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The Effect of CO_2 Pricing on Conventional and Non-Conventional Oil Supply and Demand

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This paper describes a simple probabilistic model for estimating the effect of CO_2 pricing (in this case a CO_2 tax, set at the social cost of CO_2) on oil supply and demand. The competitive price of oil over time is calculated within a Hotelling framework and is derived from the costs of producing non-conventional oil from Canadian oil sands, a substitute for conventional oil. As non-conventional oil is defined as a backstop for conventional oil, the model identifies the time of entry of non-conventional oil in the market as the time when conventional oil production alone is unable to match demand, and determines the competitive price of oil over time. The model describes the behaviour of the oil market under perfect competition, with and without a CO_2 price reflecting its social cost. The social cost of CO_2 emissions associated with the production and use of conventional and synthetic crude oil is included in the model calculations, and this paper investigates the effect of a CO_2 tax set at the social cost of CO_2 on oil prices and demand. Numerical modelling is used and a model is introduced that draws on the user's degree of belief about a series of parameters as an input. A probability distribution is assigned to these parameters. The uncertainty associated with the validity of the input data is looked at, together with the influence of each parameter on the output.

The results show that a tax on CO_2 emissions associated with fuel use would reduce demand and delay the time when conventional oil supply is unable to satisfy demand. Despite the effect of the lower rent, a CO_2 tax on fuel use would reduce demand for oil: between 81% and 99% of the CO_2 tax would be added to the oil price. Oil prices seen by countries that would remain outside an international agreement would thus be 1 to 19%

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lower than without the tax. However, a CO_2 tax enforced worldwide would still reduce oil demand and production, hence CO_2 emissions from oil production and use.

With a CO_2 tax on fuel production and not on fuel use, conventional oil supply alone is expected to be unable to match oil demand between 2012 and 2030 (90% confidence interval), with a mean value of 2019. A CO_2 tax on fuel use set at the social cost of CO_2 would delay the time when conventional oil production is unable to meet oil demand from 2019 to 2044 (mean value). With a CO_2 tax on use, the results show a 90% chance that conventional oil supply alone will be unable to meet demand between 2018 and 2090. The results show that this date is very sensitive to the price elasticity of demand and the demand growth rate: these results reveal the great potential of demand-side measures to smooth the transition to low-carbon liquid fuel alternatives.

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