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Parametric Distance Function to Efficiency Analysis of Greenhouse Gas Emissions in U.S. Agriculture

Tshepelayi Kabata

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Tshepelayi Kabata*
Agricultural Economics

1. Background

- Agriculture emits about 6 % of the total U.S. greenhouse gases.
- The sector agriculture is prompt to permit acquisition for emissions 100 tons and 25,000 tons of COe per year
- Impact of such regulation depends on the ability to reduce GHG ie efficiency

2. Objective

- To measure the ability of reducing GHG Emissions

3. Approach

- Stochastic Translog Output Distance Function
- Maximum Likelihood Estimation using Frontier in R (Coelli and Hanningsen 2013)

$$-\ln y_m = TL(x^*_{it}, y^*_{it}, b^*_{it}, t; \alpha, \beta, \dots, \pi) + \varepsilon_{it}$$

$$\varepsilon_{it} = v_{it} - u_{it}$$

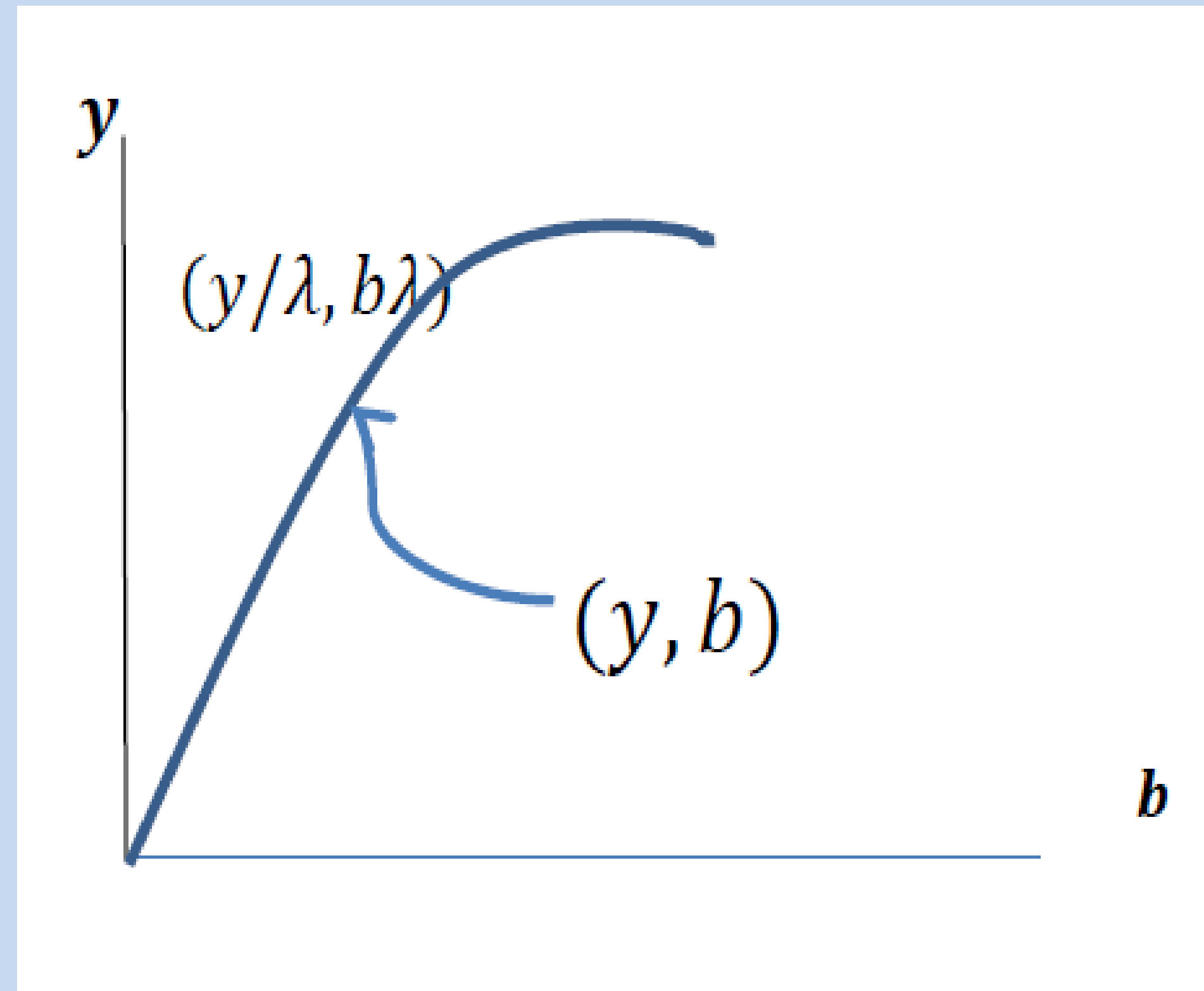
$$v_{it} \sim N(0, \sigma_v^2) \text{ and } u_{it} \sim N^+(0, \sigma_u^2).$$

$$x^* = x \cdot y_m, b^* = b \cdot y_m, y^* = y / y_m$$

$$\widehat{TE}_{it} = \exp(-u_{it})$$

TE: Technical Efficiency

Hyperbolic Output Distance Function

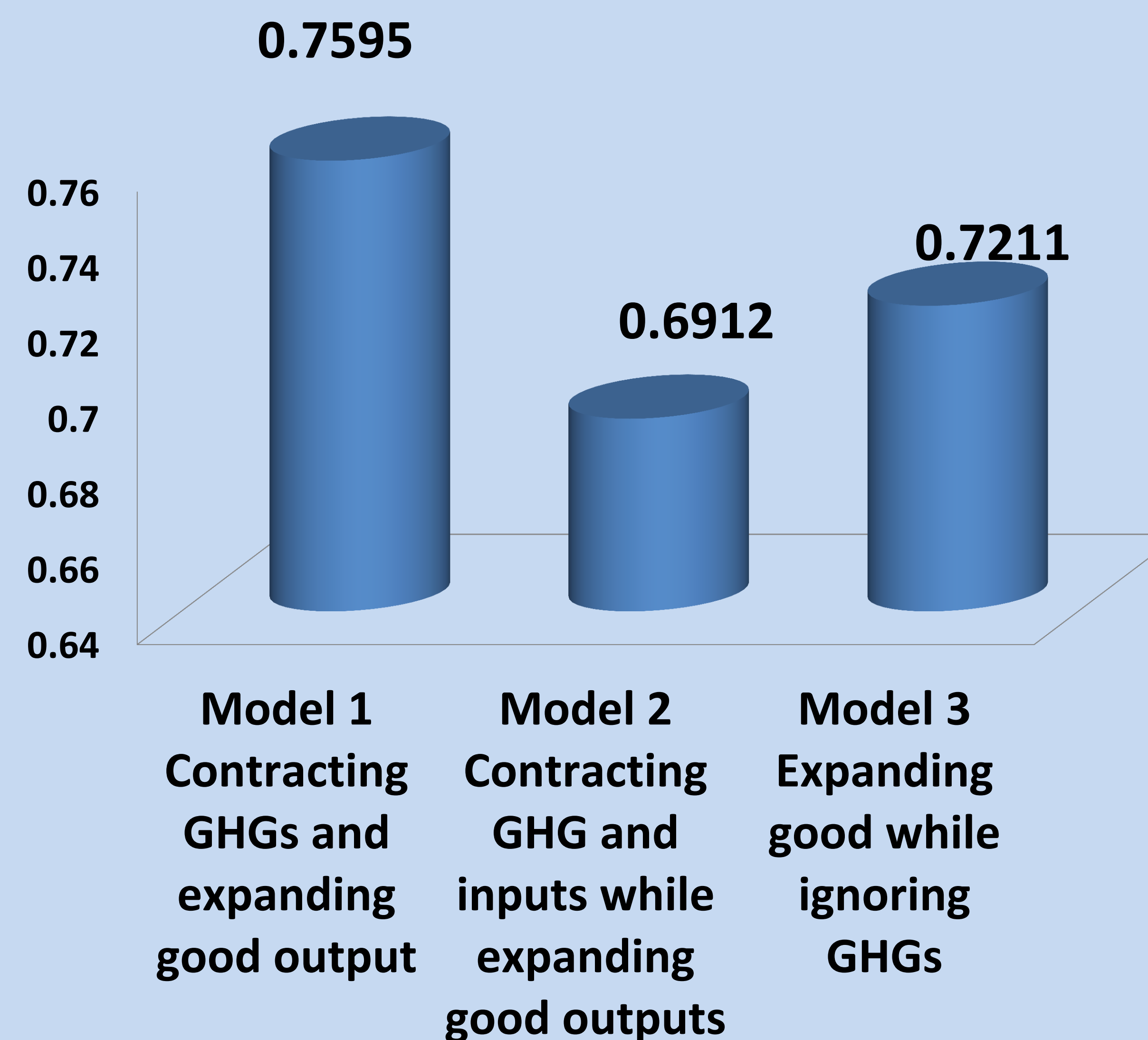


3. Data : State-Level Data 1990-2004

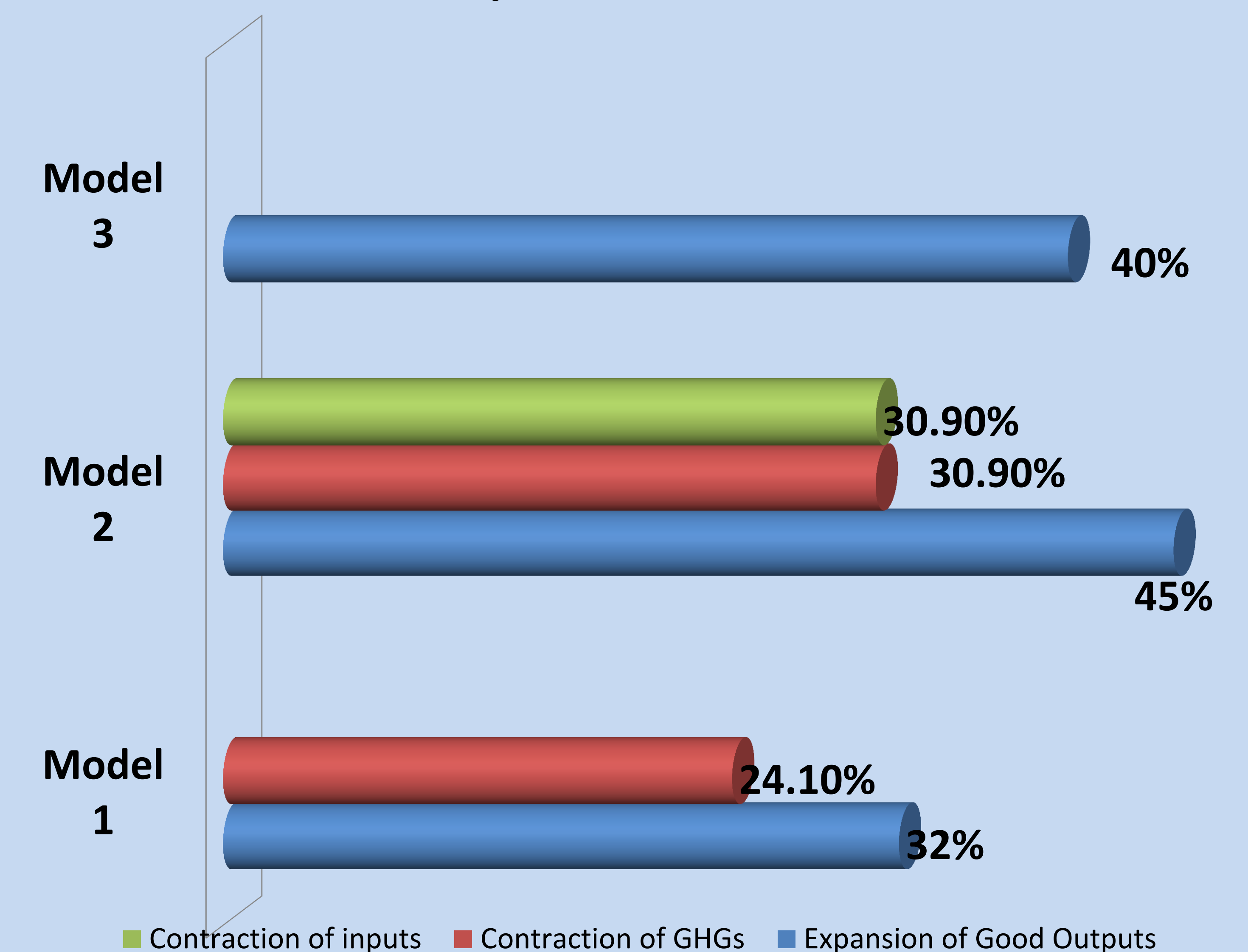
- Greenhouse Gases Emissions (EPA)
 - Methane and Nitrous Oxide
- Conventional Inputs and Outputs (ERS 2010) :
 - Index of Outputs
 - Indices of Capital, Land, Labor and Intermediate Inputs

4. Results

Efficiency scores under different Models



US Average GHG Efficiency Potential Improvement 1990-2004



5. Conclusion

- On average the US Agriculture has room to expand livestock and crops production and simultaneously reducing inputs and GHGs emissions.
- This potential differs from states

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6. Selected References

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- Henningsen, Arne and Henning, H. C. A. Christian (2009) . Imposing regional monotonicity on translog stochastic production frontiers with a simple three-step procedure. *Journal of productivity analysis*. - Vol. 32. 2009, 3, p. 217-229.

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