Web Appendix: The Micro Origins of International Business Cycle Comovement*


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Abstract

This paper investigates the role of individual firms in international business cycle comovement using data covering the universe of French firm-level value added and international linkages over 1993-2007. At the micro level, trade and multinational linkages with a particular foreign country are associated with a significantly higher correlation between a firm and that foreign country. The impact of direct linkages on comovement at the micro level has significant macro implications. Without those linkages the correlation between France and foreign countries would fall by about 0.098, or one-third of the observed average correlation of 0.291 in our sample of partner countries.

*JEL Classifications*: F44, F61, F62

*Keywords*: Comovement, International Trade, Firm-Level Shocks, Large Firms

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Appendix A  Intensive and Extensive Margins

This appendix decomposes the growth rate of aggregate value added into the intensive and extensive components, and shows that the bulk of the aggregate business cycle comovement between France and its main trading partners is accounted for by the intensive margin. The intensive component at date \( t \) is defined as the growth rate of value added of firms that had positive value added in both year \( t \) and year \( t-1 \). The extensive margin is defined as the contribution to total value added of the appearance and disappearance of firms. The log-difference growth rate of total value added can be manipulated to obtain an (exact) decomposition into intensive and extensive components:

\[
\tilde{\gamma}_A t = \ln \frac{\sum_{f \in I_t} x_{ft}}{\sum_{f \in I_{t-1}} x_{ft-1}} - \left( \ln \frac{\sum_{f \in I_{t-1}} x_{ft}}{\sum_{f \in I_{t-1}} x_{ft-1}} - \ln \frac{\sum_{f \in I_t} x_{ft}}{\sum_{f \in I_t} x_{ft-1}} \right) 
\]

where \( I_{t-1} \) is the set of firms active in both \( t \) and \( t-1 \) and \( \pi_{t,t} \) (\( \pi_{t,t-1} \)) is the share of value added produced by this intensive (sub-)sample of firms in period \( t \) (\( t-1 \)). Entrants have a positive impact on growth while exiters push the growth rate down, and the net impact is proportional to the share of entrants’/exiters’ value added in aggregate value added.\(^1\)

Using equation (A.1), aggregate correlation between France and \( C \) can be written as

\[
\rho (\tilde{\gamma}_A t, \gamma C_t) = \frac{\sigma_A}{\tilde{\sigma}_A} \rho (\gamma A t, \gamma C_t) + \frac{\sigma_{\pi}}{\tilde{\sigma}_A} \rho \left( \ln \frac{\pi_{t,t}}{\pi_{t,t-1}}, \gamma C_t \right) ,
\]

where \( \sigma_{\pi} \) is the standard deviation of the extensive margin component of equation (A.1), \( \sigma_A \) is the standard deviation of the intensive margin growth rate \( \gamma A t \), and \( \tilde{\sigma}_A \) is the standard deviation of the overall growth rate \( \tilde{\gamma}_A t \).

Thus, aggregate comovement is simply additive in the correlations of the intensive and the extensive margins. Table A9 presents the decomposition. On average, the intensive margin accounts for about 90% of the overall correlation. Figure A1 plots the aggregate correlations against the intensive and the extensive margin components, together with the 45-degree line in each case. It is clear that the variation in the business cycle correlation between France and its trading partners is much better accounted for by the intensive margin component. The cross-sectional correlation between the overall and intensive margins (Figure A1a) is 0.96. By contrast, the variation in the extensive margin correlation across countries is smaller, and does not explain nearly as well the cross-section of comovement between France and other countries (Figure A1b).

\(^1\)This decomposition follows the same logic as the decomposition of price indices proposed by Feenstra (1994).
References

Table A1. Connectedness by Sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>Share of Connected Firms</th>
<th>Share of VA by Connected Firms</th>
<th>Share in Aggregate French VA</th>
<th>Share of Connected Firms</th>
<th>Share of VA by Connected Firms</th>
<th>Share in Aggregate French VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>01-05 Agriculture, forestry and fishing</td>
<td>0.301</td>
<td>0.693</td>
<td>0.007</td>
<td>35 Other transport equipment</td>
<td>0.714</td>
<td>0.993</td>
</tr>
<tr>
<td>10-14 Mining and quarrying</td>
<td>0.525</td>
<td>0.766</td>
<td>0.005</td>
<td>36-37 Manufacturing n.e.c.</td>
<td>0.593</td>
<td>0.937</td>
</tr>
<tr>
<td>15-16 Food and tobacco</td>
<td>0.307</td>
<td>0.914</td>
<td>0.040</td>
<td>40-41 Electricity, gas, water supply</td>
<td>0.252</td>
<td>0.977</td>
</tr>
<tr>
<td>17-19 Textile, wearing apparel and leather</td>
<td>0.716</td>
<td>0.958</td>
<td>0.014</td>
<td>45 Construction</td>
<td>0.137</td>
<td>0.521</td>
</tr>
<tr>
<td>20 Wood products</td>
<td>0.574</td>
<td>0.896</td>
<td>0.005</td>
<td>50-52 Wholesale and retail trade</td>
<td>0.378</td>
<td>0.801</td>
</tr>
<tr>
<td>21-22 Paper products, publishing</td>
<td>0.459</td>
<td>0.920</td>
<td>0.026</td>
<td>55 Hotels and restaurants</td>
<td>0.069</td>
<td>0.485</td>
</tr>
<tr>
<td>23 Coke, refined petroleum, nuclear fuel</td>
<td>0.819</td>
<td>0.998</td>
<td>0.008</td>
<td>60-63 Transport</td>
<td>0.298</td>
<td>0.864</td>
</tr>
<tr>
<td>24 Chemical industry</td>
<td>0.846</td>
<td>0.997</td>
<td>0.041</td>
<td>64 Post and telecommunications</td>
<td>0.314</td>
<td>0.995</td>
</tr>
<tr>
<td>25 Rubber and plastics</td>
<td>0.782</td>
<td>0.985</td>
<td>0.017</td>
<td>70 Real estate activities</td>
<td>0.092</td>
<td>0.239</td>
</tr>
<tr>
<td>26 Mineral products</td>
<td>0.550</td>
<td>0.952</td>
<td>0.014</td>
<td>71 Rental without operator</td>
<td>0.291</td>
<td>0.866</td>
</tr>
<tr>
<td>27 Basic metals</td>
<td>0.819</td>
<td>0.996</td>
<td>0.011</td>
<td>72 Computer services</td>
<td>0.289</td>
<td>0.776</td>
</tr>
<tr>
<td>28 Metal product</td>
<td>0.517</td>
<td>0.871</td>
<td>0.028</td>
<td>73 Research and development</td>
<td>0.494</td>
<td>0.918</td>
</tr>
<tr>
<td>29 Machinery and equipment</td>
<td>0.638</td>
<td>0.963</td>
<td>0.026</td>
<td>74 Other business services</td>
<td>0.183</td>
<td>0.612</td>
</tr>
<tr>
<td>30 Office machinery</td>
<td>0.715</td>
<td>0.996</td>
<td>0.005</td>
<td>75 Public administration</td>
<td>0.154</td>
<td>0.831</td>
</tr>
<tr>
<td>31 Electrical equipment</td>
<td>0.629</td>
<td>0.976</td>
<td>0.013</td>
<td>80 Education</td>
<td>0.098</td>
<td>0.353</td>
</tr>
<tr>
<td>32 Radio, TV and communications</td>
<td>0.655</td>
<td>0.978</td>
<td>0.012</td>
<td>85 Health and social work</td>
<td>0.077</td>
<td>0.309</td>
</tr>
<tr>
<td>33 Medical and optical instruments</td>
<td>0.549</td>
<td>0.336</td>
<td>0.011</td>
<td>90-93 Personal services</td>
<td>0.148</td>
<td>0.735</td>
</tr>
<tr>
<td>34 Motor vehicles</td>
<td>0.692</td>
<td>0.987</td>
<td>0.019</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: This table presents the summary statistics for direct connectedness by sector. “Share of Connected Firms” is the number of firms in the sector that are connected to any foreign country through any means of direct connectedness (imports, exports, multinational links), divided by the total number of firms in the sector. “Share of VA by Connected Firms” is the total value added by firms in the sector that are connected to any foreign country through any means of direct connectedness (imports, exports, multinational links), divided by the total value added in the sector. “Share in Aggregate French VA” is the share of the sector’s total value added in aggregate French value added. The manufacturing sector covers NAF sectors 15 to 37.
### Table A2. Directly Connected and Not Directly Connected Firms

#### Panel A: Manufacturing Sector

<table>
<thead>
<tr>
<th>Country</th>
<th>Directly Connected</th>
<th>Not Directly Connected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. firms</td>
<td>Combined share</td>
</tr>
<tr>
<td>Belgium</td>
<td>43,270</td>
<td>0.887</td>
</tr>
<tr>
<td>Brazil</td>
<td>9,854</td>
<td>0.601</td>
</tr>
<tr>
<td>China</td>
<td>17,447</td>
<td>0.689</td>
</tr>
<tr>
<td>Germany</td>
<td>42,425</td>
<td>0.889</td>
</tr>
<tr>
<td>Italy</td>
<td>40,417</td>
<td>0.874</td>
</tr>
<tr>
<td>Japan</td>
<td>16,782</td>
<td>0.697</td>
</tr>
<tr>
<td>Netherlands</td>
<td>31,849</td>
<td>0.847</td>
</tr>
<tr>
<td>Spain</td>
<td>36,663</td>
<td>0.857</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>33,373</td>
<td>0.854</td>
</tr>
<tr>
<td>United States</td>
<td>29,697</td>
<td>0.810</td>
</tr>
<tr>
<td>Average</td>
<td>30,178</td>
<td>0.800</td>
</tr>
</tbody>
</table>

#### Panel B: Non-manufacturing Sector

<table>
<thead>
<tr>
<th>Country</th>
<th>Directly Connected</th>
<th>Not Directly Connected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. firms</td>
<td>Combined share</td>
</tr>
<tr>
<td>Belgium</td>
<td>73,570</td>
<td>0.501</td>
</tr>
<tr>
<td>Brazil</td>
<td>10,448</td>
<td>0.282</td>
</tr>
<tr>
<td>China</td>
<td>30,440</td>
<td>0.392</td>
</tr>
<tr>
<td>Germany</td>
<td>69,511</td>
<td>0.501</td>
</tr>
<tr>
<td>Italy</td>
<td>68,300</td>
<td>0.480</td>
</tr>
<tr>
<td>Japan</td>
<td>23,737</td>
<td>0.373</td>
</tr>
<tr>
<td>Netherlands</td>
<td>52,700</td>
<td>0.466</td>
</tr>
<tr>
<td>Spain</td>
<td>59,192</td>
<td>0.456</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>53,360</td>
<td>0.484</td>
</tr>
<tr>
<td>United States</td>
<td>53,075</td>
<td>0.504</td>
</tr>
<tr>
<td>Average</td>
<td>49,433</td>
<td>0.444</td>
</tr>
</tbody>
</table>

**Notes:** This table reports the features of directly connected and not directly connected firms for each partner country. The columns report the number of firms, their combined share in aggregate value added (averaged across years), and the mean correlation between firm value added growth and the foreign country’s GDP growth.
<table>
<thead>
<tr>
<th>Country</th>
<th>No. firms</th>
<th>Combined share</th>
<th>Mean $\rho(\gamma_{ft}, \gamma_{ct})$</th>
<th>No. firms</th>
<th>Combined share</th>
<th>Mean $\rho(\gamma_{ft}, \gamma_{ct})$</th>
<th>No. firms</th>
<th>Combined share</th>
<th>Mean $\rho(\gamma_{ft}, \gamma_{ct})$</th>
<th>No. firms</th>
<th>Combined share</th>
<th>Mean $\rho(\gamma_{ft}, \gamma_{ct})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>33,261</td>
<td>0.823</td>
<td>0.070</td>
<td>32,928</td>
<td>0.851</td>
<td>0.069</td>
<td>1,065</td>
<td>0.020</td>
<td>0.069</td>
<td>79</td>
<td>0.036</td>
<td>0.061</td>
</tr>
<tr>
<td>Brazil</td>
<td>7,644</td>
<td>0.541</td>
<td>0.001</td>
<td>4,080</td>
<td>0.429</td>
<td>0.003</td>
<td>0</td>
<td>0.000</td>
<td>-0.076</td>
<td>40</td>
<td>0.032</td>
<td>0.019</td>
</tr>
<tr>
<td>China</td>
<td>9,424</td>
<td>0.578</td>
<td>-0.044</td>
<td>13,240</td>
<td>0.613</td>
<td>-0.055</td>
<td>16</td>
<td>0.001</td>
<td>-0.076</td>
<td>59</td>
<td>0.013</td>
<td>-0.045</td>
</tr>
<tr>
<td>Germany</td>
<td>29,128</td>
<td>0.809</td>
<td>0.064</td>
<td>35,920</td>
<td>0.869</td>
<td>0.060</td>
<td>1,375</td>
<td>0.057</td>
<td>0.063</td>
<td>115</td>
<td>0.039</td>
<td>0.092</td>
</tr>
<tr>
<td>Italy</td>
<td>25,989</td>
<td>0.787</td>
<td>0.087</td>
<td>34,400</td>
<td>0.849</td>
<td>0.081</td>
<td>608</td>
<td>0.031</td>
<td>0.064</td>
<td>91</td>
<td>0.037</td>
<td>0.045</td>
</tr>
<tr>
<td>Japan</td>
<td>12,545</td>
<td>0.608</td>
<td>-0.037</td>
<td>9,229</td>
<td>0.603</td>
<td>-0.026</td>
<td>168</td>
<td>0.009</td>
<td>0.007</td>
<td>36</td>
<td>0.011</td>
<td>-0.060</td>
</tr>
<tr>
<td>Netherlands</td>
<td>21,774</td>
<td>0.750</td>
<td>0.088</td>
<td>23,930</td>
<td>0.804</td>
<td>0.081</td>
<td>1,084</td>
<td>0.066</td>
<td>0.065</td>
<td>34</td>
<td>0.030</td>
<td>0.102</td>
</tr>
<tr>
<td>Spain</td>
<td>26,706</td>
<td>0.788</td>
<td>0.039</td>
<td>27,676</td>
<td>0.805</td>
<td>0.033</td>
<td>270</td>
<td>0.009</td>
<td>0.027</td>
<td>122</td>
<td>0.044</td>
<td>0.053</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>24,222</td>
<td>0.776</td>
<td>0.060</td>
<td>25,535</td>
<td>0.817</td>
<td>0.058</td>
<td>1,101</td>
<td>0.050</td>
<td>0.064</td>
<td>96</td>
<td>0.038</td>
<td>0.115</td>
</tr>
<tr>
<td>United States</td>
<td>21,299</td>
<td>0.721</td>
<td>0.067</td>
<td>20,117</td>
<td>0.753</td>
<td>0.066</td>
<td>1,655</td>
<td>0.121</td>
<td>0.073</td>
<td>145</td>
<td>0.043</td>
<td>0.140</td>
</tr>
<tr>
<td>Average</td>
<td>21,199</td>
<td>0.718</td>
<td>0.040</td>
<td>22,706</td>
<td>0.739</td>
<td>0.037</td>
<td>816</td>
<td>0.036</td>
<td>0.040</td>
<td>82</td>
<td>0.032</td>
<td>0.052</td>
</tr>
</tbody>
</table>

**Panel B: Non-manufacturing Sector**

<table>
<thead>
<tr>
<th>Country</th>
<th>No. firms</th>
<th>Combined share</th>
<th>Mean $\rho(\gamma_{ft}, \gamma_{ct})$</th>
<th>No. firms</th>
<th>Combined share</th>
<th>Mean $\rho(\gamma_{ft}, \gamma_{ct})$</th>
<th>No. firms</th>
<th>Combined share</th>
<th>Mean $\rho(\gamma_{ft}, \gamma_{ct})$</th>
<th>No. firms</th>
<th>Combined share</th>
<th>Mean $\rho(\gamma_{ft}, \gamma_{ct})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>37,398</td>
<td>0.366</td>
<td>0.039</td>
<td>57,287</td>
<td>0.466</td>
<td>0.035</td>
<td>2,501</td>
<td>0.013</td>
<td>0.026</td>
<td>326</td>
<td>0.123</td>
<td>0.065</td>
</tr>
<tr>
<td>Brazil</td>
<td>5,346</td>
<td>0.209</td>
<td>-0.018</td>
<td>5,934</td>
<td>0.204</td>
<td>-0.028</td>
<td>4</td>
<td>0.000</td>
<td>-0.016</td>
<td>83</td>
<td>0.091</td>
<td>0.009</td>
</tr>
<tr>
<td>China</td>
<td>7,391</td>
<td>0.274</td>
<td>-0.063</td>
<td>26,698</td>
<td>0.362</td>
<td>-0.077</td>
<td>74</td>
<td>0.000</td>
<td>-0.127</td>
<td>149</td>
<td>0.141</td>
<td>-0.066</td>
</tr>
<tr>
<td>Germany</td>
<td>28,933</td>
<td>0.341</td>
<td>0.038</td>
<td>57,856</td>
<td>0.475</td>
<td>0.029</td>
<td>3,211</td>
<td>0.024</td>
<td>0.048</td>
<td>328</td>
<td>0.165</td>
<td>0.038</td>
</tr>
<tr>
<td>Italy</td>
<td>27,524</td>
<td>0.320</td>
<td>0.060</td>
<td>58,540</td>
<td>0.455</td>
<td>0.055</td>
<td>1,279</td>
<td>0.006</td>
<td>0.067</td>
<td>287</td>
<td>0.166</td>
<td>0.024</td>
</tr>
<tr>
<td>Japan</td>
<td>13,169</td>
<td>0.301</td>
<td>-0.049</td>
<td>14,226</td>
<td>0.322</td>
<td>-0.043</td>
<td>483</td>
<td>0.004</td>
<td>-0.054</td>
<td>70</td>
<td>0.090</td>
<td>-0.074</td>
</tr>
<tr>
<td>Netherlands</td>
<td>26,169</td>
<td>0.307</td>
<td>0.063</td>
<td>41,065</td>
<td>0.430</td>
<td>0.051</td>
<td>3,164</td>
<td>0.026</td>
<td>0.060</td>
<td>110</td>
<td>0.107</td>
<td>0.076</td>
</tr>
<tr>
<td>Spain</td>
<td>27,099</td>
<td>0.327</td>
<td>0.027</td>
<td>46,677</td>
<td>0.416</td>
<td>0.028</td>
<td>701</td>
<td>0.005</td>
<td>0.045</td>
<td>413</td>
<td>0.169</td>
<td>0.049</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>24,005</td>
<td>0.324</td>
<td>0.049</td>
<td>40,273</td>
<td>0.447</td>
<td>0.038</td>
<td>4,090</td>
<td>0.035</td>
<td>0.028</td>
<td>320</td>
<td>0.166</td>
<td>0.042</td>
</tr>
<tr>
<td>United States</td>
<td>26,721</td>
<td>0.388</td>
<td>0.068</td>
<td>38,054</td>
<td>0.472</td>
<td>0.057</td>
<td>3,953</td>
<td>0.045</td>
<td>0.080</td>
<td>294</td>
<td>0.162</td>
<td>0.062</td>
</tr>
<tr>
<td>Average</td>
<td>22,022</td>
<td>0.316</td>
<td>0.022</td>
<td>38,661</td>
<td>0.405</td>
<td>0.014</td>
<td>1,946</td>
<td>0.016</td>
<td>0.016</td>
<td>238</td>
<td>0.138</td>
<td>0.022</td>
</tr>
</tbody>
</table>

**Notes:** This table reports the features of different types of directly connected firms. The columns report the number of firms, their combined share in aggregate value added (averaged across years), and the mean correlation between firm value added growth and the foreign country's GDP growth.
### Table A4. Main Estimation Results, Manufacturing Sector

<table>
<thead>
<tr>
<th></th>
<th>(1) Baseline</th>
<th>(2) Baseline</th>
<th>(3) Baseline</th>
<th>(4) Baseline</th>
<th>(5) Baseline</th>
<th>(6) Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dep. Var: $\rho(\gamma_{ft}, \gamma_{ct})$</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importer</td>
<td>0.021***</td>
<td>0.029***</td>
<td>0.011***</td>
<td>0.010***</td>
<td>0.008***</td>
<td>0.019***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
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<tr>
<td>Exporter</td>
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<td>0.022***</td>
<td>0.005***</td>
<td>0.005***</td>
<td>0.006***</td>
<td>0.011***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>French Multinational</td>
<td>0.008</td>
<td>0.009</td>
<td>0.002</td>
<td>0.003</td>
<td>0.006</td>
<td>0.017</td>
</tr>
<tr>
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<td>(0.018)</td>
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<td>(0.013)</td>
<td>(0.013)</td>
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<tr>
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<td>0.011***</td>
<td>0.012***</td>
<td>0.010**</td>
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<td>Observations</td>
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<td>1,234,760</td>
<td>1,234,760</td>
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<td>1,234,760</td>
<td>1,283,260</td>
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<tr>
<td>Adjusted $R^2$</td>
<td>0.001</td>
<td>0.280</td>
<td>0.285</td>
<td>0.285</td>
<td>0.288</td>
<td>0.285</td>
</tr>
<tr>
<td>Firm FE</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Country FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Country×Region FE</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Country×Sector FE</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
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<td>202,454</td>
<td>202,454</td>
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<td>202,454</td>
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<td>216,471</td>
<td>216,471</td>
<td>216,447</td>
<td>216,471</td>
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<td>7,115</td>
<td>7,115</td>
<td>7,115</td>
<td>7,115</td>
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<td>815</td>
<td>815</td>
<td>815</td>
<td>815</td>
<td>838</td>
</tr>
<tr>
<td># of Firm FEs</td>
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<td>123,476</td>
<td>123,476</td>
<td>123,472</td>
<td>123,476</td>
<td>128,326</td>
</tr>
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<td># of Country FEs</td>
<td>10</td>
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<tr>
<td># of Country×Region FEs</td>
<td></td>
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<td></td>
<td></td>
<td>960</td>
</tr>
<tr>
<td># of Country×Sector FEs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>600</td>
</tr>
</tbody>
</table>

**Notes:** Standard errors clustered at the firm level. ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level. This table reports the results of estimating (4) for the manufacturing sector. The independent variables are binary indicators for whether the firm imports from a country, exports to it, is an affiliate of a multinational firm from that country, or is a French multinational with affiliates in that country.
## Table A5. Main Estimation Results, Non-manufacturing Sector

<table>
<thead>
<tr>
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<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dep. Var: $\rho(\gamma_{ft}, \gamma_{Cl})$</td>
<td>Baseline</td>
<td>Baseline</td>
<td>Baseline</td>
<td>Baseline</td>
<td>Baseline</td>
<td>Sales</td>
</tr>
<tr>
<td>Importer</td>
<td>0.027***</td>
<td>0.022***</td>
<td>0.012***</td>
<td>0.012***</td>
<td>0.012***</td>
<td>0.015***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Exporter</td>
<td>0.031***</td>
<td>0.019***</td>
<td>0.004***</td>
<td>0.004***</td>
<td>0.006***</td>
<td>0.008***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>French Multinational</td>
<td>0.034***</td>
<td>0.026***</td>
<td>0.013</td>
<td>0.012</td>
<td>0.010</td>
<td>0.016*</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Affiliate of a Foreign MNE</td>
<td>0.034***</td>
<td>0.029***</td>
<td>0.011***</td>
<td>0.010***</td>
<td>0.008***</td>
<td>0.017***</td>
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<tr>
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<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Adjusted R$^2$</td>
<td>0.000</td>
<td>0.280</td>
<td>0.286</td>
<td>0.287</td>
<td>0.288</td>
<td>0.284</td>
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<tr>
<td>Firm FE</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Country FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Country×Region FE</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Country×Sector FE</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td># of Xing links</td>
<td>208,043</td>
<td>208,043</td>
<td>208,043</td>
<td>207,987</td>
<td>208,034</td>
<td>220,598</td>
</tr>
<tr>
<td># of Ming links</td>
<td>366,022</td>
<td>366,022</td>
<td>366,022</td>
<td>365,927</td>
<td>366,016</td>
<td>382,838</td>
</tr>
<tr>
<td># of Affiliates</td>
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<td>18,484</td>
<td>18,484</td>
<td>18,481</td>
<td>18,484</td>
<td>20,682</td>
</tr>
<tr>
<td># of HQ links</td>
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<td>2,271</td>
<td>2,271</td>
<td>2,268</td>
<td>2,271</td>
<td>2,877</td>
</tr>
<tr>
<td># of Firm FEs</td>
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<td>723,022</td>
<td>722,995</td>
<td>723,020</td>
<td>723,020</td>
<td>775,876</td>
</tr>
<tr>
<td># of Country FEs</td>
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<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td># of Country×Region FEs</td>
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<td>960</td>
<td>960</td>
<td>960</td>
<td>960</td>
<td>960</td>
</tr>
<tr>
<td># of Country×Sector FEs</td>
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<td>490</td>
<td>490</td>
<td>490</td>
<td>490</td>
<td>490</td>
</tr>
</tbody>
</table>

**Notes:** Standard errors clustered at the firm level. ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level. This table reports the results of estimating (4) for the non-manufacturing sector. The independent variables are binary indicators for whether the firm imports from a country, exports to it, is an affiliate of a multinational firm from that country, or is a French multinational with affiliates in that country.
Table A6. Estimation Results, Taking Indirect Linkages into Account

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<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Panel A:</td>
<td>Panel B:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dep. Var: ρ(γ_{ft},γ_{Ct})</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importer</td>
<td>0.007***</td>
<td>0.007***</td>
<td>0.012***</td>
<td>0.012***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Exporter</td>
<td>0.004**</td>
<td>0.005***</td>
<td>0.004***</td>
<td>0.006***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>French Multinational</td>
<td>0.002</td>
<td>0.006</td>
<td>0.014</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.011)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Affiliate of a</td>
<td>0.001***</td>
<td>0.011***</td>
<td>0.013***</td>
<td>0.010***</td>
</tr>
<tr>
<td>Foreign MNE</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>DS_{f,j,C}</td>
<td>0.226***</td>
<td>0.100***</td>
<td>0.146***</td>
<td>-0.066***</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.032)</td>
<td>(0.026)</td>
<td>(0.031)</td>
</tr>
<tr>
<td>US_{f,j,C}</td>
<td>0.319***</td>
<td>0.150**</td>
<td>-0.053***</td>
<td>0.036**</td>
</tr>
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<td></td>
<td>(0.032)</td>
<td>(0.076)</td>
<td>(0.007)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Observations</td>
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<td>1,224,130</td>
<td>6,738,360</td>
<td>6,738,340</td>
</tr>
<tr>
<td>Adjusted R^2</td>
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<td>0.288</td>
<td>0.286</td>
<td>0.288</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Country FE</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Country × Sector FE</td>
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<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td># of Xing links</td>
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<td>202,313</td>
<td>206,580</td>
<td>206,571</td>
</tr>
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<td>216,346</td>
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<td>363,858</td>
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<td>7,086</td>
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<td>17,216</td>
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<tr>
<td># of HQ links</td>
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<td>815</td>
<td>2,240</td>
<td>2,240</td>
</tr>
<tr>
<td># of Firm FEs</td>
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<td>122,413</td>
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<td>673,834</td>
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<tr>
<td># of Country FEs</td>
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<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td># of Country × Sector FEs</td>
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<td></td>
<td></td>
<td>490</td>
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</table>

Notes: Standard errors clustered at the firm level. ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level. This table reports the results of estimating (7) for the manufacturing sector in Panel A and the non-manufacturing sector in Panel B. The independent variables are binary indicators for whether the firm imports from a country, exports to it, is an affiliate of a multinational firm from that country, or is a French multinational with affiliates in that country. The downstream indirect linkage indicator $DS_{f,j,C}$ is defined in (5). The upstream indirect linkage indicator $US_{f,j,C}$ is defined in (6).
Table A7. Aggregate Correlations: Contributions of Direct and Indirect Terms

<table>
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<tr>
<th>Country</th>
<th>$\rho_A$ (observed)</th>
<th>Directly Connected</th>
<th>Not Directly Connected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>0.935</td>
<td>0.795</td>
<td>0.140</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.177</td>
<td>0.165</td>
<td>0.013</td>
</tr>
<tr>
<td>China</td>
<td>-0.190</td>
<td>-0.142</td>
<td>-0.048</td>
</tr>
<tr>
<td>Germany</td>
<td>0.695</td>
<td>0.550</td>
<td>0.144</td>
</tr>
<tr>
<td>Italy</td>
<td>0.718</td>
<td>0.574</td>
<td>0.144</td>
</tr>
<tr>
<td>Japan</td>
<td>0.166</td>
<td>0.154</td>
<td>0.012</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.718</td>
<td>0.575</td>
<td>0.142</td>
</tr>
<tr>
<td>Spain</td>
<td>0.673</td>
<td>0.550</td>
<td>0.123</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.435</td>
<td>0.416</td>
<td>0.019</td>
</tr>
<tr>
<td>United States</td>
<td>0.509</td>
<td>0.442</td>
<td>0.067</td>
</tr>
<tr>
<td>Average</td>
<td>0.484</td>
<td>0.408</td>
<td>0.076</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>$\rho_A$ (observed)</th>
<th>Directly Connected</th>
<th>Not Directly Connected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>0.490</td>
<td>0.235</td>
<td>0.255</td>
</tr>
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<td>Brazil</td>
<td>-0.499</td>
<td>-0.371</td>
<td>-0.128</td>
</tr>
<tr>
<td>China</td>
<td>-0.663</td>
<td>-0.418</td>
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<tr>
<td>Germany</td>
<td>0.482</td>
<td>0.237</td>
<td>0.245</td>
</tr>
<tr>
<td>Italy</td>
<td>0.446</td>
<td>0.214</td>
<td>0.232</td>
</tr>
<tr>
<td>Japan</td>
<td>-0.382</td>
<td>-0.294</td>
<td>-0.088</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.452</td>
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<td>0.171</td>
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<tr>
<td>Spain</td>
<td>0.823</td>
<td>0.442</td>
<td>0.380</td>
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<tr>
<td>United Kingdom</td>
<td>-0.257</td>
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<td>-0.138</td>
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<tr>
<td>United States</td>
<td>0.221</td>
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<td>0.034</td>
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<tr>
<td>Average</td>
<td>0.111</td>
<td>0.039</td>
<td>0.072</td>
</tr>
</tbody>
</table>

Notes: This table reports the results of decomposition in (8) separately for the manufacturing (Panel A) and non-manufacturing (Panel B) sectors. The first column reports the actual correlation in the data.
### Table A8. Changes in Aggregate Correlations

| Country     | $\rho_A$ | $\Delta \rho_A$ | s.e.(\$\Delta \rho_A\$) | $\Delta \rho_A|\text{Trade}$ | s.e.(\$\Delta \rho_A|\text{Trade}\$) | $\Delta \rho_A|MNE$ | s.e.(\$\Delta \rho_A|MNE\$) | $\Delta \rho_A|\text{Eq.W}$ | s.e.(\$\Delta \rho_A|\text{Eq.W}\$) |
|-------------|----------|-----------------|---------------------------|-----------------------------|---------------------------------|-----------------|------------------------------|------------------|------------------|
| Belgium     | 0.935    | -0.116          | 0.019                     | -0.114                     | 0.019                           | -0.003          | 0.005                        | -0.058           | 0.008            |
| Brazil      | 0.177    | -0.063          | 0.012                     | -0.062                     | 0.011                           | -0.001          | 0.004                        | -0.019           | 0.002            |
| China       | -0.190   | -0.081          | 0.013                     | -0.080                     | 0.013                           | 0.000           | 0.002                        | -0.022           | 0.003            |
| Germany     | 0.695    | -0.121          | 0.019                     | -0.115                     | 0.019                           | -0.006          | 0.006                        | -0.059           | 0.008            |
| Italy       | 0.718    | -0.116          | 0.018                     | -0.112                     | 0.018                           | -0.004          | 0.005                        | -0.055           | 0.007            |
| Japan       | 0.166    | -0.083          | 0.013                     | -0.082                     | 0.014                           | -0.001          | 0.002                        | -0.019           | 0.003            |
| Netherlands | 0.718    | -0.114          | 0.017                     | -0.106                     | 0.017                           | -0.008          | 0.005                        | -0.042           | 0.006            |
| Spain       | 0.673    | -0.109          | 0.018                     | -0.107                     | 0.018                           | -0.002          | 0.006                        | -0.048           | 0.007            |
| United Kingdom | 0.435 | -0.114          | 0.018                     | -0.108                     | 0.018                           | -0.006          | 0.006                        | -0.045           | 0.006            |
| United States | 0.509 | -0.114          | 0.018                     | -0.101                     | 0.017                           | -0.013          | 0.008                        | -0.039           | 0.005            |
| Average     | 0.484    | -0.103          |                         | -0.099                     |                                | -0.004          |                                | -0.040           |                  |

| Country     | $\rho_A$ | $\Delta \rho_A$ | s.e.(\$\Delta \rho_A\$) | $\Delta \rho_A|\text{Trade}$ | s.e.(\$\Delta \rho_A|\text{Trade}\$) | $\Delta \rho_A|MNE$ | s.e.(\$\Delta \rho_A|MNE\$) | $\Delta \rho_A|\text{Eq.W}$ | s.e.(\$\Delta \rho_A|\text{Eq.W}\$) |
|-------------|----------|-----------------|---------------------------|-----------------------------|---------------------------------|-----------------|------------------------------|------------------|------------------|
| Belgium     | 0.490    | -0.071          | 0.022                     | -0.061                     | 0.009                           | -0.010          | 0.020                        | -0.023           | 0.002            |
| Brazil      | -0.490   | -0.029          | 0.015                     | -0.023                     | 0.005                           | -0.006          | 0.014                        | -0.003           | 0.000            |
| China       | -0.663   | -0.053          | 0.023                     | -0.043                     | 0.007                           | -0.009          | 0.022                        | -0.009           | 0.001            |
| Germany     | 0.482    | -0.076          | 0.028                     | -0.062                     | 0.009                           | -0.014          | 0.026                        | -0.022           | 0.002            |
| Italy       | 0.446    | -0.070          | 0.028                     | -0.058                     | 0.009                           | -0.013          | 0.026                        | -0.022           | 0.002            |
| Japan       | -0.382   | -0.047          | 0.016                     | -0.041                     | 0.007                           | -0.006          | 0.014                        | -0.007           | 0.001            |
| Netherlands | 0.452    | -0.064          | 0.019                     | -0.053                     | 0.008                           | -0.011          | 0.017                        | -0.016           | 0.001            |
| Spain       | 0.823    | -0.065          | 0.028                     | -0.053                     | 0.008                           | -0.012          | 0.027                        | -0.018           | 0.002            |
| United Kingdom | -0.257 | -0.073          | 0.028                     | -0.057                     | 0.009                           | -0.016          | 0.026                        | -0.017           | 0.001            |
| United States | 0.221 | -0.081          | 0.028                     | -0.064                     | 0.010                           | -0.017          | 0.026                        | -0.017           | 0.001            |
| Average     | 0.111    | -0.063          |                         | -0.051                     |                                | -0.011          |                                | -0.015           |                  |

**Notes:** This table reports the results of the aggregation exercise in (10) separately for the manufacturing (Panel A) and non-manufacturing (Panel B) sectors. The column labeled s.e.(\$\Delta \rho_A\$) reports the standard error associated with the estimated change in aggregate correlation. Columns 4-7 present the change in the correlation due to severing of trade linkages and multinational linkages separately, along with corresponding standard errors. Columns 8-9 present the change in the correlation due to severing of direct linkages assuming that all firms have equal size, along with corresponding standard errors.
Table A9. Contribution of Intensive and Extensive Margins to Overall Aggregate Correlation

<table>
<thead>
<tr>
<th>Country</th>
<th>$\rho(\tilde{\gamma}<em>{At}, \tilde{\gamma}</em>{Ct})$ (observed)</th>
<th>Intensive (share)</th>
<th>Extensive (share)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>0.674</td>
<td>1.030</td>
<td>-0.030</td>
</tr>
<tr>
<td>Brazil</td>
<td>-0.305</td>
<td>0.808</td>
<td>0.192</td>
</tr>
<tr>
<td>China</td>
<td>-0.684</td>
<td>0.731</td>
<td>0.269</td>
</tr>
<tr>
<td>Germany</td>
<td>0.379</td>
<td>1.552</td>
<td>-0.552</td>
</tr>
<tr>
<td>Italy</td>
<td>0.591</td>
<td>0.977</td>
<td>0.023</td>
</tr>
<tr>
<td>Japan</td>
<td>-0.224</td>
<td>0.748</td>
<td>0.252</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.469</td>
<td>1.207</td>
<td>-0.207</td>
</tr>
<tr>
<td>Spain</td>
<td>0.733</td>
<td>1.094</td>
<td>-0.094</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.193</td>
<td>0.045</td>
<td>0.955</td>
</tr>
<tr>
<td>United States</td>
<td>0.524</td>
<td>0.651</td>
<td>0.349</td>
</tr>
<tr>
<td>Average</td>
<td>0.235</td>
<td>0.884</td>
<td>0.116</td>
</tr>
</tbody>
</table>

Notes: This table presents the correlation of combined aggregate value added (intensive plus extensive margins), and the share of aggregate correlation due to the intensive and the extensive margins.
**Figure A1.** Overall Correlations and the Intensive and Extensive Margins

Notes: The top panel presents the scatterplot of the overall (intensive plus extensive) correlation against the intensive margin correlation. The bottom panel presents the scatterplot of overall and the extensive margins. The 45-degree line is added to both plots.