Yesterday's post discussed economic growth and how it relates in principle to carbon emissions. Basically, economic growth just means that people will be getting goods and services they prefer over today's goods and service. There's no intrinsic reason why the "better" bundle necessarily has to involve more carbon. In fact, it could involve a lot less carbon. But getting there requires either reducing the carbon intensity of energy production, the energy intensity of production processes, or the relative mix of high-energy and low-energy goods and services.

All that's very abstract. I want to try to make this more concrete by talking about how growth might relate to a carbon fee-plus-dividend scheme. Let's just pretend that the only carbon emissions are from cars and that we implemented a gas tax plus dividend arrangement. What effect would that have on growth?

Let's focus on the average consumer — call her Mary — and how this scheme affects her. We can think about two scenarios. In one, Mary's demand for gasoline is completely fixed. Basically, she has to drive a certain amount no matter what with the car she has now, and she'll pay whatever it takes to buy the gasoline. In this situation, the tax-and-dividend scheme has no effect at all. The price of gas has gone up, but she buys the same amount, paying the gas tax and then getting the money back as a dividend. The only effect of the scheme is to cycle money between her and the government. There's no effect on growth. The average consumer is left unaffected (but so is the level of emissions).

In this first scenario, the only way to cut gasoline use is rationing. That leaves Mary much worse off in terms of goods and services since she wants gasoline badly and can't get it. So from Mary's point of view, this is a fairly grim scenario in terms of consumption, where she's forced to consume goods and services she likes a lot less than she had before. This is going to be a major hit on economic growth. (But keep in mind that it may be an improvement in Mary's *welfare* anyway, if the benefits from climate change mitigation outweigh the loss in direct consumption).

Now suppose Mary's demand for gasoline is very responsive to price. Thus, the effect of the gas tax is to push her away from gasoline use and toward other products. The gas tax is highly effective, but she's worse off because she's now getting of goods and services she doesn't prefer (otherwise she would have driven less and bought other things even without the tax). The difference is in the size of the hit. The fact that her demand for driving is so elastic means she's pretty willing to substitute other things for driving, so she's not giving up that much. If we can spread out the one-time hit by phasing in the tax, it could be a relatively small drag on overall economic growth, swamped by other improvements in consumption. If we had enough time to make the transition, people might barely notice the

disappearance of gasoline as a form of fuel. In the meantime, the main drivers of economic growth (technological change and improved human capital) would continue to operate.

Over time, the world can adjust to higher gas costs in a variety of ways that makes reductions in gas use more painless. Fuel efficient cars can replace less efficient ones. Public transit can improve. People can locate closer to jobs and stores (which can also move to be closer to them). They can learn to enjoy activities that takes place at home, and sellers will start providing more (and better) goods and services for home use. We've been talking about focusing on the consumption side of gasoline and car uses, but the same is true on the production side: firms will figure out ways to provide transportation services that involve less use of gasoline, such as much more efficient cars, electric cars, and alternative fuels.

But all of these changes take time. If we need to cut gas use very quickly, it's going to have a significant negative impact on people — they'll be stuck with bundles of goods and services they don't like nearly as well. (Of course, they'll also experience less harm from climate change, which make be a worthwhile exchange).Thus, the response to a tax-and-refund system depends on how much Mary's gasoline consumption responds to prices, which will be smaller in the short run than in the long run. The dispute over growth and climate change my come down to a disagreement over timing.

The same analysis applies if we move the focus from gasoline use to fossil fuel use more generally. The real issue seems to be about timing. Basically, the question is whether we have to cut carbon a lot more quickly than we can make the necessary technological, economic and social adjustments. If we do, there's going to be a very painful adjustment process, maybe painful enough to swamp all the other factors that might promote economic growth. Whether this is true depends on your degree of pessimism about the speed of climate change versus your degree of optimism about the pace of decarbonizing the economy. But it still seems reasonable to think that we can have our low carbon and improvements in goods and services at the same time.