We start with the following linear model:

$$Y_{jt} = \beta_0 + \beta_1 X_{jt}^1 + \ldots + \beta_N X_{jt}^N + a_j + \mu_{jt}$$
$$t=2008,2011 \;\; ; \; j=firm\ 1,\ldots,firm\ N \qquad [S1.1]$$

The variable a_j represents the "unobserved heterogeneity" and covers the unobserved factors that do not change over time, but which affect the endogenous variable. Generally, the variable a_j, is also known as the "unobserved effect" or "fixed effect". Hence, the model (S1.1) takes the names of the unobserved effects model or fixed effects model. The idiosyncratic error, μ_{jt}, represents the unobserved factors that change over time and which affect the endogenous variable. The combination of the two terms, $(a_j + \mu_{jt})$, is known as the composite error.

Given that a_j does not depend on time, we can take the first differences of the data from the two years. For a cross-sectional observation *j*, we can estimate for each year:

$$Y_{j2011} = (\beta_0 + \delta_0) + \beta_1 X_{j2011}^1 + \ldots + \beta_N X_{j2011}^N + a_j + \mu_{j2011} \qquad [S1.2]$$

$$Y_{j2008} = \beta_0 + \beta_1 X_{j2008}^1 + \ldots + \beta_N X_{j2008}^N + a_j + \mu_{j2008} \qquad [S1.3]$$

$$j=firm\ 1,\ldots,firm\ N$$

If we take away equations [I.2] y [I.3], we are left with:

$$\left(Y_{j2011} - Y_{j2008}\right) = \delta_0 + \beta_1\left(X_{j2011}^1 - X_{j2008}^1\right) + \ldots$$
$$\ldots + \beta_N\left(X_{j2011}^N - X_{j2008}^N\right) + \left(\mu_{j2011} - \mu_{j2008}\right) \qquad [S1.4]$$

The final expression of the first differences model is:

$$\Delta Y_j = \delta_0 + \beta_1 \Delta X_j^1 + \ldots + \beta_N \Delta X_j^N + \Delta\mu_j \qquad [S1.5]$$

where "Δ" represents the change from t=2008 to t=2011. The unobserved effect, a_j, does not appear in the equation [S1.5], as it has been eliminated by using the difference. The intercept that appears in the new model, δ_0, is in reality the change in the constant from t=2008 to t=2011.

Figure S1. Development of the first differences model