities (services)	9.17%	-10.00%		9.29%	-9.83%
Wholesale and retail trade	1.28%	-1.79%		1.31%	-1.45%
Finance, insurance and real estate	0.27%	-0.41%		0.30%	-0.08%
Personal and business services	0.31%	-0.21%		0.33%	0.15%
Government enterprises	0.84%	-1.10%		0.88%	-0.76%

Equivalent variations in full consumption and consumption are the traditional measures of economic welfare in CGE models. When IGEM is simulated with the estimated elasticity of substitution between consumption and leisure, S.3036 results in a welfare loss of 0.06% of full wealth or lifetime full consumption. and 1.01% of full expenditure of lifetime consumption. When consumption and leisure are made less elastic, the welfare losses are reduced to 0.03% and 0.48%, respectively. These are dramatic effects from a single parameter with, unfortunately, little or no basis for selection beyond expert opinions.

A new econometric model, rich in demographic detail, by Jorgenson and Slesnick (2008) involves four top-tier components of household full consumption – non-durables, capital services, consumer services and leisure. The compensated elasticity of labor supply derived from these estimates is around 0.7 and the uncompensated elasticity of labor supply is close to zero. Given the nature and magnitude of inter-temporal substitutions, these new results support the more elastic results from IGEM over the calibrated assumptions employed in other models.