University of Innsbruck

Working Papers in Economics and Statistics

Productive disasters? Evidence from European firm level data

Andrea M. Leiter, Harald Oberhofer and Paul A. Raschky

2007-25

Productive disasters? – Evidence from European firm level data

A. M. Leiter*
H. Oberhofer†
P. A. Raschky‡

October 16, 2007

Abstract

This paper examines the impact of floods on firms' capital accumulation, employment growth and productivity by using a difference-in-difference approach and considering firms' asset structure. We find evidence that companies in flooding regions show higher growth of total assets and employment than firms in areas which did not face a flooding. This positive effect is even more pronounced for companies with larger shares of intangible assets. Regarding the firms' productivity a significantly negative flood effect is observable which declines with increasing share of intangible assets.

JEL Codes: D24, Q54, R10, C21

Keywords: Natural Disasters, Firm Growth, Gibrat's Law, Productivity, Difference-in-Differences

*Department of Economics, Faculty of Economics and Statistics, Universitätsstrasse 15, 6020 Innsbruck, Austria.
Tel.:(+43)512 507 7404. E-mail: andrea.leiter@uibk.ac.at.

†Department of Public Finance, Faculty of Economics and Statistics, Universitätsstrasse 15, 6020 Innsbruck, Austria.
Tel.:(+43)512 507 7164. E-mail: harald.oberhofer@uibk.ac.at.

‡Department of Public Finance, Faculty of Economics and Statistics, Universitätsstrasse 15, 6020 Innsbruck, Austria and alpS - Centre for Natural Hazard Management, 6020 Innsbruck, Austria.
Tel.:(+43)512 507 7160. E-mail: paul.raschky@uibk.ac.at.

1 Introduction

Natural disasters such as hurricanes, earthquakes, floods occur every year and leave their mark on landscape, population and industries. While there is no doubt that disasters are accompanied by human suffering recent studies provide evidence that the consequences of natural hazards on aggregated output can be positive.

In public perception and media coverage reports on disaster losses are dominated by figures on destroyed or damaged capital stock. In contrast, economic literature on the effects of natural catastrophes favours flow variables as loss measurement, because of their comprehensiveness and consistency (Rose 2004, Ikefuji and Horii 2006). The general findings in the existing empirical literature on the impact of disaster on output can be summed up as followed: As a direct effect, natural disasters physically destroy the factors of production, labour (e. g., Anbarci, Escaleras and Register 2005, Kahn 2005, Halliday 2006) and physical capital (Albala-Bertrand 1993). These direct impacts cause business interruptions at the affected firms and set off additional indirect effects at companies up- and downstream in the supply chain (Rose 2004). The aftershock period can follow several paths, that have been simulated in a numerical model by Tol and Leek (1999). If the investment rules of the firms do not change and lost capital is not replaced the level of production is permanently lowered. Given that the destroyed capital stock is replaced, either through insurance, internal reserves or governmental aid, the output might just drop in the immediate aftermath of the event and than increase at an even higher rate. Economic scholars largely agree that the major impetus for this rise in the output-rate comes from an update in technology and/or factor composition. For example, Skidmore and Toya (2002) argue that disasters induce an update of the capital stock and provoke the use of new technologies which positively influence long-run growth. Furthermore, the authors point to the possibility that since the expected return to physical capital decreases due to higher risk to physical capital loss, the relative return to labour input correspondingly increases. This development may lead to higher investment in employment which also has the potential to improve company's performance. Using a gravity equation framework and running panel data regressions Crespo-Cuaresma, Hlouskova and Obersteiner (2007) analyse the effects of catastrophic risks on the degree of trade-related foreign knowledge spillovers. Their results indicate that only relatively developed developing countries experience a positive effect due to capital upgrading while in general natural hazards negatively influence technology spillovers between industrialized and developing countries.

Raschky (2007) provides a short-run analysis of flooding effects. The author points out that in the short-run (within the same year) floods decrease regional income, followed by an increase in the next period. The natural catastrophe might result in investment activity in production factors that goes beyond the sole replacement of disaster losses and result in a less productive factor composition. The idea of an increase in total factor productivity might therefore hold in the long-run, however, this increase seems to be preceded by a decrease in factor productivity in the short-run. Firms need some time to adjust the optimal composition of production factors and have to learn about their productivity (Jovanovic 1982). An additional negative effect of disasters observable via factor productivity could merge from the demand side of the market (Auffret 2003, Shughart 2006, Sobel and Leeson 2006). The magnitude of the disaster effect on a firm is not solely determined by the magnitude of the natural process itself (e. g., Richter-scale, water level) but also by company-specific factors such as investment strategies (Tol and Leek 1999, Skidmore and Toya 2002), factor composition (Jovanovic 1982) or disaster relief (Sobel and Leeson 2006, Shughart 2006). Okuyama (2003) puts forward that older capital stock is more vulnerable to natural disaster. However, the 'age' of the capital stock is a rather ambiguously defined and is hard to transfer in a consistent measure over different types of capital stock. The analyses so far have a clear mid to long-run perspective. Furthermore, most of the previously mentioned studies examine the economic effects of natural disasters on industry performance using highly aggregated data. This paper explicitly focuses on the immediate flood effects. To our knowledge there is no empirical study so far that estimates the short-term effects of natural disasters on firm-level. It thus augments the existing econometric literature on natural hazards and growth by emphasizing on these effects resulting from disasters in the immediate aftermath of an event. We also take into account the idea of various levels of 'resilience' depending on the type of capital stock via the structure of firms' assets. In this paper we analyse the effects of floods on physical capital accumulation, the level of employment and productivity using cross-section data of European companies. Physical capital is measured by a firm's total asset, employment is expressed as number of employees and productivity is depicted as operating revenue per employee. Using a difference-in-difference (DID) approach we find that physical capital accumulation as well as the level of employment is significantly higher in flooding regions. This positive effect is even more pronounced for companies with high intangible assets (e.g. know-how, patents, software, trademarks). Regarding productivity we find a significantly negative impact on the post-flooding productivity level in general. This negative effect on the operating revenue per employee decreases with increasing proportion of intangibles.

The following sections describe the procedure and findings in detail. Section 2 presents the data and descriptive statistics, Section 3 discusses the model and the econometric procedure. Section 4 provides the estimation results. Finally, Section 5 concludes.

2 Data

The investigation of immediate direct and indirect effects of natural disasters on a firm level requires data on firm performance as well as information on natural disasters. The firm level data are provided by the AMADEUS Database.[1] The used version of the AMADEUS database contains the time period from 1993 until 2004. Only manufacturing companies are included in the final dataset to assure that, only enterprises, which use potentially destructible capital stocks in the production process, are analyzed.

The data on the natural disaster event (flood) is provided by the EM-DAT dataset collected by the Centre for Research on the Epidemiology of Disasters

[1]The Bureau van Dijk distributes the AMADEUS database, which includes financial statements, profit and loss accounts and information on companies' organizational structure of 8.8 million firms located in 40 European countries.

Table 1: Number of firms listed by country

Country	Number of Firms	Percent
France	31,607	21.97
Greece	1,053	0.73
Hungary	1,590	1.11
Italy	69,463	48.29
Spain	30,447	21.17
United Kingdom	9,694	6.74
Total	143,854	100.00

(CRED) in Brussels.The flood event has to fulfill at least one out of a list of criteria to be included in the EM-DAT. The possible scenarios are: 10 or more killed people, 100 or more affected people, declaration of emergency or a call for international assistance as a consequence of the flood incident (see Raschky 2007). The AMADEUS and EM-DAT databases are merged using the information about the regional location of the companies and the regional occurrence or non-occurrence of flood events.

The aim of this empirical investigation is to analyze the effects of one flood on firms' performance. For this reason one flood event has to be selected which occurred somewhere in the middle of the time series to investigate possible effects on firm performance. Within the years 1996 and 2001 the largest flooding happened in the year 2000 and affected 30 NUTS2 regions in Europe. To assure that firms in the affected areas were only confronted to the flood in 2000, all companies in regions where another flood event occurred before and/or after 2000 have been eliminated from the data sample.

Table 1 shows the number of firms located in countries where at least one region has been affected by a flooding in 2000. Countries which had no flood in 2000 are not included in the final dataset. For a DID estimation the treatment and the control group should be approximately balanced in terms of sample size. Table 2 reveals that the treatment (affected) and control groups (non-affected) are well balanced.

Table 2: Number of firms in non-affected and affected areas

	Number of Firms	Percent
No-Flood	72,665	50.51
Flood	71,189	49.49
Total	143,854	100.00

2.1 Descriptive Statistics

This section gives a short summary statistics of the variables which will be used for estimation in Section 3.

Table 3 reports the mean, standard deviation, minimum and maximum of the dependent variables in the estimation models. Companies which are located in the non-flood-affected regions are clearly larger in terms of capital (measured in total assets) and labour (expressed as number of employees). Despite this higher level of input factors, companies in the non-flood-affected regions are on average less productive than firms in flood regions and average productivity decreases over time for all enterprises. The major difference in factor endowments between the firms could indicate a structural economic distinction between the analysed regions. However, the used DID approach allows to control for these differences in the estimation procedure.

Table 4 reports the same data attributes for the explaining variables. Companies in the affected and non-effected regions also differ in the mean of the initial vales of total assets and employees. The average age of the companies in affected and non-affected regions is very similar and companies in flooding areas tend to slightly use more intangible assets in the production process which are more reliable against flood events than tangible assets.

3 Empirical strategy

We infer our empirical model of capital accumulation from the Gibrat's Law firm size literature (e. g. Evans 1982, Sutton 1997, Fotopoulus and Louri 2004). In these studies, initial values of the firm size and age of the company are included as explanatory variables. The effect of hazards on productivity is examined using a procedure analogous to the Cobb-Douglas framework.

3.1 Explanatory variables

The econometric implementation follows the DID approach described in Wooldridge (2002). We consider two time periods – before and after flooding – and split our sample into two groups – flooding and non-flooding regions. The former (latter) is called the treatment (control) group. The time dummy which equals 1 for the period after the flooding and 0 otherwise, allows us to account for aggregate changes over time which are relevant for both groups. The treatment dummy (1 if a flood occurred, 0 otherwise) considers differences between the treatment and control group before a flooding occurred. The interaction of the time and flood dummy represents the DID estima-

Table 3: Summary statistics of dependent variables

Variable	Treatment/Period	Observations	Mean	Std. Dev.	Min	Max
Total Assets	0/0	52,654	23,468.260	584,505.000	0	84,921,488.670
	0/1	52,654	30,778.370	1,307,563.000	0	245,066,930.700
	1/0	48,057	15,906.990	285,944.800	0	44,195,956.670
	1/1	48,057	17,548.100	299,147.200	0	49,453,999.000
Employees	0/0	40,470	144.010	1,982.839	1	269,666.700
	0/1	40,470	148.683	1,961.473	1	266,000.000
	1/0	43,162	74.933	886.977	1	147,276.000
	1/1	43,162	84.352	979.629	1	146,294.000
Productivity	0/0	40,193	235.025	987.462	.036	159,217.800
	0/1	40,193	212.787	692.335	2	89,664.780
	1/0	43,112	275.813	1,172.836	0	164,618.500
	1/1	43,112	250.274	3,678.005	1	711,740.700

Table 4: Summary Statistics of explaining Variables

Variable	Treatment/Period	Observations	Mean	Std. Dev.	Min	Max
Initial Total Assets	0/0	50,043	21,096.860	361,901.300	0	54,371,806.000
	1/0	50,626	14,855.440	248,473.700	0	41,470,366.000
Inital Employment	0/0	33,060	175.640	2,189.420	1	287,000.000
	1/0	39,565	87.040	996.620	1	141,315.000
Age	0/0	64,348	17.770	18.230	0	302.000
	1/0	63,939	17.300	15.340	0	801.000
Sh. o. Int. Assets	0/0	52,212	.032	.076	0	1
	0/1	52,212	.033	.075	0	1
	1/0	47,958	.036	.073	0	1
	1/1	47,958	.037	.073	0	.911

Notes: Companies age is calculated using 1999 as reference year tor. It equals one for treatment group members in the after flood period. This estimator solely measures the flood effects on capital accumulation and productivity, respectively, since we control for the general group- and time-specific effects. The econometric advantage of using the frequency of flooding as treatment is its exogeneity. I. e., the occurrence of such an event is independent on study designs and country specific characteristics.[2]

In the physical capital and employment regressions we include besides the DID variable, the time and treatment dummy, the initial values of physical capital and employment, respectively, age of the firm, the ratio of intangible assets to total assets and an interaction term of the DID dummy with the share of intangibles. The motivation for the latter stems from the assumption that the consequences of floods on capital accumulation may differ depending on the vulnerability of the capital stock. We assume that tangible (intangible) assets are potentially more (less) exposed to floods. Productivity (measured as operating revenue per employee) is regressed on capital- and labour inputs, ratio of intangible assets to total assets, interaction of this share of intangibles with the DID estimator, and DID, time and treatment effects.[3] While the assets and employment estimates analyse the direct effects of floods, the productivity function refers to indirect flooding impacts.

[2]We are aware that the inclusion of a flood event in the EM-DAT database may be for example correlated with a country's ability to prevent floods and/or mitigate their potential for damage. Consequently, depending on the negative outcome flood may or may not fulfill the requirement to be included in the database. However, as the classification of an event as natural disaster does not solely depend on (financial) damages but also on other consequences (e. g., fatalities, people affected, state of emergency) and as the group of countries considered is rather homogeneous regarding their economic development we think that the inclusion of an event in the database is rather independent on country specific characteristics such that the classification of floods as an exogenous treatment should be justified.

[3]The log values of the continuous variables are used in the regressions.

interpreted as indirect effects as they influence productivity via the input factors.

3.2 Estimation procedure

To analyse which factors determine physical capital accumulation and employment growth we run OLS and 2SLS regressions for both, physical capital accumulation and employment growth. The motivation to use instrumental variables arises from the fact that the initial values of total assets and number of employees, which are values from 1997, are themselves generated by each firm's growth process. As shown in Table 4 the treatment group differs in their initial values of total assets and level of employment. This difference might influence the growth dynamics in the regions which may lead to potential endogeneity such that the OLS model would not provide consistent estimates.

We take the logarithm of all continuous variables before we include them in the regression functions. In the OLS case we regress total assets (*ltoas*) and number of employees (*lempl*), respectively, on its corresponding initial value (*ltoasi*) or (*lempli*), firm's age (*lage*), share of intangible assets compared to total assets (*SIA*), time (*time*), treatment (*treatment*) and DID (*DID*) dummies, the interaction of the share of intangibles with the DID dummy (*SIA**DID*), industry (*ind*) and country (*country*) specific effects and on a constant:

$$Ltoas_{ijrct} = \beta_0 + \beta_1 * ltoasi_{ijrct} + \beta_2 * lage_{ijrct} + \beta_3 * SIA_{ijrct} + \beta_4 * time_t + \beta_5 * treatment_r + \beta_6 * DID_{rt} + \beta_6 * (SIA * DID)_{ijrct} + \varphi * ind_i + \iota * country_c + \epsilon_{ijrct} \tag{1}$$

$$Lempl_{ijrct} = \gamma_0 + \gamma_{ijrct} * lempli_{ijrct} + \gamma_2 * lage_{ijrct} + \gamma_3 * SIA_{ijrct} + \gamma_4 * time_t + \gamma_5 * treatment_r + \gamma_6 * DID_{rt} + \gamma_6 * (SIA * DID)_{ijrct} + \lambda * Ind_i + \kappa * Country_c + \nu_{ijrct} \tag{2}$$

The indices represent a company i in industry j located in region r[4] in country c at period t.[5] In the IV regression we instrument the initial capital (labour) values using (i) the average amount of total assets (average number of employees) in each NACE industry and (ii) the industry specific minimum efficient scale which is another proxy for firm size.[6] A Hausman specification test is used to identify the appropriate model.

The model for productivity is embedded in a Cobb-Douglas production func-

[4] In this paper region is defined in terms of risk, i. e., the dummy describes the flooding and non-flooding areas.

[5] i ranges from 1 to 143,854; j from 1 to 103; c from 1 to 6; r=1,2 and t=1,2.

[6] Our measure of minimum efficient scale (MES) is the 50 percent percentile of the initial total assets (employment) distribution within a NACE industry within our data sample and is therefore only a proxy for the real MES.

tion framework and takes the following form:

$$\begin{aligned} Y_{ijrct} = \delta_0 + \delta_1 * ltoas_{ijrct} + \delta_2 * lempl_{ijrct} + \delta_3 * SIA_{ijrct} + \delta_4 * time_t + \\ \delta_5 * treatment_r + \delta_6 * DID_{rt} + \delta_6 * (SIA * DID)_{ijrct} + \\ \phi * ind_i + \upsilon * country_c + \eta_{ijrct} \end{aligned} \tag{3}$$

with Y, *ltoas* and *lempl* representing the operating revenue per employee, total assets and number of employees, respectively. Again, i, j, r, c and t index company, industry, region, country and period, respectively.

4 Results

In order to examine the importance of disasters in determining physical capital accumulation and employment growth we run two separate regressions for each of the dependent variables, applying OLS and IV models. Columns (1) and (2) of Table 5 depict the estimates using total assets as the dependent variable, columns (3) and (4) report regression results with the number of employees as dependent variable. In all four equations, the initial values of capital stock and level of employment reveal a positive influence on the corresponding present values (dependent variables). The level of the corresponding OLS-coefficients in (1) and (3) and the IV-parameter in (4) indicate that companies with low initial values possess a higher capital stock growth (total assets and number of employees, respectively) than firms with large opening stocks. I. e., as these coefficients are significant different from one we conclude that small companies grow faster than their larger counterparts. This observation corresponds to the empirical findings in the firm size literature (e. g. Fotopoulus and Louri 2004, Bloningen and Tomlin 2001) but contradicts the argument of Gibrat (1931) who proposes that growth of companies is independent of its initial size (capital stock). However, the coefficient of initial total assets in column (2) do not significantly differ from 1 and supports the statement of Gibrat (1931) that the initial firm size is not a relevant factor for firm growth. Company's age reveals a significant and negative impact on total assets and employees, respectively, in all four regressions indicating, that the capital stock growth of young firms is larger. This finding is in line with the results in studies examining firm size determinants (e. g. Evans 1982, Sutton 1997). Also a consistent picture is observable regarding the time effects. The time dummy captures the variation in the physical capital stock and level of employment between the before and after flood period. In all equations it reveals a positive influence on growth of total assets and number of employees. The treatment dummy reveals that total assets and the level of employment are on average lower in the treatment group but this difference is only significant for labour. We also controll for industry and country specific effects by including industry and country dummies and find that they are jointly significant determinants of the dependent variables.

The key parameters for our analysis are the share of intangible assets, the DID estimator (time*treatment) and its interaction with the asset share (time*treatment*SIA).

Some authors point at the different resilience of assets regarding disasters (e. g. Okuyama 2003, Skidmore and Toya 2002). We take this idea into account by introducing the structure of firms' assets and distinguishing between intangible and tangible assets. While the latter is potentially exposed to flood the former is not. Hence, a higher (lower) positive (negative) DID effect if expected for intangible assets. The OLS-coefficients in (1) indicate that total assets growth significantly decrease with an increasing proportion of intangible assets. However, the IV-parameter in column (4) suppose a significant rise in employment growth with increasing shares of intangibles. The corresponding values in column (2) and (3) are positive but not significantly different from zero. The importance of the asset structure in determining the economic consequences of floods is strengthened by the coefficients of the DID variable and its interaction with the share of intangibles. As can be seen in Table 5 the corresponding coefficients are significantly positive across all estimation models. This indicates that companies in the affected regions possess significantly higher total assets growth and employment growth after a flooding occurs than firms in non affected areas. This positive effect is even more pronounced for companies with large shares of intangible assets. In order to choose the appropriate estimation model for total assets and employment, respectively, we conduct a Hausman specification test. The results of the test statistics are reported in the bottom of Table 5 and indicate that the IV model should be favoured over the OLS estimates in case of total assets. For employment, the OLS version outperforms the IV alternative.

To summarize, the effects of floods positively influence the physical capital accumulation and employment growth. This may be traced back to (replacement) investment in new and more valuable equipments. The increase in total assets and employment is more distinct for firms with high intangible assets which may be a result of the durability of intangibles regarding the physical impacts of floods. We interpret these impacts as 'direct' effects of floods as the production factors capital and labour are immediately affected by flooding.

Indirect effects may occur due to the consequences of floods on input factors which are passed on the production process. We measure the indirect effects of a flooding via their impact on productivity. The corresponding estimates are reported in Table 6.[7] Firms with a high amount of intangible assets are apparently less efficient. Different from the asset and employment estimates the time dummy suggest a general decrease of productivity over time. An overall economic downturn could be an explanation of this observation. The productivity of the treatment (flooding) group is on average significantly higher than in the control group as it is denoted by the treatment dummy. One reason for the higher productivity in flooding areas may be an efficient restructuring of factor inputs to protect companies from economic losses due to floods. For example, if agents are aware that their firms are located in a flooding zone they may choose a mix of input factors which reduce potential losses if a flooding occurred. The included industry and country dummies are again jointly significant.

Also in the productivity equation, the flood effects on companies in the treatment group are depicted by the DID estimator and its interaction with the share of intangibles. The overall lower productivity of companies in affected

[7]The negative sign of the labour input coefficient accomplishes as we define our productivity measure by operating revenue per employee. Thus, we divide the CD production function by L and taking the log of the CD production function. Taking the logarithm of $Y/L = AK^{\beta}L^{-\beta}$ leads to $\log(Y/L) = \log A + \beta \log K - \beta \log L$.

areas in the post-flood period – as represented by the DID coefficient – can be explained by a time consuming learning process to adopt an appropriate composition of factor inputs (Jovanovic 1982). Floods might have destroyed factors such that a replacement and/or restructuring have to take place to achieve an efficient mix of inputs. Another reason for the decrease in productivity may be the demand sensitivity of our productivity measure. A short-run overall economic downturn associated with a short-run decrease in demand reduces firms' turnover and could lead to diminished turnovers per employee.[8] The interaction of the DID variable with the variable representing the asset structure (SIA) reveals a significant positive influence on firms' productivity. We interpret this as evidence that companies in affected areas with less assets at risk are confronted with diminishing negative effects on their productivity while firms with large tangible assets may face more severe negative consequences due to floods. In order to provide a deeper insight into these effects we differentiate equations (1), (2) and (3) with respect to the DID parameter and calculate the marginal effects of the flooding for firms located in the affected regions, considering various levels of intangible assets. Table 7 reports the marginal effects of floods on total assets, employment, and productivity at different shares of intangible assets. The calculations refer to companies located in affected regions after the flooding occurred. The estimates regarding total assets clarify that the overall increase in capital growth does not hold for all companies. Rather, firms with high tangible assets are

[8]Demand shocks may complicate our analyses if such shocks are restricted to some regions. However, as long as the recession is symmetric, i. e., if the economic downturn affects all European countries on a comparable extent, our estimates will not be biased. We control for such effects by including country dummies.

negatively effected by floods which is expressed as decrease in total assets. From the 70th percentile of intangibles on a positive flood effect is observable. A monotonic increase is also recognisable for employment. The higher the amount of intangible assets of companies, the more the flood fosters employment growth in the post-flood-period. Our short-run results regarding firms' productivity reveal that these positive direct effects on factor inputs are not passed on. In fact, the occurrence of floods significantly reduces the efficiency of companies in affected areas. As mentioned above, the lower productivity may be a result of inefficient factor compositions as companies might not be able to immediately adopt the proper mix of physical capital and labour employment. Another explanation for the decreasing productivity could be a general economic recession in the short-run accompanied by a decreasing demand for products. Such development would reduce firms' turnover, and hence, the turnover per employee. However, the negative effect of floods on productivity is diminishing with increasing shares of intangible assets.

5 Conclusions and Discussion

In economic terms, natural disasters can initiate a sudden, exogenous shock for production factors – at least on firm-level. The corresponding consequences do not only evolve through the physical destruction per se but may be accompanied by effects on labour and productivity.

In this paper we examine the consequences of floods on firms' factor endowment and productivity and differentiate between highly and less floodresistant endowments. Using a DID approach we distinguish between affected and non-affected regions and two periods – before and after flooding – to analyse the change in total assets, in employment and in productivity (measured by turnover per employee) induced by a flooding. Our estimates provide evidence that the physical capital stock accumulation and employment growth is higher for companies which are located in flooding areas. This positive impact is increasing with increasing share of intangible assets but it is not passed on to firms' productivity. Rather, the coefficient of the DID variable in the productivity equation is significantly negative. However, its interaction with the share of intangibles reveals a significant and positive impact on productivity indicating diminishing negative effects of floods on productivity with increasing shares of intangibles.

Marginal flood effects are calculated at different level of intangible assets to examine the influence of floods on physical capital accumulation, employment growth and productivity. The results indicate that physical capital accumulation and employment growth is the higher the higher the proportion of intangibles. Contrary to this trend, post-flooding productivity in the treatment group is lower. However, the negative trend slows down with increasing shares of intangible assets. We interpret the findings regarding the impact of floods on total assets accumulation, employment growth and productivity that firms with high intangibles are less vulnerable regarding flood impacts.

Table 5: Estimates on total assets and employment

Variable	(1) OLS	(2) IV	(3) OLS	(4) IV
Initial Total Assets	0.915*** (0.001)	1.012*** (0.008)		
Initial Employment			0.905*** (0.001)	0.982*** (0.008)
Age	−0.092*** (0.002)	−0.146*** (0.005)	−0.055*** (0.002)	−0.098*** (0.005)
Share o. Int. Assets (SIA)	−0.008*** (0.002)	0.002 (0.001)	0.000 (0.001)	0.003*** (0.001)
Time	0.110*** (0.004)	0.110*** (0.004)	0.160*** (0.004)	0.160*** (0.004)
Treatment (Flood)	−0.003 (0.004)	−0.004 (0.004)	−0.03*** (0.004)	−0.026*** (0.004)
Time * Treatment (DID)	0.080*** (0.010)	0.068*** (0.010)	0.089*** (0.009)	0.084*** (0.009)
Time * Treatment * SIA	0.017*** (0.001)	0.015*** (0.002)	0.012*** (0.002)	0.011*** (0.002)
Industry Dummys	yes	yes	yes	yes
F-Stat	15.342***	7.289***	13.332* * *	8.681***
(df; df)	(102; 96,839)	(102; 96,839)	(102; 84,207)	(102; 84,207)
Country Dummys	yes	yes	yes	yes
F-Stat	274.811***	213.479***	98.828***	50.647***
(df; df)	(5; 96,839)	(5; 96,839)	(5; 84,207)	(5; 84207)
Sargan Test		1.876 (0.1708)		1.780 (0.1821)
Hausman Test	142.070** (0.039)		93.250 (0.9226)	
Observations	96,954	96,954	84,322	84,322
R^2	0.908	0.900	0.900	0.895

Notes: Standard errors are given in parenthesis. The symbols ** and *** indicate the 5% and 1% level of significance.

Included instruments: average firm size in NACE-classification industries, minimum efficient scale.

Table 6: Estimates of Productivity

Variable	Productivity OLS
Total Assets	0.694^{***} (0.002)
Employment	-0.752^{***} (0.002)
Share of Int. Assets (SIA)	-0.139^{***} (0.001)
Time	-0.021^{***} (0.003)
Treatment (Flood)	0.111^{***} (0.004)
Time * Treatment (DID)	-0.019^{**} (0.008)
Time * Treatment * SIA	0.004^{***}(0.002)
Industry Dummys	yes
F-Stat	102.132^{***}
(df; df)	(102; 118,667)
Country Dummys	yes
F-Stat	1432.461^{***}
(df; df)	(5; 118,667)
Observations	118,782
R^2	0.709

Notes: Standard errors are given in parenthesis. The symbols ** and *** indicate the 5% and 1% level of significance.

Table 7: Marginal effects of floods for different shares of intangible assets (SIA)

	Total Assets	Employment	Productivity
Mean	0.002 (0.160)	0.035*** (41.880)	−0.037*** (61.540)
10% Percentile	−0.033*** (20.280)	0.005 (0.670)	−0.047*** (61.610)
20% Percentile	−0.020*** (9.750)	0.016*** (7.320)	−0.043*** (67.370)
25% Percentile	−0.015** (6.150)	0.020*** (12.210)	−0.042*** (68.340)
30% Percentile	−0.011 (3.420)	0.023*** (17.810)	−0.041*** (68.350)
40% Percentile	−0.003 (0.350)	0.030*** (30.690)	−0.039*** (65.780)
50% Percentile	0.004 (0.410)	0.036*** (44.620)	−0.037*** (60.260)
60% Percentile	0.011 (3.260)	0.042*** (58.130)	−0.035*** (52.660)
70% Percentile	0.018*** (8.490)	0.047*** (70.570)	−0.033*** (43.580)
75% Percentile	0.022*** (11.890)	0.051*** (76.170)	−0.032*** (38.660)
80% Percentile	0.026*** (15.660)	0.054*** (81.140)	−0.031*** (33.710)
90% Percentile	0.036*** (25.100)	0.062*** (89.680)	−0.028** (22.900)
Observations	25,988	23,955	32,091

Notes: Values of F-Statistic from non-linear Wald test given in parenthesis. The symbols ** and *** indicate the 5% and 1% level of significance.

References

Albala-Bertrand, J. M. (1993), 'Natural Disaster Situations and Growth: A Macroeconomic Model for Sudden Disaster Impacts', *World Development* **21**(9), 1417–1434.

Anbarci, N., Escaleras, M. and Register, C. A. (2005), 'Earthquake Fatalities: The Interaction of Nature and Political Economy', *Journal of Public Economics* **89**(9-10), 1907–1933.

Auffret, P. (2003), 'High Consumption Volatility: The Impact of Natural Disasters?'. World Bank Policy Research Paper 2962, World Bank.

Bloningen, B. A. and Tomlin, K. (2001), 'Size and Growth of Japanese Plantes in the United States', *International Journal of Industrial Organization* **19**(6), 931–952.

Crespo-Cuaresma, J., Hlouskova, J. and Obersteiner, M. (2007), 'Natural Disasters as Creative Destruction? Evidence from Developing Countries', *Economic Inquiry,* **forthcoming**.

Evans, D. S. (1982), 'Tests of Alternative Theories of Firm Growth', *Journal of Political Economy* **95**(4), 657–674.

Fotopoulus, G. and Louri, H. (2004), 'Firm Growth and FDI: Are Multinationals Stimulating Local Industry Development?', *Journal of Industry, Competition and Trade* **4**(3), 163–189.

Gibrat, R. (1931), *Les Inequalities Economiques*, Sirey, Paris.

Halliday, T. (2006), ‘Migration, Risk, and Liquidity Constraints in El Salvador’, *Economic Development and Cultural Change* **54**(4), 893–925.

Ikefuji, M. and Horii, R. (2006), ‘Natural Disasters in a Two-Sector Model of Endogenous Growth’, *Mimeo* . Graduate School of Economics, Osaka University.

Jovanovic, B. (1982), ‘Selection and Evolution of Industry’, *Econometrica* **50**(3), 649–670.

Kahn, M. E. (2005), ‘The Death Toll from Natural Disasters: The Role of Income, Geography and Institutions’, *Review of Economics and Statistics* **87**(2), 271–284.

Okuyama, Y. (2003), ‘Economics of Natural Disasters: A Critical Review’, *Mimeo* . Regional Research Institute, West Virginia University.

Raschky, P. A. (2007), ‘Estimating the Effects of Risk Transfer Mechanisms against Floods in Europ and U.S.A.: A Dynamic Panel Approch.’, *Mimeo* . Working Papers in Economics and Statistics No. 2007-05, University of Innsbruck.

Rose, A. (2004), Economic Principles, Issues, and Research Priorities in Hazard Loss Estimation, *in* Y. Okuyama and S. E. Chang, eds, ‘Modeling Spatial and Economic Impacts of Disasters’, Springer-Verlag, Berlin, pp. 13–36.

Shughart, W. F. (2006), 'Katrinanomics: The Politics and Economics of Disaster relief', *Public Choice* **127**(1-2), 31–53.

Skidmore, M. and Toya, H. (2002), 'Do Natural Disasters promote long-run Growth?', *Economic Inquiry* **40**(4), 664–687.

Sobel, R. S. and Leeson, P. T. (2006), 'Government's Response to Hurricane Katrina: A Public Choice Analysis', *Public Choice* **127**(1-2), 55–73.

Sutton, J. (1997), 'Gibrat's Legacy', *Journal of Economic Literature* **35**(1), 40–59.

Tol, R. S. J. and Leek, F. P. M. (1999), Economic Analysis of Natural Disasters, *in* T. E.Downing, A. A. Olsthoorn and R. S. J. Tol, eds, 'Climate, Change and Risk', Routledge, London, pp. 308–327.

Wooldridge, J. M. (2002), *Econometric Analysis of Cross Section and Panel Data*, MIT-Press, Cambridge and London.

University of Innsbruck – Working Papers in Economics and Statistics
Recent papers

2007-25 **Andrea M. Leiter, Harald Oberhofer and Paul A. Raschky:** Productive disasters? Evidence from European firm level data.
2007-24 **Jesus Crespo Cuaresma:** Forecasting euro exchange rates: How much does model averaging help?
2007-23 **Matthias Sutter, Martin Kocher and Sabine Strauß:** Individuals and teams in UMTS-license auctions.
2007-22 **Jesus Crespo Cuaresma, Adusei Jumah and Sohbet Karbuz:** Modelling and Forecasting Oil Prices: The Role of Asymmetric Cycles.
2007-21 **Uwe Dulleck and Rudolf Kerschbamer:** Experts vs. discounters: Consumer free riding and experts withholding advice in markets for credence goods.
2007-20 **Christiane Schwieren and Matthias Sutter:** Trust in cooperation or ability? An experimental study on gender differences. *Conditionally accepted for publication in: Economics Letters.*
2007-19 **Matthias Sutter and Christina Strassmair:** Communication, cooperation and collusion in team tournaments – An experimental study.
2007-18 **Michael Hanke, Jürgen Huber, Michael Kirchler and Matthias Sutter:** The economic consequences of a Tobin-tax – An experimental analysis.
2007-17 **Michael Pfaffermayr:** Conditional beta- and sigma-convergence in space: A maximum likelihood approach.
2007-16 **Anita Gantner:** Bargaining, search, and outside options. *Revised version forthcoming in: Games and Economic Behavior.*
2007-15 **Sergio Currarini and Francesco Feri:** Bilateral information sharing in oligopoly.
2007-14 **Francesco Feri:** Network formation with endogenous decay.
2007-13 **James B. Davies, Martin Kocher and Matthias Sutter:** Economics research in Canada: A long-run assessment of journal publications. *Revised version forthcoming in: Canadian Journal of Economics.*
2007-12 **Wolfgang Luhan, Martin Kocher and Matthias Sutter:** Group polarization in the team dictator game reconsidered. *Revised version forthcoming in: Experimental Economics.*
2007-11 **Onno Hoffmeister and Reimund Schwarze:** The winding road to industrial safety. Evidence on the effects of environmental liability on accident prevention in Germany.
2007-10 **Jesus Crespo Cuaresma and Tomas Slacik:** An “almost-too-late” warning mechanism for currency crises.
2007-09 **Jesus Crespo Cuaresma, Neil Foster and Johann Scharler:** Barriers to technology adoption, international R&D spillovers and growth.
2007-08 **Andreas Brezger and Stefan Lang:** Simultaneous probability statements for Bayesian P-splines.
2007-07 **Georg Meran and Reimund Schwarze:** Can minimum prices assure the quality of professional services?.
2007-06 **Michal Brzoza-Brzezina and Jesus Crespo Cuaresma:** Mr. Wicksell and the global economy: What drives real interest rates?.
2007-05 **Paul Raschky:** Estimating the effects of risk transfer mechanisms against floods in Europe and U.S.A.: A dynamic panel approach.
2007-04 **Paul Raschky and Hannelore Weck-Hannemann:** Charity hazard - A real hazard to natural disaster insurance.
2007-03 **Paul Raschky:** The overprotective parent - Bureaucratic agencies and natural hazard management.
2007-02 **Martin Kocher, Todd Cherry, Stephan Kroll, Robert J. Netzer and Matthias Sutter:** Conditional cooperation on three continents.
2007-01 **Martin Kocher, Matthias Sutter and Florian Wakolbinger:** The impact of naïve advice and observational learning in beauty-contest games.

University of Innsbruck

Working Papers in Economics and Statistics

2007-25

Andrea M. Leiter, Harald Oberhofer and Paul A. Raschky

Forecasting euro exchange rates: How much does model averaging help?

Abstract

This paper examines the impact of floods on firms' capital accumulation, employment growth and productivity by using a difference-in-difference approach and considering firms' asset structure. We find evidence that companies in flooding regions show higher growth of total assets and employment than firms in areas which did not face a flooding. This positive effect is even more pronounced for companies with larger shares of intangible assets. Regarding the firms' productivity a significantly negative flood effect is observable which declines with increasing share of intangible assets.

ISSN 1993-4378 (Print)
ISSN 1993-6885 (Online)