Large Firms and International Business Cycle Comovement

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Recent years have seen a significant improvement in our understanding of the micro origins of aggregate fluctuations. An influential strand of the literature argues that the observed firm size distribution is so fat-tailed that shocks to large firms can lead to aggregate fluctuations, dubbed "granular" (Gabaix, 2011; Carvalho and Grassi, 2015). Gabaix (2011) measures the contribution of large firms to aggregate fluctuations by constructing a composite shock to the top 100 firms in the US – referred to as the granular residual – and shows that this shock can indeed have an impact on US GDP growth.

If the largest firms matter for aggregate fluctuations, it stands to reason that these same firms should also play an important role in cross-country business cycle comovement. This is because, as we will show below, the top 100 firms are even more internationalized than the average firm (through trade and multinational relationships), and these international linkages are a conduit for transmitting shocks across borders. Taking granularity into account can improve our understanding of international comovement. The quantitative literature that employs representative firm models has struggled to capture the trade-comovement relationship. Kose and Yi (2006) and Johnson (2014) show that even quite sophisticated IRBC models fail to generate the observed positive association, dubbing it the trade-comovement puzzle.

Our previous work (di Giovanni, Levchenko and Mejean, 2016) provides a forensic account of the micro origins of the international business cycle comovement, using a dataset on the universe of French firms' value added, imports and exports, and multinational status. At the micro level, we thus have information on both i) the comovement between individual firms' and foreign countries' output, and ii) direct linkages between these firms and foreign countries through trade and multinational activities. We show that directly connected firms account for a substantial share of the aggregate comovement between France and its partners. Severing direct trade and multinational linkages with the typical country would lower France's correlation with it by about 0.09. This result is due to the fact that larger firms tend to exhibit more trade and multinational linkages to foreign countries, and thus firms that are directly connected to foreign countries account for a large share of French aggregate output.

This paper further investigates the role of large firms in international business cycle comovement by focusing on the top 100 largest firms in our data, echoing Gabaix's definition of the granular residual. The main finding is that a substantial share of the overall impact of direct linkages on comovement can be traced back to just 100 firms.

In the remainder of the paper, we establish that the top 100 firms (i) are important in aggregate; (ii) exhibit stronger international linkages than the rest of the economy; and (iii) contribute substantially to aggregate comovement.

Data

We use data on the universe of French firm-level value added, imports, and exports over the period 1993-2007, as well as a survey of the firms' multinational linkages, namely whether each firm is an affiliate of a foreign multinational, or is itself a French parent with affiliates abroad. The data are described in di Giovanni, Levchenko and Mejean (2016). As reported in that paper, the dataset has about 1,000,000 firms, and thus the share of the top 100 in the total number of firms is infinitesimal. The top 100 firms are chosen based on the total value added.

Observation 1: The top 100 firms are important in aggregate

Table 1 presents the shares of the top 100 firms in the aggregate value added, trade, and multinational value added. These shares are averages over 1993-2007; the values are stable across years. The top 100 firms account for over 22% of aggregate value added and exports, and 18% of imports. Over 15% of the total value added of foreign multinational affiliates operating in France is actually due to the top 100 firms. This indicates that a significant share of the top 100 firms are actually foreign-owned. Finally, the large majority of the France-based output of the French multinational parent firms is accounted for top 100 firms (82%). These results establish the aggregate importance of the top 100 firms, and suggest that it may be fruitful to look at their role in aggregate comovement.

Observation 2: The top 100 firms are more internationally connected

Table 2 describes the top 100's international linkages, and compares them to the non-top 100 firms. As in di Giovanni,

Levchenko and Mejean (2016), for each of France's trading partners, we define a firm to be *directly connected* if it imports from, exports to, has affiliates in, or is an affiliate of a parent from, that country. These types of direct linkages are of course not mutually exclusive, and the same firm may exhibit up to 3 simultaneously.

Having classified all firms as directly connected or not with each country, we ask, what is the share of total value added in France that is accounted for by the directly connected firms? Table 2 does this separately for the top 100 and the rest. Once again, there are about a million firms in our data, so virtually all the firms are in the non-top 100 category.

There is a pronounced difference in the degree of direct connectedness between the top 100 and the rest. For the average trading partner, nearly all of the top 100 firms by value added (90%) are directly connected to it. Furthermore, in the top 100 firms, this number is uniformly close to 1 across all the top 10 trading partners, indicating that most of the top 100 are directly connected to nearly all of these countries at the same time. By contrast, outside of the top 100, firms directly connected to a particular market are responsible for only about 46% of the total value added in that set of firms, about half of what we get in the top 100. International linkages are thus far more pervasive among the top 100 than outside of this set of firms.

Figure 1 further illustrates this phenomenon. It plots the share of firms, and the share of total value added, that are connected to each number of the top 10 markets, separately for the top 100 and the rest. Two-thirds of the top 100 firms, accounting for 80% of the total value added in that group, are connected to all 10 markets. Another 10% of firms are connected to 9 out of 10 markets. There are very few firms in the top 100 that serve less than 9 markets. By contrast, outside of the top 100, 80% of firms and nearly 40% of the value added is accounted for by firms that are connected to zero markets.

TABLE 1—AGGREGATE IMPORTANCE OF THE TOP 100 FIRMS

Share of the top 100 in aggregate:	
Value added	0.219
Exports	0.220
Imports	0.183
Value added of foreign MNEs' affiliates	0.152
Value added of firms with foreign affiliates	0.828

Note: This table reports the share of the aggregates accounted for by the top 100 firms.

TABLE 2—THE IMPORTANCE OF THE DIRECTLY CONNECTED FIRMS

	Top 100		Not Top 100	
Country	Directly connected	Not directly connected	Directly connected	Not directly connected
Belgium	0.915	0.085	0.544	0.456
Brazil	0.780	0.220	0.272	0.728
China	0.901	0.099	0.372	0.628
Germany	0.915	0.085	0.545	0.455
Italy	0.918	0.082	0.519	0.481
Japan	0.904	0.096	0.357	0.643
Netherlands	0.912	0.088	0.498	0.502
Spain	0.898	0.102	0.498	0.502
United Kingdom	0.933	0.067	0.511	0.489
United States	0.967	0.033	0.501	0.499
Average	0.904	0.096	0.462	0.538

Note: This table reports the share of total value added accounted for by the directly and the not directly connected firms, for the top 100 and the non-top 100 sets of firms.
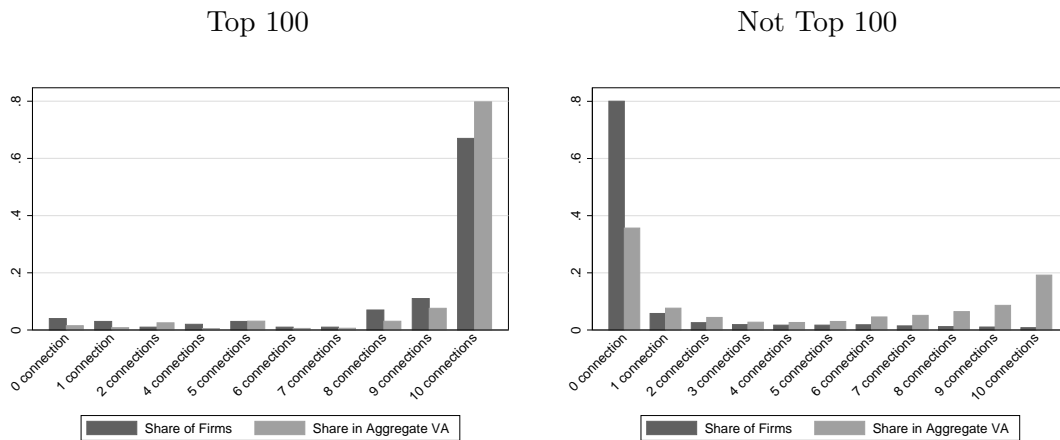

FIGURE 1. NUMBERS OF MARKETS SERVED

Note: This figure displays the share of firms (dark bars), and share of value added (light bars), by how many of the top 10 markets they are connected to.

OBSERVATION 3: THE TOP 100 FIRMS
CONTRIBUTE TO INTERNATIONAL
COMOVEMENT

Finally, we assess the contribution of the top 100 firms to aggregate comovement between France and its trading partners. To do this, we make use of the regression estimates and aggregation procedure in di Giovanni, Levchenko and Mejean (2016). That paper estimates the relationship between direct linkages and comovement (in the spirit of Frankel and Rose, 1998) at the firm level. We find that, even after controlling for firm and country fixed effects, firms that import, export, and/or have multinational links to a country have a higher correlation with that country. Based on these regression estimates and the observed direct linkages, we can form a prediction for the change in the correlation $\widehat{\Delta\rho}(\gamma_{ft}, \gamma_{\mathcal{C}t})$ between real (deflated by the GDP deflator) value added growth γ_{ft} of firm f and the real GDP growth $\gamma_{\mathcal{C}t}$ of country $\mathcal{C}$ that would occur if the direct linkages between that firm and that country were severed.

We can then use these predicted firm-level correlations to aggregate up to the impact of severing all direct linkages of the top 100 firms on the aggregate correlation between France and country $\mathcal{C}$:

(1)
$$\widehat{\Delta\rho}(\gamma_{At}, \gamma_{\mathcal{C}t}) = \sum_{f \in \text{top } 100} w_{ft-1} \frac{\sigma_f}{\sigma_A} \widehat{\Delta\rho}(\gamma_{ft}, \gamma_{\mathcal{C}t}).$$

This expression gives the predicted change in the aggregate correlation between France and country $\mathcal{C}$, $\widehat{\Delta\rho}(\gamma_{At}, \gamma_{\mathcal{C}t})$. The right-hand side is an aggregation of the firm-level predicted correlation change $\widehat{\Delta\rho}(\gamma_{ft}, \gamma_{\mathcal{C}t})$, where w_{ft-1} is the share of firm f in total French value added, σ_f and σ_A are the standard deviations of the firm-level and French aggregate growth rates, respectively, and we are summing over only the top 100 firms. The exercise thus answers the question: how much would the output growth correlation between France and country $\mathcal{C}$ fall if the direct linkages between just the top 100 firms and that country were severed?

Table 3 reports the results. For reference, the first column reports the actual correlation between French output growth and the GDP growth of each country. The average in this sample of countries is 0.29. The second column reports the change in the aggregate correlation if the top 100 firms severed their links to that country. On average, the correlation would fall by 0.024, equivalent to about 8% of the observed average level. In di Giovanni, Levchenko and Mejean (2016) we report that the change in the correlation due to severing all French firms' direct linkages with the average foreign country is 0.09. The top 100 firms thus account for one quarter of the overall effect.

The next four columns split the total into the component due to trade linkages and the component due to multinational linkages. About 80% of the aggregate effect is due to trade rather than multinational linkages, echoing the finding in di Giovanni, Levchenko and Mejean (2016) for all connected firms.

The disproportionate impact of the top 100 firms is a combination of the fact that they are large (Table 1), and that they exhibit greater direct international linkages (Table 2). If all firms in the French economy were of equal size, the implied change in the aggregate correlation would be uniformly zero (results not reported). Trivially, the change in the aggregate correlation would also be zero had these firms not been directly connected to foreign markets. This demonstrates that the top 100 firms matter for the aggregate comovement due to the combination of their large size and their significant direct connectedness.

CONCLUSION

In the spirit of the granular fluctuations literature, we explore the role of the top 100 firms in France in the aggregate business cycle comovement between France and its trading partners. We find that the top 100 firms (i) are important in aggregate; (ii) exhibit much stronger international linkages than the rest of the economy. As a result, just as idiosyncratic shocks to the largest – "granular " – firms matter for aggregate fluctuations, they also matter for

TABLE 3—CHANGES IN AGGREGATE CORRELATIONS DUE TO THE TOP 100 FIRMS

Country	Actual ρ_A	$\Delta\rho_A$	$s.e.(\Delta\rho_A)$	$\Delta\rho_A\|Trade$	$s.e.(\Delta\rho_A\|Trade)$	$\Delta\rho_A\|MNE$	$s.e.(\Delta\rho_A\|MNE)$
Belgium	0.758	-0.024	0.012	-0.019	0.003	-0.004	0.011
Brazil	-0.269	-0.019	0.009	-0.015	0.003	-0.004	0.009
China	-0.545	-0.024	0.013	-0.020	0.003	-0.004	0.012
Germany	0.643	-0.025	0.015	-0.019	0.003	-0.006	0.015
Italy	0.630	-0.025	0.015	-0.020	0.003	-0.006	0.015
Japan	-0.183	-0.022	0.009	-0.019	0.003	-0.003	0.008
Netherlands	0.618	-0.024	0.010	-0.019	0.003	-0.005	0.010
Spain	0.876	-0.025	0.015	-0.019	0.003	-0.006	0.015
UK	0.010	-0.026	0.016	-0.020	0.003	-0.006	0.015
US	0.372	-0.028	0.015	-0.021	0.003	-0.007	0.015
Average	0.291	-0.024		-0.019		-0.005	

Note: This table reports the results of the aggregation exercise in equation (1). 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.

international business cycle comovement. These findings underscore the importance of learning about the micro underpinnings of the international business cycle. They suggest that a full account of international comovement requires a framework that microfounds aggregate fluctuations based on firm-level shocks.

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