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ANALYSIS AND METHODS

Meeting the demand: An estimation of potential future greenhouse gas emissions from meat production

Nathan Fiala

Department of Economics, University of California, Irvine, 3151 Social Science Plaza, Irvine, CA 92697-5100, USA

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ABSTRACT

Current production processes for meat products have been shown to have a significant impact on the environment, accounting for between 15% and 24% of current greenhouse gas emissions. Meat consumption has been increasing at a fantastic rate and is likely to continue to do so into the future. If this demand is to be met, technology used in production in the form of Confined Animal Feeding Operations (CAFOs) will need to be expanded. This paper estimates future meat consumption and discusses the potential aggregate environmental impact of this production if the use of CAFOs is expanded. I first separate meat into beef, chicken and pig products and estimate the elasticities associated with each product in order to forecast the world demand for meat. Using research on the environmental impact of food production in the US, which uses one of the most efficient CAFO processes in the world, I then calculate the total potential greenhouse emissions of this meat production and discuss the impact of these consumption patterns. I find that, under an expanded CAFO system, meat production in the future will still be a large producer of greenhouse gases, accounting for up to 6.3% of current greenhouse gas emissions in 2030.

1. Introduction

In a recent report on the environmental impact of livestock production, Steinfeld et al. (2006) found that the production of meat is currently contributing between 4.6 and 7.1 billion tonnes of greenhouse gases each year to the atmosphere, which represents between 15% and 24% of total current greenhouse gas production. Much of this effect is due to deforestation for grazing and processes that many countries are still using to produce meat which requires the animals to live longer than in other more economically efficient processes.[1]

Many countries that have inefficient production facilities are either looking to foreign countries to find cheaper alternatives for meat products,[2] or are beginning to adopt the more economically efficient processes of developed countries in the form of Confined Animal Feeding Operations (CAFOs). Nierenberg (2006) finds that CAFOs are the fastest growing form of meat production in developing nations, either

E-mail address: nfiala@uci.edu.

[1] Economically efficient here refers to processes that produce meat faster and at lower costs, which for beef means a feedlot system similar to the US. This does not always mean more efficient from an environmental or social perspective. As will be discussed later, the feedlot system itself introduces a number of special problems.

[2] For example, in 2002 Ghana eliminated tariffs on chicken imports, which has lead to extremely low cost chicken products from the US and Europe to flood their market. As it costs local producers much more to produce chicken than foreign competitors, local production has essentially ended. While this is bad for local producers, consumers are now eating much more chicken than they could have afforded before (Atarah, 2005).

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supported by local governments to improve the competitiveness of local production or fueled by large corporations moving to countries with fewer regulations. This leads to the question of what would be the effect on the estimates of greenhouse gas production if the number of CAFOs increases in countries with low tech processes?

The CAFO system, while reducing economic costs, puts the environment at risk. Subak (1999) calculates the environmental effects of methane and CO_2 emissions of cattle in a US style feedlot system, one of the most efficient meat production processes in use today. In total, to produce 1 kg of beef in a US feedlot requires the equivalent of 14.8 kg of CO_2. As a comparison, 1 gallon of gasoline emits approximately 2.4 kg of CO_2 (EPA, 2005). Producing 1 kg of beef thus has a similar impact on the environment as 6.2 gallons of gasoline, or driving 160 miles in the average American mid-size car.

The impact of future consumption growth is also an important part of this question. There is currently a large difference between meat consumption in countries with high incomes and those with low incomes. The average American consumes approximately 124 kg of meat each year, the highest in the world. By contrast, the average worldwide consumption is 31 kg a year, with Bangladesh the lowest at 3 kg per person (FAO, 2006). This situation though is changing as meat consumption around the world has more than doubled in the last 15 years, with many developing countries, especially those in Asia, leading this growth.

As people achieve higher and higher incomes, their ability to purchase not just more products, but also those of higher quality, increases. Cars are a good example of this phenomenon. As a person's income increases, she will likely purchase a more expensive car. Much of the literature on meat consumption has assumed that this same situation holds for food products. The logic is as follows: as people realize higher incomes, they acquire the ability to purchase more desired foods. For many people this would mean a switch from traditional, low cost foods such as wheat and rice to higher cost meat products such as beef, poultry and pig. Both Keyzer et al. (2005) and York and Gossard (2004) have found that income does have a substantial effect, though both of these papers assume that meat is a unified product and have estimated total meat, defined as the total beef, chicken and pig products a person eats. All meat though is not the same. For example, while total meat consumption per capita has been growing around the world at a very high rate, this is driven mostly by chicken and pig products as beef consumption per capita has actually been slowly falling. This difference in preferences across meat products makes aggregation a problem for the prediction of future consumption.

This paper brings together existing data on greenhouse gas production for different meat products, along with a projection of future worldwide consumption, to determine the potential impact of greater adoption of CAFOs. While a number of papers have estimated meat consumption patterns,[3] this paper makes the following contributions to the literature on consumption patterns and the environment. First, I include data on prices to capture price elasticity effects. Second, I add a parameter for lagged consumption in order to observe how much of meat consumption is due to either partial adjustment or persistence effects. Third, I differentiate meat into beef, chicken and pig products and estimate separate equations. Fourth, I forecast meat consumption using these estimates to the years 2010, 2020 and 2030. I bring together data on greenhouse gas production for the US and Europe in order to approximate the present and forecast the future potential environmental impact of meat consumption under a CAFO system. Finally, using these results, I discuss the implications of this impact and what additional technology is available to alleviate it.

The main findings of the paper are as follows. First, if current consumption patterns continue, the amount of total meat consumed in the year 2030 will be 72% higher than the amount consumed in 2000, lead mostly by large increases in chicken and pig consumption. Second, the production of this meat in 2030, under CAFO systems, will produce almost 1.9 billion tonnes of greenhouse gases. Finally, while there are some solutions to limit this effect, they will be very difficult to implement. Thus, if nations are serious about cutting their production of greenhouse gases, meeting future meat demand will need to be a serious area of discussion for policy makers.

The rest of the paper proceeds as follows. Section 2 describes the data used in the estimations. Section 3 presents the model, estimation results and forecast estimates. Section 4 reviews the existing environmental data on CAFOs and incorporates them into the results from Section 3. In Section 5 I discuss some solutions that have been put forward to reduce this production. Section 6 is then the conclusion of the paper.

2. Data

The data I use is a panel as it is by country and year. Per capita GDP in constant 2000 US dollars is used for income and urban population as percent of total population is used for

Table 1 – Countries in the sample

Algeria	Greece	Niger
Argentina	Guinea	Nigeria
Australia	Honduras	Panama
Belize	Hungary	Paraguay
Bolivia	India	Peru
Bulgaria	Indonesia	Philippines
Burkina Faso	Italy	Portugal
Burundi	Jamaica	Romania
Cameroon	Japan	Rwanda
Chile	Kenya	South Africa
China	South Korea	Spain
Colombia	Laos	Sri Lanka
Republic of the Congo	Madagascar	Thailand
Costa Rica	Malawi	Togo
Cte d'Ivoire	Malaysia	Trinidad and Tobago
Dominican Republic	Mali	United States of America
Egypt	Mexico	Uruguay
El Salvador	Morocco	Venezuela
France	Mozambique	Zimbabwe
Gambia	Nepal	
Ghana	Nicaragua	

[3] See FAO (2006), Keyzer et al. (2005), OECD (2007), USDA (2001) and York and Gossard (2004).