# Access to Credit, Factor Allocation and Farm Productivity: Evidence From the CEE Transition Economies

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# Introduction and Objectives

- Shortage of credit has long been identified as a crucial factor determining farm development not only in transition and developing countries but also in developed economies (Bhattacharyya and Kumbhakar 1997; Blancard *et al*., 2006; Heltberg 1998; Lee and Chambers, 1986; Färe, Grosskopf and Lee, 1990).

- The availability of farm credit is determined by various factors :
  - market integration and contracting (Dries and Swinnen 2004; Swinnen 2007)
  - contract enforcement/asymmetric information and availability of collateral (Bester, 1985; Ghosh, Mookherjee, and Ray, 2000)
  - rural insurance markets and informal rural institutions
  - government support measures (Ciaian and Swinnen, 2009)

# Introduction and Objectives, cont.

- There is relative extensive literature on credit markets in developing countries usually focusing on the impact of credit on productivity, farm inputs and other aspects of rural development (e.g. Bhattacharyya and Kumbhakar 1997; Carter and Olinto 2003; Feder 1985; Heltberg 1998).

- Most of the agricultural transition literature analyses factors determining farm credit in transition countries (Latruffe et al., 2008; Petrick, 2004; Petrick and Latruffe, 2003; Davis et al., 2003; Bezemer, 2002).

- Relatively few studies analyse how credit constraint affects farms' input choices and productivity in the transition countries (e.g. Dries and Swinnen 2004; Gorton and White, 2007; Swinnen 2007).

## Objectives

- This paper analyses how farm access to credit affects farm input allocation and farm productivity in the CEE transition countries.
- First, we analyse theoretically the effect of credit constraint.
- Second, we apply a semi-parametric propensity score matching (PSM) estimator to perform empirical tests.

# Theoretical framework

- We adopt the approach of Lee and Chambers (1986) and Blancard et. al (2006) who model short-run and long-run credit constraint and tested it for US and France.

- We assume profit maximization of representative farm:

$$\Pi = pf(X,Y) - w_X X - w_Y Y$$

***p*** – price
***f(X,Y)*** – production
***X*** – Variable input
***Y*** – Fixed input
$w_i$- input price

# Theoretical framework, cont.

**Credit constraint:**

- The value of credit ***C*** is predetermined level of expenditure which cannot be exceed when purchasing variable and/or fixed inputs:

$$\alpha w_X X + \delta w_Y Y \leq C`$$

- ***α, δ*** are dummy variables; e.g. if ***δ*** = 1 the farm is credit constrained in the long-run; if ***δ*** = 0 farm is not credit constrained in the long-run.

- The *short-run credit constraint* (***α=1***) arises due to a time lag between the realization of agricultural production and payment for variable inputs throughout the season.
- The *long-run credit constraint* (***δ=1***) arises due to the mismatch in timing of costs incurred on fixed inputs and cash flow from fixed inputs extended over several years.

## No credit constraint:

- Implies that (***α=0, δ*** =0):

$$\frac{pf_X}{pf_Y} = \frac{w_X}{w_Y}$$

- Relative input prices determine equilibrium marginal productivities of inputs and hence input allocation and production level.
- Credit, *C*, has no effect on input and farm productivity.

## Theoretical framework, cont.

**Short-run credit constraint:**

- Implies that (***α=1, δ*** =0):

$$\frac{pf_X}{pf_Y} = \frac{(1+\lambda)w_X}{w_Y}$$

- The short run-credit constraint has *asymmetric impact* on input allocation.
- Relative input costs change: The cost of credit constrained variable input ***X*** increases by the shadow price, ***λ***.
- The equilibrium credit constrained variable input decreases.
- The credit un-constrained fixed input may increase or decrease depending on the size substitution and the scale effect.
- Productivity decreases.

## Short-run and Long-run credit constraint:

- Implies that (***α=1, δ*** =1):

$$\frac{pf_X}{pf_Y} = \frac{(1+\lambda)w_X}{(1+\lambda)w_Y} = \frac{w_X}{w_Y}$$

- The short run-credit constraint has symmetric impact on input allocation.
- Relative input costs do not change .
- There is no substitution between inputs. Only the scale effect will reduce the output and input use.

# Empirical analysis

## Data

- FADN farm level data for 8 CEE countries for 2004 and 2005
- Approximately 37 416 observations.
- The FADN data set contains a number of variables on yield, output, costs, subsidies and taxes, income, balance sheet, and financial indicators.
- Stratified sample

# Estimation approach

- We employ a **propensity score matching (PSM) estimator** (Rosenbaum and Rubin, 1983).
  - Compare performance of farms that differ only in their access to credit
  - Construct counterfactual based on observed characteristics

- The PSM compares the effect of farm having access to credit *(C=1)* with farm with no (limited) credit *(C=0)* on farm outcome (performance) variable ***Q*** for given vector of observable covariates ***Z***. Then the expected casual effect of the treatment on farm performance:

$$E(Q_1 - Q_0|Z,C=1).$$

# Estimation approach, cont.

- Advantages of the PMS.
  - Do not impose any functional form assumption on how access to credit may affect farm's performance
  - Allow for any heterogeneity and non-linearlities in the effect of credit
  - Addresses endogenoeity problem

- Matching procedure relies on two critical assumptions:
  - *selection on observables* assumption
    - conditional on ***Z***, without access to credit the treated farms would perform the same as the control farms
  - *common support* assumption.
    - propensity score is bounded from 0 and 1, i.e. the treatment is not predicted too well.

# Empirical implementation

- The **dependent variable** (in the probit model): farm credit (total liabilities).
  - To better understand the impact of credit, we employ the matching not only for farms having access to credit but also for farms with different levels of credit.
  - We split the whole sample into 8 credit groups according to the size of credit: Group 1 contains farms with zero credit; Groups from 2 to 8 contain farms with gradually increasing credit-output ratio.
  - The matching is done to obtain the following comparisons: group 2 vs group 1, group 3 vs group 2, etc.

| Credit group | Credit / output, % | No observations |
|---|---|---|
| 1 | 0 | 10832 |
| 2 | 0-10 | 4406 |
| 3 | 10-20 | 4147 |
| 4 | 20-30 | 3976 |
| 5 | 30-45 | 3853 |
| 6 | 45-70 | 3687 |
| 7 | 70-100 | 3377 |
| 8 | >100 | 3131 |

# Empirical implementation, cont.

- **Outcome variables (Q):** TFP, investments, variable costs, labour, and land.

- ***Key explanatory variables (Z)***: subsidies, share of land owned, share of hired labour, total fixed owned assets, farm size, dummy variables

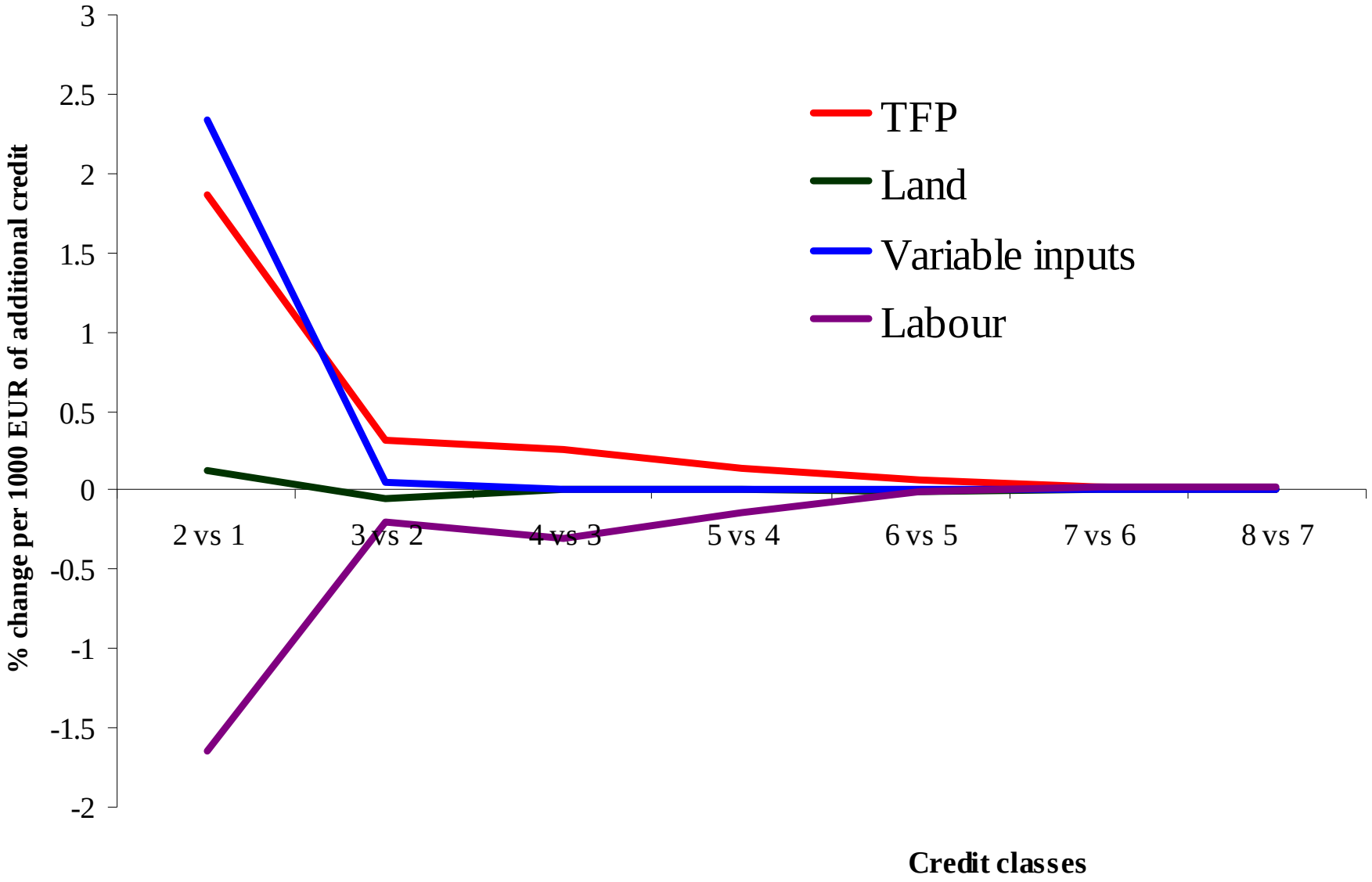
# Empirical results

## Results for pooled sample:

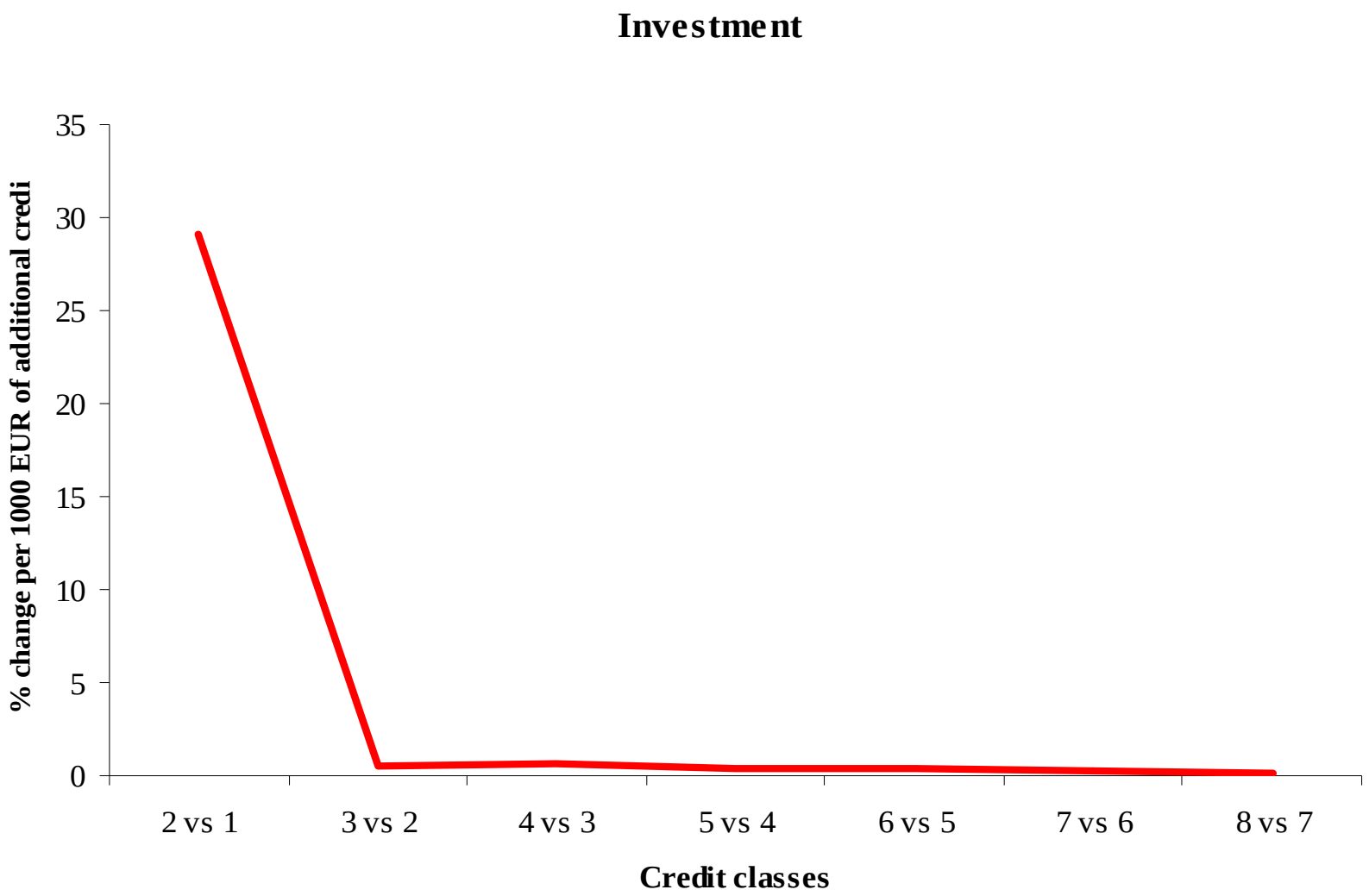
Percentage change of TFP and input use per 1000 EUR of additional credit

| | TFP | Investment | Land | Variable inputs | Labour |
|---|---|---|---|---|---|
| **2** vs 1 | 1.87*** | 29.04*** | 0.12 | 2.34*** | -1.64*** |
| **3** vs 2 | 0.31*** | 0.56 | -0.05 | 0.05** | -0.20* |
| **4** vs 3 | 0.25*** | 0.62*** | 0.00 | 0.00 | -0.31*** |
| **5** vs 4 | 0.14*** | 0.41*** | 0.00 | 0.00 | -0.14*** |
| **6** vs 5 | 0.07*** | 0.44*** | -0.01 | 0.00 | -0.01 |
| **7** vs 6 | 0.02 | 0.21*** | 0.00 | 0.01* | 0.02 |
| **8** vs 7 | 0.00 | 0.14*** | 0.00 | 0.01** | 0.02** |

# Empirical results, cont.



# Empirical results, cont.



## Empirical results, cont.

**Results for pooled sample:**

- The results suggest that access to (higher) credit has a positive impact on the TFP. The increase in the TFP ranges between 0.07% and 1.87% per 1000 EUR of additional credit with the largest gain in productivity being for low level of credit (indicates a decrease in the marginal productivity of additional credit).
- No impact on the land was found.
- Credit has a positive effect on the use of variable inputs (between 0.01%, and 2.34% per 1000 EUR of additional credit).
- Credit has a negative impact on the labour use (between -0.14%, and -1.64% per 1000 EUR of additional credit). This indicates that labour is substituted for capital.

# Empirical results, cont.

## Country level results:

- The country level estimates are largely consistent with the pooled sample results.

- The statistical significance level is smaller for the country level results than for pooled sample. However, this is expected, as the sample size is considerably smaller.

# Conclusions

- In summary, the results suggest that farms are credit constrained both in the short-run as well as in the long-run.
- Farms are asymmetrically credit constrained: Farms tend to be credit constrained for investments and variable inputs, but credit unconstrained for land and labour.
- Access to credit increases TFP up to 1.9% per 1000 EUR of additional credit.
- Variable inputs and capital investments increase up to 2.3% and 29%, respectively, per 1000 EUR of additional credit.

# Conclusions, cont.

- Land and labour appear not to be credit constrained.

- This could be explained by the fact that farms may likely better cope with financing land and labour compared to variable inputs and investments.
  - The use of family labour reduces the need for pre-financing capital because family labour may address credit problem by postponing household consumption for the period, when the revenue from the production sales is collected
  - Farms may alleviate credit constraint for land through rental markets (more than 50% of land is rented in CEE).
  - Additionally, in most cases rents are paid at the end of the season, which further reduces the pre-financing needs for land.
  - Furthermore, land may serves as collateral and therefore, this is an additional factor which may reduce farms' credit constraint on land.