Material Balance and Agricultural Productivity

Robert G Chambers[1]

December 4, 2022

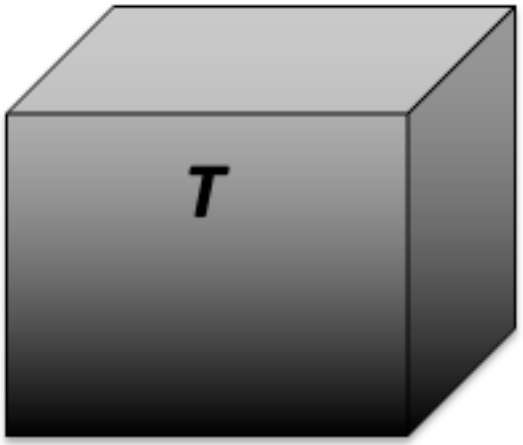
[1]University of Maryland, College Park

- **Question** *How Important is the Material Balance Issue and How to Deal with It?*

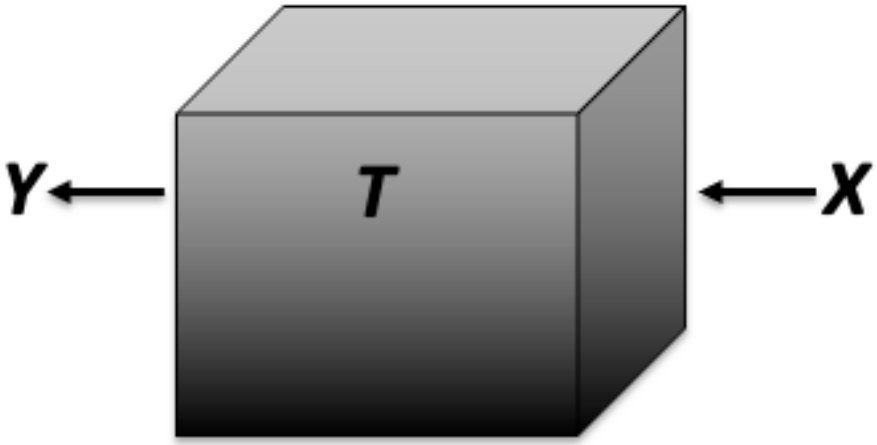
- **Question** *How Important is the Material Balance Issue and How to Deal with It?*
- **Answer** *I Don't Know*

- **Question** *How Important Ss the Material Balance Issue and How to Deal with It?*
- **Answer** *I Don't Know*
- **Guess** *Bigger Than Many of Us Understand*

Problem: Understand Technology



Method: Use Information on Input and Outputs (Netputs)



Early attempts

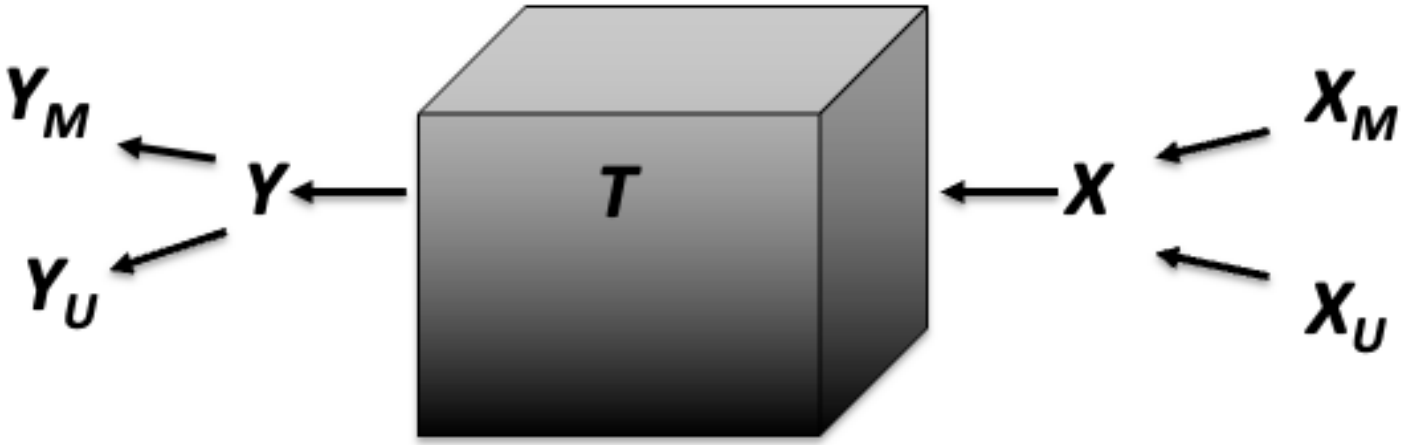
- **Barton, 1949** *"Since World War I all inputs per unit of farm output have been reduced by 25 percent. During this period total production inputs...increased about 15 percent and the volume of farm output rose by 50 percent."*

Early attempts

- **Barton, 1949** *"Since World War I all inputs per unit of farm output have been reduced by 25 percent. During this period total production inputs...increased about 15 percent and the volume of farm output rose by 50 percent."*
- **Schultz, 1956** *The analytical task...is to re-establish a strong and satisfactory linkage between input and output over time. ...we would do well...to keep in mind the characteristics of an ideal input-output formula...where output over inputs...stayed at or close to one.*[2]

[2] I am indebted to Zvi Griliches for viewing the problem...in this way.

Enter Ayres and Kneese 1969 (Material Balance)



Putting Things Together

- **Schultz + Ayres and Kneese**

$$\hat{Y}_M - \hat{X}_M = \hat{X}_U - \hat{Y}_U$$

Putting Things Together

- **Schultz + Ayres and Kneese**

$$\hat{Y}_M - \hat{X}_M = \hat{X}_U - \hat{Y}_U$$

- **Schultz + Ayres and Kneese + ERS/USDA (1948-2019)**

$$\hat{Y}_M - \hat{X}_M = 178\% - 4.2\%$$

Putting Things Together

- **Schultz + Ayres and Kneese**

$$\hat{Y}_M - \hat{X}_M = \hat{X}_U - \hat{Y}_U$$

- **Schultz + Ayres and Kneese + ERS/USDA (1948-2019)**

$$\hat{Y}_M - \hat{X}_M = 178\% - 4.2\%$$

- **My guess** *I don't mean to suggest that we've missed 174% of what's happened. But I worry that we might be uncomfortably close.*

Bottom Line: Agriculture is often an Extractive Industry

- **Great Plains** *Thaler et al. (2022) estimate that "... soil thickness on hilltops in the Midwest has declined at an average rate of nearly 2 mm per year over the past 150 years."*

Bottom Line: Agriculture is often an Extractive Industry

- **Great Plains** *Thaler et al. (2022) estimate that "... soil thickness on hilltops in the Midwest has declined at an average rate of nearly 2 mm per year over the past 150 years."*
- **What to do about it?** *Get on with measuring X_U and Y_U*

Bottom Line: Agriculture is often an Extractive Industry

- **Great Plains** *Thaler et al. (2022) estimate that "... soil thickness on hilltops in the Midwest has declined at an average rate of nearly 2 mm per year over the past 150 years."*
- **What to do about it?** *Get on with measuring X_U and Y_U*
- **Thanks!**