Econometric Analysis of the Effects of Subsidies on Farm Production Based on a Microeconomic Household Model: Evidence from Norway

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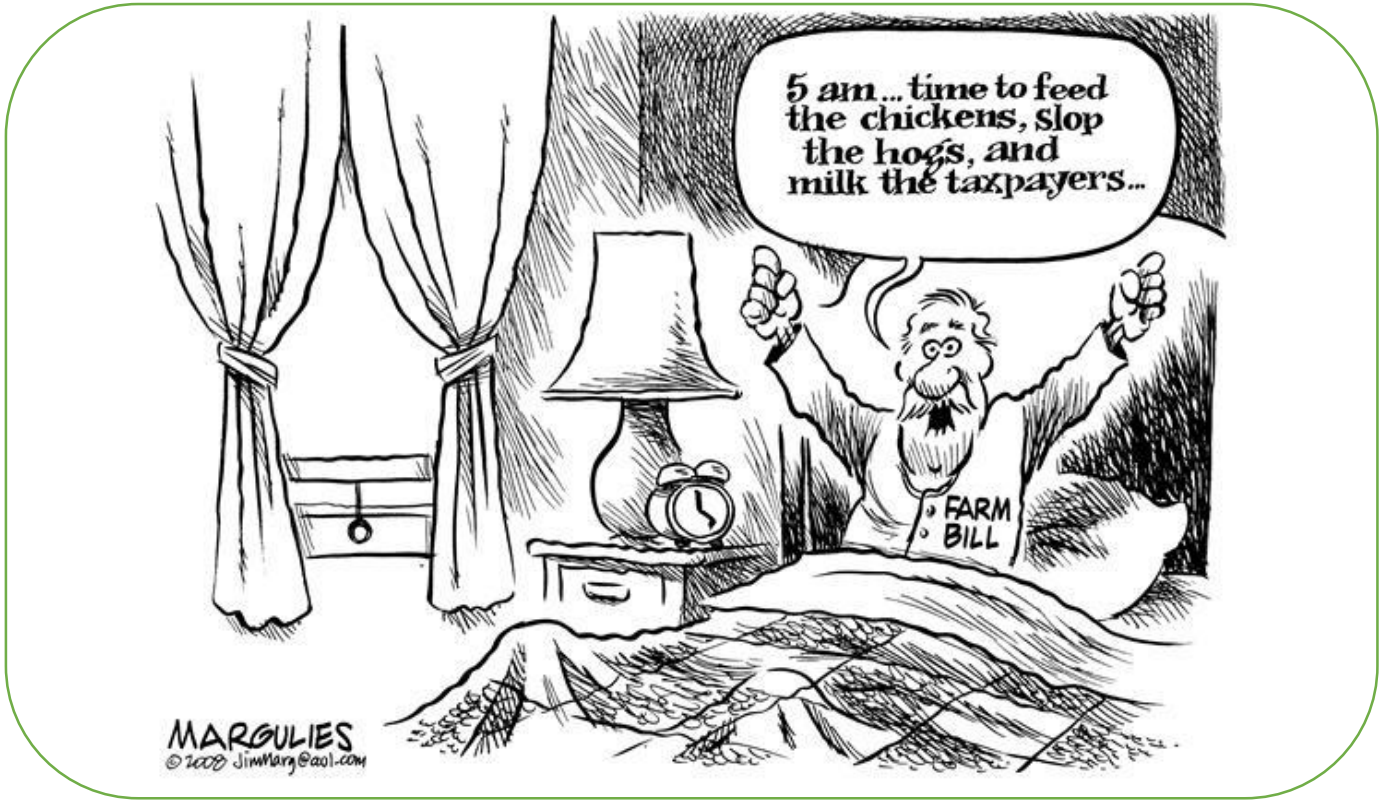
Motivation



Source: Humphrey, G. (2014). Farming The Government Political Cartoons. Available at: https://dekerivers.wordpress.com/2014/02/04/farming-the-government-political-cartoons/ [Last accessed 3/17/2018]

Motivation

We wanted to analyze the effect of subsidies on labor allocation, input use, and production of family farms…

- **Literature**:
  - Coupled and decoupled subsidies, environmental payments
  - Productivity
  - Efficiency
  - Input allocation
  - …

…but how to model agricultural subsidies adequately?

Motivation
Methodological Challenges

- Modeling approaches in the literature often *ad hoc:*
  - Reduced form
  - Subsidies directly enter production fct. as inputs or outputs
  - Factor influencing efficiency

  } → No theoretical basis governs estimation

- Subsidy payments are not exogenous
- Input use is not exogenous

  } → Disregarding endogeneity; Biased results

Research Question & Objectives

What are the effects of subsidies on farm production under consideration of endogeneity of input variables and subsidies?

Objective 1: Conceptual basis

- Find and explain a theoretical model that describes the effects of subsidies on farm production decisions adequately

Objective 2: Empirical application

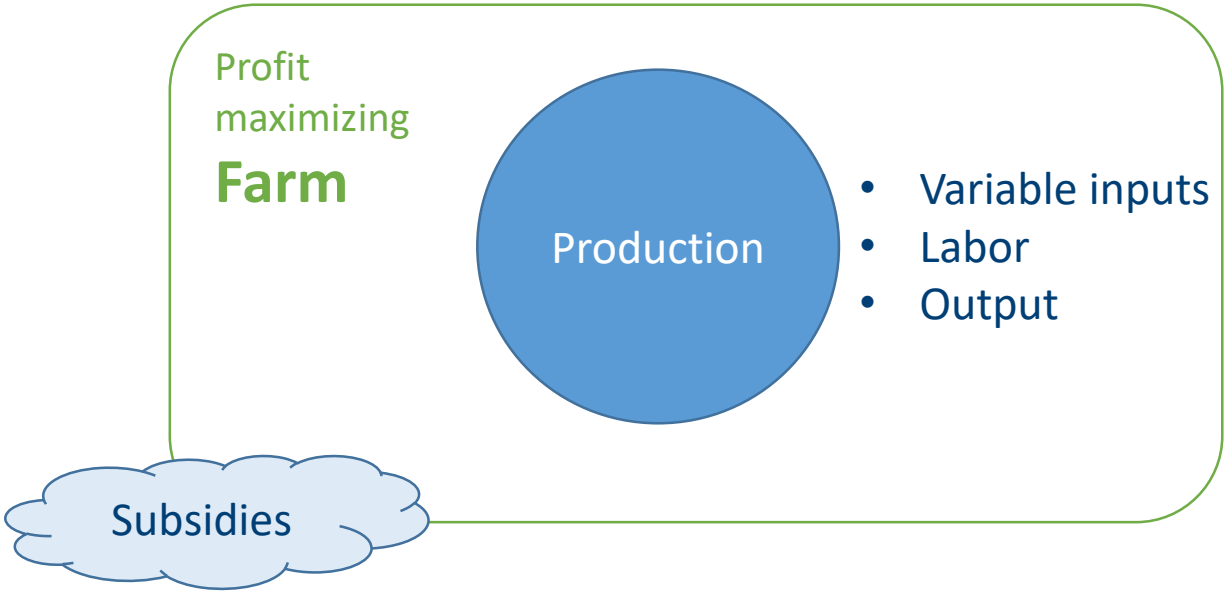
- Demonstrate the application of the theoretical model to real-world data
- Analyze the effects of subsidies on farm production

Theoretical Model

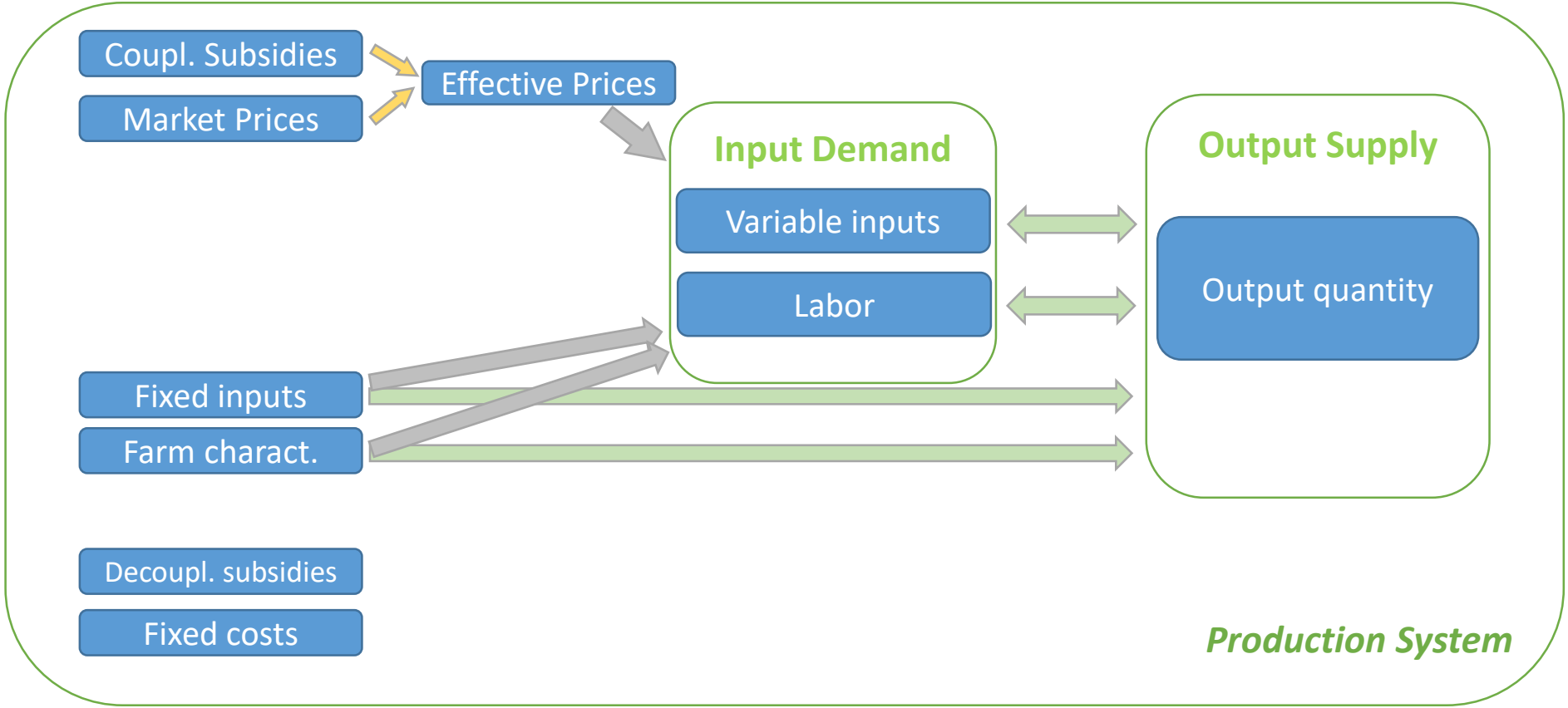
Source: Henningsen, A., Kumbhakar, S. C. and Lien, G. (2011).

Henningsen, A., Kumbhakar, S. C. and Lien, G. (2011). Econometric analysis of the effects of subsidies on farm production in case of endogenous input quantities. Paper presented at the XIIth International Congress of the European Association of Agricultural Economists (EAAE) in Zürich, Switzerland, available at http://purl.umn.edu/114548 [accessed October 2, 2017].

Traditional Farm Model
Decision Making Process

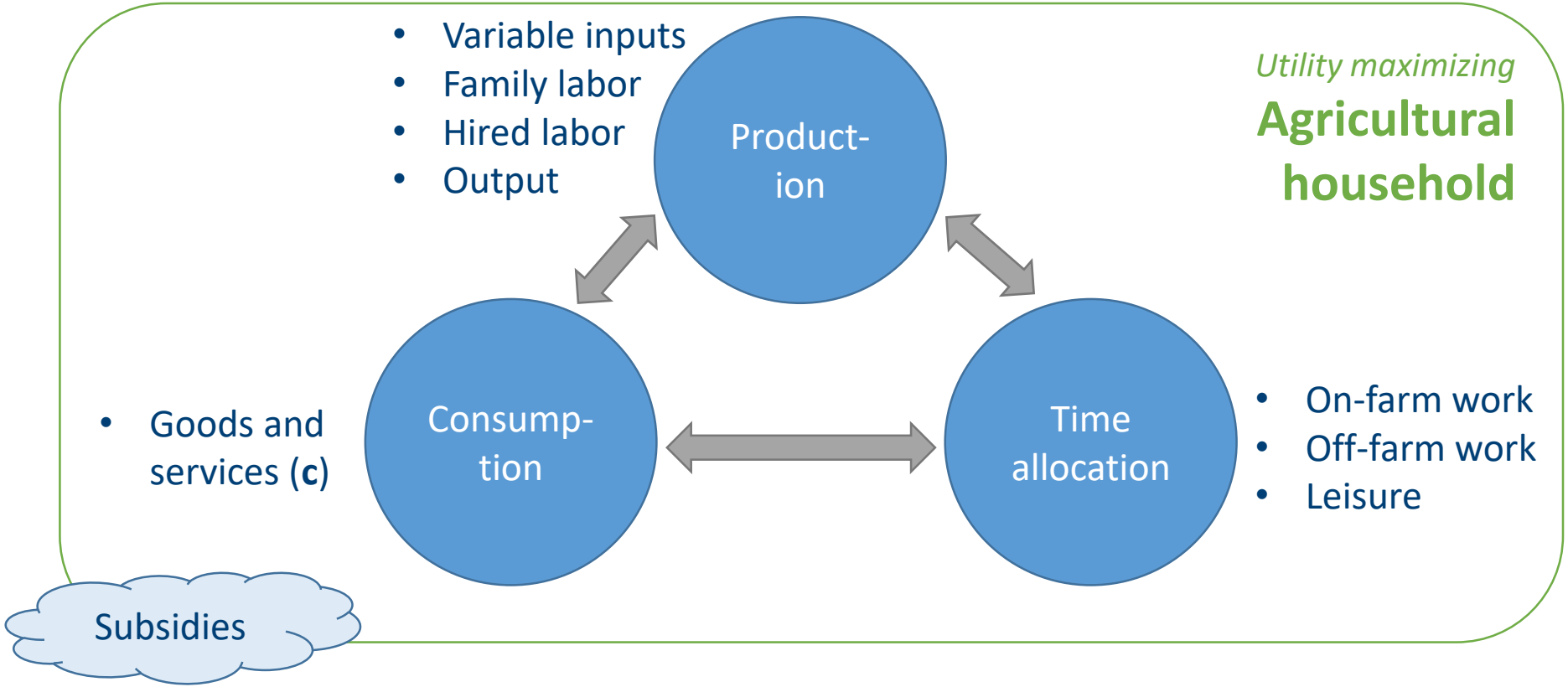


Traditional Farm Model

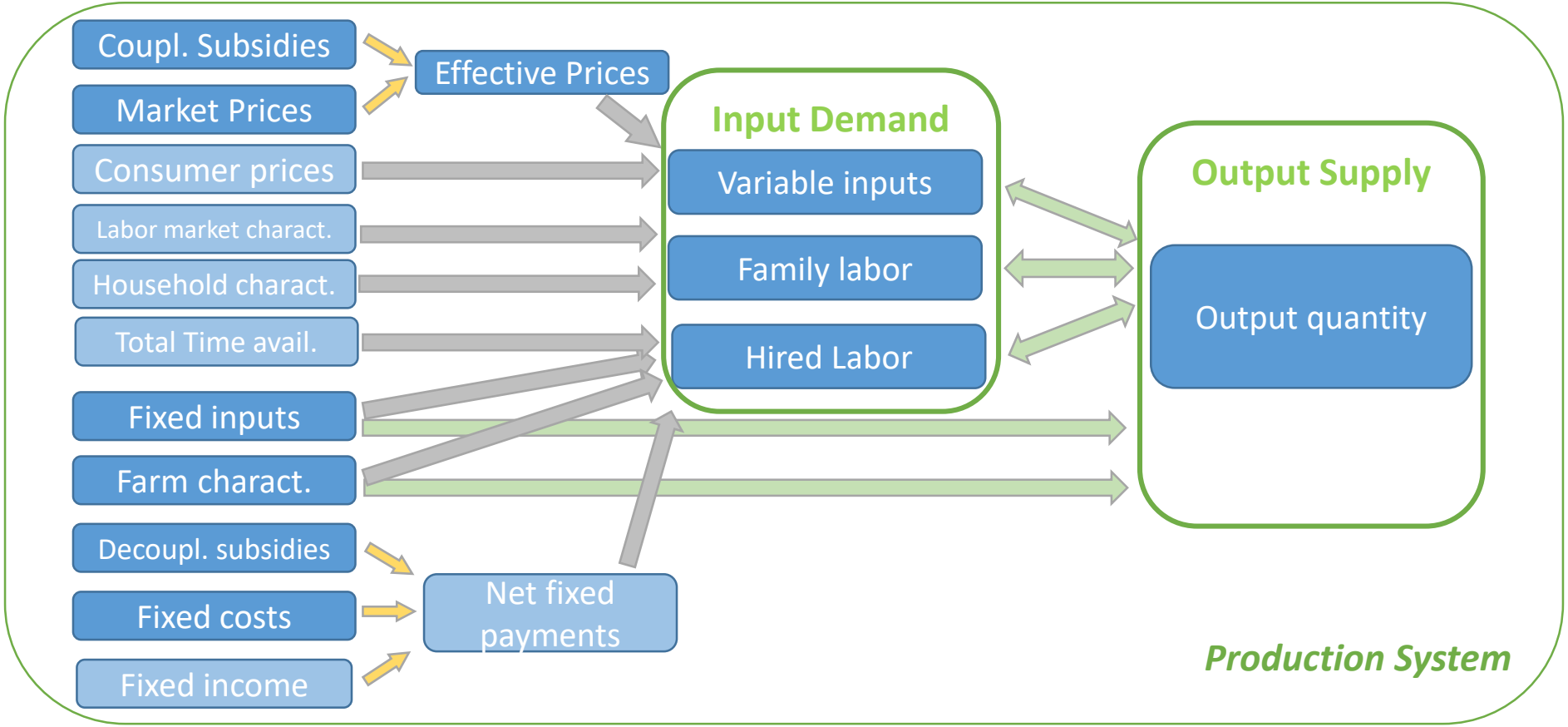


Farm Household Model

Decision Making Process



Farm Household Model



Subsidy Impact Assessment
Non-Standard Elasticities

- **Elasticities are unit-free**

- **Examples:**

$$\varepsilon_{output,InpSub} = \frac{\partial\ output}{\partial\ InpSub} \times \frac{InpPrice_j}{output}$$

$$\varepsilon_{output,DecSub} = \frac{\partial\ output}{\partial\ DecSub} \times \frac{farm\ revenue}{output}$$

- **Advantages**:
  - incorporating size of subsidies relative to prices/revenue
  - more natural interpretation
  - concept can be used even if subsidies are zero

Theorectical Concept
Summary

Traditional farm model and farm household model

- are based on microeconomic theory
- account for endogeneity of subsidy payments
- account for endogeneity of input use

Additionally, the farm household model

- allows for linkages between farm and household
- allows for non-homogeneity of labor
- allows for (labor) market imperfections

Impact assessment via non-standard elasticity concept

Empirical Specification

Data

- Norwegian agriculture:
  - Small-scaled
  - Family-based
  - Highest support to farmers worldwide
- Unbalanced panel data set from NIBIO
  - Norwegian grain farms
  - Contains all relevant variables required by theoretical model

A

- 16 years (1991 – 2006)
- 1616 observations on 184 farms
- Average participation: 8.8 years

B

- 25 years (1991 – 2016)
- 2473 observations on 247 farms
- Average participation: 12 years

Empirical Specification
Input Demand Functions

Functional form:

Quadratic Equation

- Homogeneity of degree zero in all monetary values

A

translog

- z-variables included as shifters
- Inverse hyperbolic sine transformation of net fixed payments
- Homogeneity of degree zero in all monetary values

B

Estimation strategy:

- Fixed effects estimation

Empirical Specification
Production Functions

- **Functional Form: Cobb Douglas** A B

- **Estimation strategy:** Instrumental variable approach for panel data (Balestra and Varadharajan-Krishnakumar 1987)
  - Endogenous regressors

    Variable inputs | Family labor | Hired Labor

  - 'Instrumented' by instrumental variables
    - explanatory variables of input demand equations:

    Effective Prices | Consumer prices | Labor market charact. | Fixed inputs

    Total Time avail. | Net fixed payments | Farm charact. | Household charact.

Preliminary Results

Household vs. Farm Model

- **Input demand functions**
  - Wald tests reject farm model in favor of household model

- **Production functions**
  - Labor homogeneity cannot be rejected
  - Higher precision of coefficient estimates for the household model

- **Consistency with microeconomic theory**
  - Farm household model performs better
  - Both models show considerable inconsistencies

Subsidy Elasticities – Preliminary Results

	Coupled Input Subsidies		Coupled Output Subsidies		Decoupled Subsidies	
	Elasticity	P-value	Elasticity	P-value	Elasticity	P-value
Total on-farm labor	**-1.19**	**($< 10^{-5}$)**	**0.13**	**(0.460)**	**0.0097**	**(0.061)**
	-0.29		**0.35**		**0.001**	
On-farm family labor	**0.47**	**(0.020)**	**0.19**	**(0.246)**	**0.0099**	**(0.051)**
	-0.14		**0.58**		**0.000**	
Hired labor	**-0.78**		**-041**		**0.004**	
Variable Inputs	**-0.63**	**(0.822)**	**-0.12**	**(0.390)**	**0.0045**	**(0.990)**
	1.03		**0.48**		**0.001**	
Output quantity	**-0.32**	**(0.555)**	**0.03**	**(0.007)**	**0.0026**	**(0.902)**
	-0.17		**0.17**		**0.000**	
Revenue	**-0.14**		**1.02**		**1.00**	
Transfer Efficiency	**-0.40**		**1.02**		**1.00**	

2011 2018

Limitations

- Time horizon
- Static model
- Inconsistency with microeconomic theory
- Low statistical precision

Summary

- Sound theoretical model – entirely based on microeconomic theory
- Accounts for endogeneity in subsidies and inputs
- Allows for linkages between farm and household
- Allows for heterogeneity of labor and labor market imperfections
- Method for consistent econometric estimation
- Limitations

Thank you very much for your attention!

Christian Stetter