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Keywords: External financial dependence, financial constraints, financial crisis, firm performance.

JEL Classification: G10, G30, L25, F10.

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Abstract

Economic research has often relied on a measure of external financial dependence that is constructed using U.S. data and applied to other countries under the assumption of a stable industry ranking across countries. We exploit unique survey data from seven European countries to show that correlations of financial dependence across countries are weak, questioning this assumption. We then use the novel survey-based measure to show that the global financial crisis had a disproportionately negative impact on the real performance of financially dependent firms.

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1 Introduction

How do financial market conditions impact on real economic performance? This question has been examined at least since Schumpeter (1911) and regained particular relevance after the global financial crisis that started in 2008. Rajan and Zingales (1998, henceforth RZ) achieved significant progress towards establishing a causal effect of financial development on real growth by exploiting differences in external financial dependence (EFD) across industries. RZ measure industry-level EFD as the share of investment not financed by internal cash flow in the median listed U.S. firm. Their approach rests on two main assumptions: First, if the U.S. capital market is close to perfect, credit demand by listed U.S. firms should not be contaminated by supply-side imperfections, but instead reflect technological fundamentals.¹ Second, in applying the EFD index of U.S. industries to other countries, RZ assume that the industry ranking is constant across countries. It is the second assumption that we seek to test in this letter.

Since the seminal contribution by RZ, their EFD index has been used in many applications to different research questions and countries.² For instance, Manova (2013) uses the RZ index to identify the role of credit constraints for international trade, Dell’Ariccia et al. (2008) and Kroszner et al. (2007) examine how the real effects of banking crises vary by EFD, and Chor and Manova (2012) analyze the differential impact of the global financial crisis on exports.

In this letter, we exploit a unique survey question in the EFIGE dataset³ to examine the correlations of EFD across seven European countries and to test RZ’s second assumption for the first time using cross-country data.⁴ We then use both the RZ index and the survey-based measure in firm-level regression analysis to examine the differential effect of the global financial crisis on real performance of manufacturing firms across industries with varying EFD.

We find that industry rankings of EFD are weakly correlated across European countries, which challenges the stable-ranking assumption. The regression analysis reveals that the crisis had a disproportionately negative impact on firm performance in financially dependent industries according to the survey-based EFD index. In contrast, the RZ index yields insignificant or counter-intuitive estimates.

¹ While this conjecture is not the main subject of our paper, the global financial crisis of 2008, which originated in the U.S., has revealed that U.S. capital markets are still far from frictionless even in the 21st century.

² At the time of this writing, the paper by RZ ranks among the top 100 most cited research papers in economics (<https://ideas.repec.org/top>) with more than 7,500 citations registered on Google scholar (<https://scholar.google.com>, both accessed on February 17, 2017).

³ The data were collected in the project “European Firms in a Global Economy” (Altomonte and Aquilante, 2012, see <http://bruegel.org/efige/>).

⁴ Von Furstenberg and von Kalckreuth (2006, 2007) use U.S. data to investigate whether the RZ index reflects fundamental industry characteristics.

2 Data

To obtain the survey-based measure of EFD, we exploit the following question from EFIGE:

In the industry your firm works, how dependant [sic] are companies on external financing? To give your answer please use a score from 1 (not dependent [at] all) to 5 (Extremely dependent).

This question has three key advantages: First, it was posed at the same time to 14,364 manufacturing firms in seven European countries.⁵ Second, it mitigates reporting bias by addressing general conditions in the firm's industry rather than the firm's own financial situation. Third, its general formulation should cover all relevant aspects of EFD. Our survey-based measure of EFD is the arithmetic mean of firms' responses by industry j and country c .

Since the original RZ index is not available for the European industry classification used in EFIGE (NACE Rev. 1.1), we follow RZ in computing the index from Compustat data on U.S. firms. We choose firms from the more recent period 1990-2005 and assign to each firm the NACE code corresponding to its SIC code.⁶

For our analysis of firm performance, we merge the industry-level EFD measures to the Orbis firm dataset provided by Bureau van Dijk (BvD). Our panel includes 190,418 manufacturing firms from the seven EU countries under study over the period 2005-2010. It covers only firms (i) whose core activity is classified as manufacturing by their NACE code and (ii) which belong to the size classes medium, large, and very large, as defined by BvD. We compute real growth rates of performance variables (see Section 4), using producer price indices at the most disaggregate industry level that is available from Eurostat for each country (usually 4-digit NACE).

3 Comparing industry rankings of EFD

Industry rankings of EFD for the RZ index for the U.S. (from Compustat) and the survey-based measure by country (from EFIGE) are listed in Table A.1 in the Appendix. Table 1 shows Spearman rank correlation coefficients for all pairwise comparisons between these rankings.

⁵ The data contain a representative sample for manufacturing firms with 10 or more employees surveyed in 2010 in Austria (AUT), France (FRA), Germany (DEU), Hungary (HUN), Italy (ITA), Spain (ESP), and the United Kingdom (GBR).

⁶ See the Web Appendix available on our website for details. In a related paper, Ferrando et al. (2008) compute the RZ index for listed European firms.

Two observations stand out. First, the ranking of U.S. industries based on the RZ index is not positively correlated with the rankings of EFD as perceived by European firms and reported in the EFIGE survey. Instead, the correlation coefficients reported in the first row of Table 1 are even negative for most countries except Italy and Spain, for which they are small and insignificant.

Second, when comparing the survey-based measure across countries, the industry ranking is highly unstable. Only for six out of 21 pairwise comparisons does the correlation coefficient exceed 0.3 and it is only significant at the 5% level (based on a two-sided t-test) in three of these cases. The correlation is close to zero for most country pairs and even negative in eight cases.⁷

Provided that the EFD score reported by firms for their industry is systematically related to the fundamental EFD, these observations indicate that (i) the RZ index is uncorrelated with EFD in European industries and (ii) even within Europe, there are substantial differences in the industry rankings of EFD across countries. These findings cast doubt on the standard practice of applying the EFD index based on U.S. firms to other countries.

Table 1: Correlations of EFD rankings across countries

	AUT	DEU	ESP	FRA	GBR	HUN	ITA
U.S. (Compustat)	-0.2707	-0.0200	0.0889	-0.1680	-0.2087	-0.0652	0.1104
AUT (EFIGE)		-0.0767	0.5609**	0.2887	-0.3699	-0.3263	-0.5414**
DEU (EFIGE)			0.2739	0.4279**	-0.1174	0.2925	0.3600*
ESP (EFIGE)				0.5178**	-0.1196	0.2105	-0.1937
FRA (EFIGE)					0.0761	-0.0446	0.0247
GBR (EFIGE)						0.2826	0.3391
HUN (EFIGE)							0.3982*

The table shows Spearman rank correlation coefficients for pairwise comparisons between the rankings of EFD across countries listed in Table A.1. The EFD index for U.S. firms is computed from Compustat for 1990-2005, following RZ. The remaining measures are based on average values of reported EFD by industry and country from the EFIGE survey. Correlation coefficients exceeding 0.3 are marked in bold. Asterisks indicate significance levels based on a two-sided t-test: * $p < 0.10$, ** $p < 0.05$.

4 Firm performance in the global financial crisis

We now use the Orbis panel dataset for 2005-2010 to analyze the differential impact of the global financial crisis on firms' real performance depending on EFD. This exercise fulfills the

⁷ Some firms in the EFIGE dataset were surveyed in a pilot study, some months before the main survey. Also, some industries host few firms. In unreported robustness checks, we confirm that the general picture of weak correlations in Table 1 remains unchanged after excluding firms from the pilot study or restricting the sample to countries and industries with at least ten observations.

double purpose of (i) assessing the detrimental impact of the crisis on firm performance through the credit channel, and (ii) evaluating the usefulness of the alternative EFD measures for this purpose.⁸

We estimate the following econometric model:

$$\Delta \ln Y_{cijt} = \beta \text{Crisis}_{ct} \times \text{EFD}_{cj} + \delta_{ct} + \delta_{cij} + \varepsilon_{cijt}, \quad (1)$$

where $\Delta \ln Y_{cijt} \equiv \ln Y_{cijt} - \ln Y_{cij,t-1}$ measures real growth in the performance of firm i , which is active in country c and industry j in year t . We examine the following dimensions of firm performance Y_{cijt} : real turnover (operating revenues), employment (number of workers), real labor productivity (value added per worker), and real exports (only available for AUT, GBR, and HUN). The key explanatory variable is the interaction term $\text{Crisis}_{ct} \times \text{EFD}_{cj}$ between the EFD measure (either from Compustat or EFIGE) and the dummy variable Crisis_{ct} , which equals one in the years of the banking crisis, as classified by the Worldbank's Global Financial Development Database (GFDD, Cihak et al., 2012).⁹ In theory, we would expect that a negative credit supply shock in the crisis tightens existing credit constraints and thereby reduces the quantities of inputs employed and output produced by constrained firms (captured by Y_{cijt}).¹⁰ Furthermore, the effect of credit constraints should be stronger in industries that depend more on external finance, as shown theoretically by Manova (2013) for exports. Based on this hypothesis, we expect $\beta < 0$.

Importantly, the firm fixed effect δ_{cij} in Equation (1) accounts for any time-invariant characteristics of countries, industries, and firms (such as firm size, productivity, and the level of EFD). The country-year fixed effect δ_{ct} controls for the overall crisis impact in each country and any other country-specific shocks. Equation (1) is essentially a firm-level variant of the main specification by Dell'Ariccia et al. (2008), who assess the effects of banking crises on real performance in a panel of countries and industries. Compared to their specification, our approach cannot include industry-year fixed effects, because we look at a single crisis, but it has the significant advantage of exploiting within-firm variation.

Table 2 summarizes our results of estimating Equation (1) for different performance variables and the two alternative EFD measures. When measuring EFD based on the EFIGE survey,

⁸ Our seven-country sample does not offer sufficient cross-country variation in financial development to re-assess the original RZ specification. We therefore exploit the shock to credit conditions in the crisis for identification, which also offers the advantage of controlling for firm-specific effects.

⁹ The GFDD indicate that the banking crisis started already in 2007 in GBR, but only in 2008 in the other six countries, and it did not end until 2010.

¹⁰ Empirical studies using linked firm-bank data have established a causal effect of the credit supply shock in the crisis on firm employment (Chodorow-Reich, 2013) and exports (Amiti and Weinstein, 2011).

our hypothesis is confirmed: all dimensions of firm performance were more negatively affected by the crisis in financially dependent industries compared to industries with low EFD. The estimated interaction effect is always negative and significant at conventional levels (with p-values in the range of 1-9%). In contrast, the interaction effect with the Compustat index is zero for employment and exports, and it suggests a counter-intuitive positive correlation for turnover and labor productivity. These results indicate that *if* the credit crunch had a differential effect on firm performance in line with our hypothesis and the existing literature, then the EFIGE measure is able to identify this effect for European firms, while the RZ index is not.

Table 2: Differential crisis impact on firm performance by EFD

	Turnover		Employment		Labor productivity		Exports	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Crisis</i> × <i>EFD</i> (EFIGE)	-0.075** (0.036)		-0.041* (0.024)		-0.080** (0.036)		-0.083** (0.032)	
<i>Crisis</i> × <i>EFD</i> (Compustat)		0.010** (0.005)		0.001 (0.002)		0.011** (0.004)		0.003 (0.012)
Observations	707,039	707,039	505,612	505,612	305,026	305,026	91,791	91,791
Firms	190,418	190,418	167,537	167,537	105,219	105,219	27,177	27,177
Clusters	163	163	163	163	139	139	70	70
R ² (within firm)	0.114	0.114	0.013	0.013	0.048	0.048	0.029	0.029

The table shows OLS estimates of Equation (1). The dependent variable for each column is the annual growth rate (in logs) of the respective variable indicated in the header. All regressions control for firm fixed effects and country-year fixed effects. Standard errors clustered by industry-country cell are reported in parentheses. Asterisks indicate significance levels: * p<0.10, ** p<0.05.

One might suspect that the estimations using the EFIGE measure suffer from an endogeneity issue due to reverse causality. If firms rated their industry lower in terms of EFD because they were hit harder by the crisis, this effect might bias our estimates of β downward. Even though we cannot fully rule out such a bias, we have three reasons to believe that it is not driving our results. First, the survey question is not concerned with the firm's own current circumstances, but targets general conditions in the industry. Second, for our results to be unbiased, we do not require that the reported EFD is entirely unaffected by the crisis. In particular, a uniform increase in the reported EFD of all firms in a given country would be absorbed by country-year fixed effects. Since the firms were surveyed simultaneously and since the crisis was highly synchronized across countries, as pointed out by Baldwin (2009) and confirmed in industry-level data,¹¹ we would not expect the EFD ranking in 2010 to differ systematically from the fundamental ranking. Third, in an important robustness check, we construct an alternative EFD

¹¹ EFIGE questionnaires were completed by all firms (except those from the pilot study) between January and May 2010 (Altomonte and Aquilante, 2012), while the majority of country-industry pairs in our sample experi-

measure based on questions in the EFIGE survey, which inquire about how the firm has financed its investments over the years 2007-2009. We compute the share of investments not financed internally for the median firm by industry, reflecting the idea of the RZ index. This alternative (country-industry specific) EFD measure is based on the firm's accounts and hence not prone to subjective judgment. The regressions using this measure confirm the differential crisis effects of Table 2 (see the Web Appendix). This finding further suggests that the differences across EFD measures documented in Table 1 are not merely driven by differences in measurement, but reflect inherent differences in EFD rankings across countries.

We conduct a series of additional robustness checks, which are detailed in the Web Appendix. The pattern that we find in our main regressions is insensitive to (i) controlling for additional interaction terms of year dummies with industry characteristics (capital intensity, share of tangible assets, average firm size, and the Herfindahl index of turnover in 2005), (ii) including the non-crisis period 2011-13, (iii) considering only the countries and industries for which the EFIGE EFD measure is based on at least ten firms, (iv) excluding potential outliers with extreme growth rates (top and bottom 1% of our dependent variables), and (v) excluding firms from the EFIGE pilot study when computing the EFD measure. In these robustness checks, the interaction term of the crisis dummy with the survey-based EFD measure is always estimated to be negative and remains statistically significant with few exceptions, while the interaction effect is never negative and significant for the Compustat index.

5 Concluding remarks

This letter suggests that an industry which is highly financially dependent in one country may rank low on EFD in another country. Investigating the fundamental determinants of these international differences seems an interesting area for future research. Our results further question the standard practice of applying an EFD index based on U.S. data to other countries. In a related paper, Ciccone and Papaioannou (2016) argue that this approach will cause a “benchmarking bias” if the U.S. index is a less noisy proxy (a better benchmark) for some countries than for others. In light of these insights, we suggest that future research on financial dependence should not rely exclusively on the U.S. index, but consider country-specific measures as complementary whenever possible. Finally, our findings suggest that the credit channel did contribute to reducing real firm performance in the global financial crisis.

enced the steepest drop in monthly output between October 2008 and March 2009 (based on seasonally adjusted volume indices of production for 2-digit NACE industries from Eurostat).

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A Data Appendix

Table A.1: EFD rankings across countries

code	NACE Rev 1.1 industry name	U.S. (Compustat)		AUT (EFIGE)		FRA (EFIGE)		DEU (EFIGE)		ITA (EFIGE)		ESP (EFIGE)		HUN (EFIGE)		GBR (EFIGE)									
		EFD	rank firms	EFD	rank firms	EFD	rank firms	EFD	rank firms	EFD	rank firms	EFD	rank firms	EFD	rank firms	EFD	rank firms								
16	Tobacco	-3.4462	1	13				4.0000	25	3			3.6432	24	4										
19	Leather and footwear	-1.3422	2	27	2.3369	5	32	2.6854	2	13	2.3101	10	115	2.8816	1	47	2.9467	6	4	3.7160	24	10			
361	Furniture	-0.5680	3	66				3.1252	17	67	2.5925	21	141	3.1542	8	206	3.3559	15	14	3.0595	6	90			
22	Publishing and printing	-0.4268	4	166	3.3747	14	34	3.0589	23	148	3.1547	19	105	3.3323	18	100	2.4970	2	27	3.2662	17	208			
28	Fabricated metal products	-0.3272	5	173	3.2828	13	70	2.6043	17	839	3.1429	18	510	2.3607	13	611	3.2016	10	580	3.1897	11	101	3.1667	12	301
35	Other transport equipment	-0.3057	6	92	5.0000	20	2	2.6581	19	16	3.4073	23	20	2.2043	2	33	3.6122	23	42	4.3720	22	3	2.9638	5	21
150	Food (excl. beverages)	-0.1454	7	197	3.0028	5	28	2.4341	10	194	3.0753	14	285	2.4027	15	200	3.0976	6	402	3.2721	13	52	3.2786	19	137
21	Pulp, paper and paper products	-0.1343	8	89	3.1800	8	10	2.4652	11	83	2.9631	10	62	2.3601	12	71	2.8854	2	27	3.1055	9	16	3.1883	14	47
23	Coke and refined petroleum products	-0.1114	9	63				2.3333	4	3	2.5695	1	4	2.1253	1	8							2.6991	1	6
26	Non-metallic mineral products	-0.0884	10	74	3.4615	17	18	2.3615	6	153	2.8727	7	94	2.3268	11	167	3.5672	22	163	3.5639	18	30	3.1494	11	56
20	Wood products, except furniture	-0.0627	11	62	3.2144	11	21	2.6703	20	93	3.4386	24	103	2.5789	20	88	3.2587	15	212	3.4507	16	17	3.2313	15	89
17	Textiles	-0.0427	12	75	3.8595	19	8	2.5975	16	118	2.8296	4	77	2.2046	3	196	3.4058	21	46	3.0567	8	7	3.1762	13	52
240	Chemicals (excl. pharmaceuticals)	0.0047	13	300	2.5833	2	5	2.4253	8	79	2.8719	6	76	2.2595	7	88	3.0600	5	104	3.2483	12	18	3.6003	23	94
34	Motor vehicles	0.0759	14	140	2.8214	4	6	2.4947	12	73	3.1681	20	41	2.2219	6	47	3.2527	14	64	3.2851	14	11	3.1297	10	33
27	Basic metals	0.0870	15	144	3.0087	6	13	2.9574	22	68	3.2563	21	58	2.4630	18	76	3.2279	12	68	4.2548	21	7	3.2682	18	54
18	Wearing apparel and fur	0.1021	16	124	3.6062	18	5	2.6242	18	55	2.7240	3	17	2.2743	8	109	3.3879	20	50	3.1564	10	17	3.3609	20	42
25	Rubber and plastic products	0.1205	17	150	3.2621	12	22	2.5890	14	226	2.9824	11	192	2.3638	14	167	3.2049	11	148	3.4907	17	40	3.2613	16	122
29	Machinery and equipment	0.1255	18	397	3.2055	10	48	2.4290	9	249	3.0743	13	503	2.4175	16	381	3.1288	7	305	3.0420	7	68	3.0931	8	208
31	Electrical machinery and apparatus	0.3269	19	615	3.4449	16	13	2.2367	3	113	2.9376	8	106	2.2066	4	143	2.9768	3	60	2.4296	1	18	3.0822	7	116
360	Other manufacturing (excl. furniture)	0.3719	20	159	2.1752	1	5	2.1247	2	16	2.9420	9	105	2.6424	23	70	3.0394	4	52	3.8399	20	4	3.1111	9	168
159	Beverages	0.3992	21	74	2.7172	3	4	2.5896	15	18	2.8582	5	62	2.6245	22	38	3.3667	19	57	3.7313	19	10	3.3663	21	10
30	Office machinery and computers	0.6565	22	365	3.1667	7	7	1.8791	1	8	3.3431	22	28	2.6667	24	9	3.2489	13	6	5.0000	23	1	3.3976	22	8
33	Medical/ precision/ optical instruments	1.0336	23	818	3.3855	15	15	2.3879	7	58	3.0637	12	192	2.2967	9	71	3.2590	16	25	2.7671	4	6	2.7771	2	80
32	Radio/ TV/ communication equipment	1.1559	24	296	3.1834	9	5	2.5131	13	94	3.1101	15	56	2.4211	17	49	3.1744	9	25	2.9181	5	9	2.7901	3	101
244	Pharmaceuticals	8.6029	25	731				2.7505	21	23	3.1121	16	19	2.2075	5	20	3.2990	17	17	2.5000	3	2	2.9621	4	10

The table shows rankings of industries in terms of external financial dependence (EFD) by country. The first three columns report the EFD measure for U.S. firms computed from Compustat data over the period 1990-2005, following RZ (see the Web Appendix). The remaining columns report averages of EFD by industry reported in the EFIGE survey in 2010.



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