Estimating Generalized Sustainable Value at Sector Level

Application to Finnish dairy farms

12.9.2012

Sustainable value at firm level

Firm's sustainability performance or sustainable value (SV) – difference between firm's economic output produced by using a resource bundle $\mathbf{x}_i = (x_{i1} \ldots x_{i2})'$ and opportunity cost of these resources:

$$SV_i = y_i - OC(\mathbf{x}_i)$$

OC can be:

1) a nonlinear function of resources
2) functional form does not need to be assumes a priori

Sustainable value at firm level

OC is unknown => must be estimated

OC of using a resource for an activity refers to the income foregone by not using resource in the best alternative activity

Production function – maximum amount of output that can be obtained from the given amounts of input resources

Numerical value of production function $f(\mathbf{x})$ can be interpreted as the total opportunity cost of bundle $\mathbf{x}$

Sustainable value at firm level

$SV_i = y_i - OC(\mathbf{x}_i)$ can be rewritten as $SV_i = y_i - f(\mathbf{x}_i)$

By reorganizing the terms, receive the standard regression equation: $y_i = f(\mathbf{x}_i) + SV_i$

where SV can be estimated at *firm-level* using alternative methods, e.g.

- Data Envelopment Analysis (DEA)
- Stochastic Frontier Analysis (SFA)
- etc.

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Sustainable value at sector level

Proposed procedure:

1. Identify production line, sector, or region whose aggregate sustainability performance will be assessed

Group of firms $I = \{1,\ldots,n\}$ can represent firms in a specific sector, specialization, region or any other group

Sustainable value at sector level

Proposed procedure:

2. Identify relevant economic, environmental and social resources (inputs and outputs) to be included in the assessment from FADN and possibly other sources

Sustainable value at sector level

Proposed procedure:

3. Calculate averages of resources and output. These values characterize the representative farm of group *I*

$$\bar{y} = \sum_{i \in I} y_i / n$$

$$\bar{\mathbf{x}} = \sum_{i \in I} \mathbf{x}_i / n$$

Include the representative farm's data in the data set

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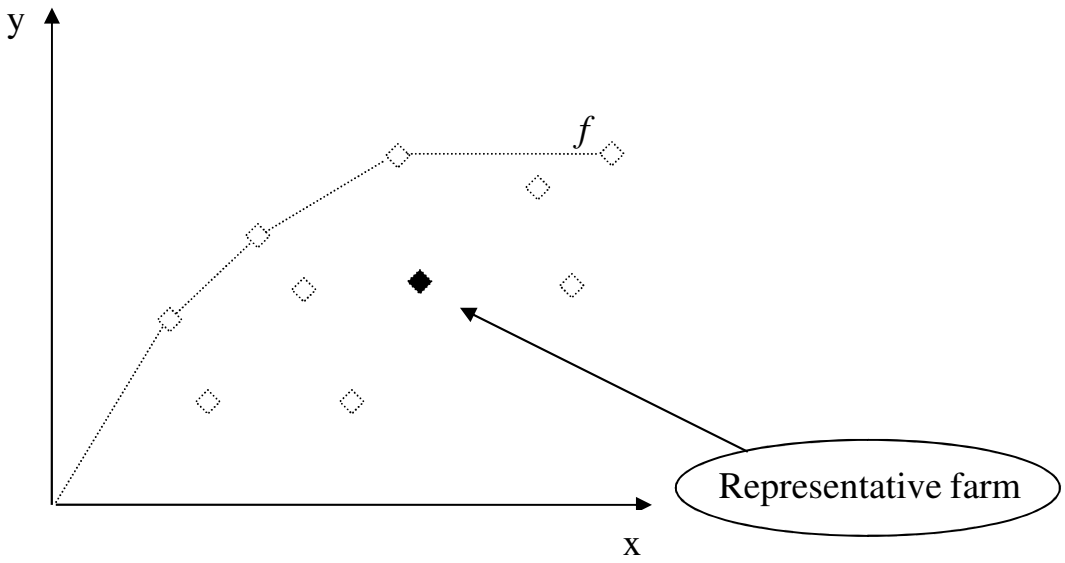
Sustainable value at sector level

Proposed procedure:

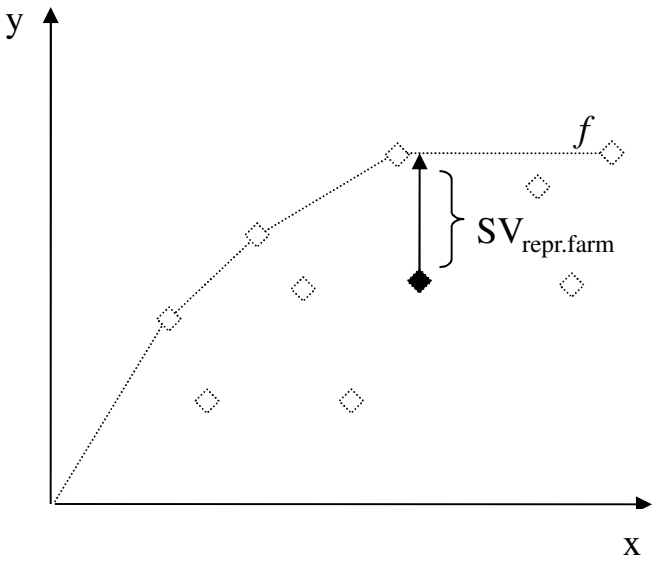
4. Estimate the benchmark technology with your preferred method (for example, DEA)



Sustainable value at sector level

Proposed procedure:

5. Calculate SV of the representative farm



$$SV_{\text{repr.farm}} = \bar{y} - f\left(\bar{\mathbf{x}}\right)$$

Sustainable value at sector level

Proposed procedure:

6. To obtain an aggregate SV measure of the production line (sector), multiply the SV estimate of the representative farm by number of farms presented in the sample (sample size)

$$aggrSV_l = n \cdot \left(\bar{y} - f\left(\bar{\mathbf{x}} \right) \right)$$

Application to Finnish dairy farms

Data:

year 2004, sample size n = 332

Output

- Total revenue from milk and other products (SE131), €

Inputs

- Labor (SE011), hr
- Total utilized agricultural area (SE025), ha
- Farm capital (SE510), €
- Total energy cost (SE345), €
- Fertilizers (SE295), €

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Application to Finnish dairy farms

Results:

- Calculated averages for the representative dairy farm

$$\bar{y}^{dairy} = \sum_{i \in I} y_i^{dairy} / n$$

$$\bar{\mathbf{x}} = \sum_{i \in I} \mathbf{x}_i / n$$

- Included averages in the data sample

- Estimated the benchmark technology by output oriented DEA model with variable returns to scale

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Application to Finnish dairy farms

Results:

- Resulting efficiency score of the representative dairy farm is equal to 0.649 (which means that the representative farm achieves a bit more than half of its potential output)

- Calculated SV value for the representative dairy farm, which resulted in about -49,615€

The results are negative by construction, since in DEA model, frontier envelopes the observed data from above; only farms with SV=0 are diagnosed as efficient

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Application to Finnish dairy farms

Results:

- Weights of inputs for the representative dairy farm

Inputs	Repr. dairy farm
Labor	0.01
Farm capital	0.15
Energy	0.88
UAA	0.05
Fertilizer	0.19

- *Labor input has the smallest weight*
- *Energy input has the largest weight*

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Application to Finnish dairy farms

Results:

- To obtain aggregate SV measure for dairy production line, the estimated SV of the representative dairy farm is multiplied by number of farms in the sample (n = 332)

- Aggregate SV of the Finnish dairy sector for year 2004 resulted in about -16.5 million € (-16,521,842 €)

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