External Financial Dependence and Firms’ Crisis Performance across Europe

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SRC Discussion Paper No 65
February 2017
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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.

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


This paper is published as part of the Systemic Risk Centre’s Discussion Paper Series. The support of the Economic and Social Research Council (ESRC) in funding the SRC is gratefully acknowledged [grant number ES/K002309/1].

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Published by
Systemic Risk Centre
The London School of Economics and Political Science
Houghton Street
London WC2A 2AE

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External Financial Dependence and Firms’ Crisis Performance across Europe *

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February 17, 2017

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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*The authors gratefully acknowledge financial support by the Volkswagen Foundation within its program “Europe and Global Challenges” as well as by the Economic and Social Research Council (UK) [grant number: ES/K002309/1]. The paper has benefited from valuable comments and suggestions by Bohdan Kukharskyy and Wilhem Kohler. Lennart Jansen provided excellent research assistance.

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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. 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. 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 dataset 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. 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 disproportionally 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 dependent (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. 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.

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.

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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

<table>
<thead>
<tr>
<th></th>
<th>AUT</th>
<th>DEU</th>
<th>ESP</th>
<th>FRA</th>
<th>GBR</th>
<th>HUN</th>
<th>ITA</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. (Compustat)</td>
<td>-0.2707</td>
<td>-0.0200</td>
<td>0.0889</td>
<td>-0.1680</td>
<td>-0.2087</td>
<td>-0.0652</td>
<td>0.1104</td>
</tr>
<tr>
<td>AUT (EFIGE)</td>
<td>0.5609**</td>
<td>0.2887</td>
<td>-0.3699</td>
<td>-0.3263</td>
<td>-0.5414**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEU (EFIGE)</td>
<td>0.4279**</td>
<td>-0.1174</td>
<td>0.2925</td>
<td>0.3600*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESP (EFIGE)</td>
<td>0.5178**</td>
<td>-0.1196</td>
<td>0.2105</td>
<td>-0.1937</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRA (EFIGE)</td>
<td>0.2826</td>
<td>0.3391</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GBR (EFIGE)</td>
<td>0.3982*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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:

\[
\Delta \ln Y_{cijt} = \beta \text{Crisis}_{ct} \times \text{EFD}_{cj} + \delta_{ct} + \delta_{cij} + \varepsilon_{cijt},
\]

(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 \(\text{Crisis}_{ct}\), 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 \(\delta_{cij}\) 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 \(\delta_{ct}\) 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 reassess 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

<table>
<thead>
<tr>
<th></th>
<th>Turnover</th>
<th>Employment</th>
<th>Labor productivity</th>
<th>Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Crisis × EFD (EFIGE)</td>
<td>-0.075**</td>
<td>-0.041*</td>
<td>-0.080**</td>
<td>-0.083**</td>
</tr>
<tr>
<td></td>
<td>(0.036)</td>
<td>(0.024)</td>
<td>(0.036)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>Crisis × EFD (Compustat)</td>
<td>0.010**</td>
<td>0.001</td>
<td>0.011**</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Observations</td>
<td>707,039</td>
<td>707,039</td>
<td>505,612</td>
<td>505,612</td>
</tr>
<tr>
<td>Firms</td>
<td>190,418</td>
<td>190,418</td>
<td>167,537</td>
<td>167,537</td>
</tr>
<tr>
<td>Clusters</td>
<td>163</td>
<td>163</td>
<td>163</td>
<td>163</td>
</tr>
<tr>
<td>R² (within firm)</td>
<td>0.114</td>
<td>0.114</td>
<td>0.013</td>
<td>0.013</td>
</tr>
</tbody>
</table>

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

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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).
References


Table A.1: EFD rankings across countries

<table>
<thead>
<tr>
<th>NACE Rev 1.1 industry</th>
<th>U.S. (Compustat)</th>
<th>AUT (EFIGE)</th>
<th>FRA (EFIGE)</th>
<th>DEU (EFIGE)</th>
<th>ITA (EFIGE)</th>
<th>ESP (EFIGE)</th>
<th>HUN (EFIGE)</th>
<th>GBR (EFIGE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>code</td>
<td>EFD rank firms</td>
<td>EFD rank firms</td>
<td>EFD rank firms</td>
<td>EFD rank firms</td>
<td>EFD rank firms</td>
<td>EFD rank firms</td>
<td>EFD rank firms</td>
<td>EFD rank firms</td>
</tr>
<tr>
<td>16 Tobacco</td>
<td>-3.4462</td>
<td>1</td>
<td>13</td>
<td>4.0000</td>
<td>25</td>
<td>3</td>
<td>3.6432</td>
<td>24</td>
</tr>
<tr>
<td>19 Leather and footwear</td>
<td>-1.3422</td>
<td>2</td>
<td>27</td>
<td>2.3369</td>
<td>5</td>
<td>32</td>
<td>2.6854</td>
<td>2</td>
</tr>
<tr>
<td>361 Furniture</td>
<td>-0.5680</td>
<td>3</td>
<td>66</td>
<td>3.1252</td>
<td>17</td>
<td>67</td>
<td>5.2925</td>
<td>21</td>
</tr>
<tr>
<td>22 Publishing and printing</td>
<td>-0.4268</td>
<td>4</td>
<td>166</td>
<td>3.0589</td>
<td>14</td>
<td>34</td>
<td>1.5477</td>
<td>23</td>
</tr>
<tr>
<td>28 Fabricated metal products</td>
<td>-0.3272</td>
<td>5</td>
<td>173</td>
<td>2.6043</td>
<td>17</td>
<td>839</td>
<td>2.3607</td>
<td>13</td>
</tr>
<tr>
<td>35 Other transport equipment</td>
<td>-0.3057</td>
<td>6</td>
<td>92</td>
<td>2.6581</td>
<td>19</td>
<td>16</td>
<td>2.2043</td>
<td>23</td>
</tr>
<tr>
<td>150 Food (excl. beverages)</td>
<td>-0.1454</td>
<td>7</td>
<td>89</td>
<td>3.1800</td>
<td>8</td>
<td>10</td>
<td>2.4652</td>
<td>11</td>
</tr>
<tr>
<td>21 Pulp, paper and paper products</td>
<td>-0.1343</td>
<td>8</td>
<td>89</td>
<td>3.1380</td>
<td>8</td>
<td>21</td>
<td>2.6360</td>
<td>2</td>
</tr>
<tr>
<td>23 Coke and refined petroleum products</td>
<td>-0.1114</td>
<td>9</td>
<td>63</td>
<td>3.2333</td>
<td>4</td>
<td>3</td>
<td>2.5695</td>
<td>1</td>
</tr>
<tr>
<td>26 Non-metallic mineral products</td>
<td>-0.0884</td>
<td>10</td>
<td>74</td>
<td>3.4615</td>
<td>17</td>
<td>18</td>
<td>2.3615</td>
<td>6</td>
</tr>
<tr>
<td>20 Wood products, except furniture</td>
<td>-0.0627</td>
<td>11</td>
<td>62</td>
<td>3.2144</td>
<td>11</td>
<td>21</td>
<td>2.6703</td>
<td>20</td>
</tr>
<tr>
<td>17 Textiles</td>
<td>-0.0427</td>
<td>12</td>
<td>75</td>
<td>3.8595</td>
<td>19</td>
<td>8</td>
<td>2.9575</td>
<td>16</td>
</tr>
<tr>
<td>240 Chemicals (excl. pharmaceuticals)</td>
<td>0.0047</td>
<td>13</td>
<td>300</td>
<td>2.3833</td>
<td>2</td>
<td>5</td>
<td>2.4523</td>
<td>8</td>
</tr>
<tr>
<td>34 Motor vehicles</td>
<td>0.0759</td>
<td>14</td>
<td>140</td>
<td>2.8214</td>
<td>4</td>
<td>6</td>
<td>2.4947</td>
<td>12</td>
</tr>
<tr>
<td>27 Basic metals</td>
<td>0.0870</td>
<td>15</td>
<td>144</td>
<td>3.0087</td>
<td>6</td>
<td>13</td>
<td>2.9574</td>
<td>22</td>
</tr>
<tr>
<td>18 Wearing apparel and fur</td>
<td>0.1021</td>
<td>16</td>
<td>124</td>
<td>3.6062</td>
<td>18</td>
<td>5</td>
<td>2.6242</td>
<td>18</td>
</tr>
<tr>
<td>25 Rubber and plastic products</td>
<td>0.1205</td>
<td>17</td>
<td>150</td>
<td>3.2621</td>
<td>12</td>
<td>22</td>
<td>2.5890</td>
<td>14</td>
</tr>
<tr>
<td>29 Machinery and equipment</td>
<td>0.1255</td>
<td>18</td>
<td>397</td>
<td>3.2055</td>
<td>10</td>
<td>48</td>
<td>2.4290</td>
<td>9</td>
</tr>
<tr>
<td>31 Electrical machinery and apparatus</td>
<td>0.3269</td>
<td>19</td>
<td>615</td>
<td>3.4449</td>
<td>16</td>
<td>13</td>
<td>2.2367</td>
<td>3</td>
</tr>
<tr>
<td>360 Other manufacturing (excl. furniture)</td>
<td>0.3719</td>
<td>20</td>
<td>159</td>
<td>2.1752</td>
<td>1</td>
<td>5</td>
<td>2.1247</td>
<td>2</td>
</tr>
<tr>
<td>159 Beverages</td>
<td>0.3992</td>
<td>21</td>
<td>74</td>
<td>2.7172</td>
<td>3</td>
<td>4</td>
<td>2.5896</td>
<td>18</td>
</tr>
<tr>
<td>30 Office machinery and computers</td>
<td>0.6565</td>
<td>22</td>
<td>365</td>
<td>3.1667</td>
<td>7</td>
<td>1</td>
<td>3.8791</td>
<td>1</td>
</tr>
<tr>
<td>33 Medical/ precision/ optical instruments</td>
<td>1.0336</td>
<td>23</td>
<td>818</td>
<td>3.3855</td>
<td>15</td>
<td>15</td>
<td>2.3879</td>
<td>7</td>
</tr>
<tr>
<td>32 Radio/ TV/ communication equipment</td>
<td>1.1559</td>
<td>24</td>
<td>296</td>
<td>3.1834</td>
<td>9</td>
<td>5</td>
<td>2.5131</td>
<td>13</td>
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<tr>
<td>244 Pharmaceuticals</td>
<td>8.6029</td>
<td>25</td>
<td>731</td>
<td>2.7055</td>
<td>21</td>
<td>23</td>
<td>3.1121</td>
<td>16</td>
</tr>
</tbody>
</table>

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.