9 Global Value Chains during the Great Trade Collapse: A Bullwhip Effect?

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9.1 Introduction

The Great Trade Collapse is one of the most striking features of the recent global financial crisis, with the ongoing recovery still driving a wedge between output and trade. Apart from its magnitude, the fall in trade during the crisis has also been quite homogeneous across all countries: more than 90 percent of Organisation for Economic Co-operation and Development (OECD) countries have exhibited simultaneously a decline in exports and imports exceeding 10 percent. The fall has also been very fast, with trade virtually grinding to a halt in the last quarter of 2008. All these findings have led to qualifying the drop in trade during the crisis as "severe, sudden and synchronized" (Baldwin and Evenett 2009, 1). A number of transmission mechanisms (Baldwin 2009) have been proposed that could account for such peculiarities, making the latest generalized trade drop quite unique among the many episodes of trade decline after a financial crisis (Abiad, Mishra, and Topalova 2010). Among those mechanisms, a particular role has been attributed to the emergence of global supply chains over the last decade and to the different compositional effects of the demand shock on trade and GDP. A role has also been acknowledged for the credit crunch suffered by internationalized firms (Bricongne et al. 2012).

Considering the transmission mechanism of global value chains, a first argument is that the magnitude of the trade drop is due to a problem of multiple accounting. In a world increasingly characterized by vertical specialization—that is, with goods produced sequentially in stages across different countries—the same component of a final good is exchanged (and thus recorded at gross value as trade) several times before the final product reaches the consumer. As a result, for a given

reduction in income, trade should decline "not only by the value of the finished product, but also by the value of all the intermediate trade flows that went into creating it" (Yi 2009; but also previously Bergoeing et al. 2004).

A second channel that relates the magnitude and the synchronization of the latest trade drop to the emergence of global value chains is the inherent adjustment in inventories after a demand shock that the existence of interfirm linkages implies. The wider fluctuations in terms of trade elasticities are in this case an overreaction due to adjustments in the stocks of intermediate inputs by firms involved in complex supply chains (Stadtler 2008; Escaith, Lindenberg, and Miroudot 2010; Freund 2009). According to this argument, known as the "bullwhip effect" (Forrester 1961), each participant to a supply chain had a greater observed variation in demand during the crisis and the initial negative shock propagated up the value chain. The logic is as follows. When final demand is subject to volatility, businesses typically face forecast errors against which they try to shelter by building safety stocks of inventories. Upstream participants to a supply chain face greater demand volatility than downstream ones, so the need for such stocks rises moving up the value chain. The result is that variations in final demand are amplified as one moves away from the final customer. When applied to the current context, the foregoing logic implies that with falling demand, orders decreased more than proportionally because firms were able to draw on inventories after expectations of lower future demand. Firms involved in value chains reduced their stocks more than proportionally while the shock propagated up the value chain. Alessandria, Kaboski, and Midrigan (2011) successfully tested this argument for the United States.

Exploiting transaction-level French trade data matched with ownership data for the period 2007–2009, we first find evidence of an overreaction of trade in intermediates in line with that suggested by Alessandria, Kaboski, and Midrigan (2011), then we notice different dynamics of value chains according to their organizational mode: trade of intermediates among related parties reacted with a faster drop at the outburst of the crisis and a faster recovery thereafter. In other words, verticalized multinational groups were able to adjust faster to the negative demand shock. Although a role for the financing capabilities internal to the group cannot be excluded in softening the financial constraints in times of recovery, our hypothesis is that hierarchies of firms belonging to the same multinational groups are better able to optimize inven-

tories management and do not suffer from the informative asymmetries of buyer/supplier contracts when compared with value chains consisting of independent parties. From this perspective, the different (better) management of inventories by internalized firms can be considered a firm-specific advantage (FSA) that prevails on country- and industry-level characteristics. And indeed, the bullwhip effect is a notion studied and developed in the fields of business and management that allows us to shed more light on the costs and benefits of an enlarged firm (better, group) boundary. For a detailed discussion of the notion of FSAs as opposed to country and industry contexts, see also chapter 1.

For example, to better manage orders along the supply chain, Wal-Mart stores frequently transmit sales data to the headquarters, which then use this information to fine-tune the shipments from suppliers to stores through the distribution center. Clearly, the successful implementation of this sort of demand-driven strategies requires a degree of trustful collaboration and information sharing that is much easier to attain among related than independent parties.

The chapter is organized as follows. In section 9.2, we introduce our newly assembled dataset that allows us to capture interfirm proprietary linkages and we provide some descriptive statistics of the peculiarities of value chains organized by multinational business groups. In section 9.3, we exploit our dataset to draw some stylized facts that relate the trade collapse to the organizational modes of value chains. In section 9.4, we discuss the results of our empirical investigation. In section 9.5, we present some concluding remarks.

9.2 The Dataset: Trade and Interfirm Linkages

Our transaction-level dataset has been built exploiting three different available sources: French customs' monthly data for exports and imports by firms; Orbis by Bureau van Dijk for annual balance sheet data; and the Ownership Database by Bureau van Dijk for data on intragroup linkages. In particular, the first source allowed us to collect over 62 million monthly transactions of products classified according to the Harmonized Commodity Description and Coding System (HS) six-digit classification with their countries of origin and destination for the period 2007M1 to 2009M12; we therefore cover the whole period of the trade collapse and the following recovery. The second source reports the core and secondary economic activities of firms involved or not in international trade, as well as annual data on firms' size and financial

accounts. The third source, which is based on information provided by companies themselves or by national official bodies when in charge, allows us to track the proprietary network of affiliates belonging to the same headquarters and located worldwide.

The final outcome is a sample with different levels of interlocking economic disaggregation, from consolidated multinational groups to single affiliates, from industries to products, which are traded by single firms organized as multinational groups or as independent firms. Moreover, space disaggregation and a time disaggregation are present in the sample. The former enables us to consider both the geographical dispersion of trade flows and the locations of the property networks of hierarchies composed by a French or a foreign headquarters and their own affiliates worldwide. The disaggregation by month, on the other hand, allows us to properly split the period of analysis following the timing of the financial crisis and hence its fast transmission to firm trading activities.

We end up with over 62 million transactions by 167,833 exporting and/or importing firms located in France in the period 2007–2009 from all sector of economic activities, including manufacturing, services, and primary industries. Out of the total number of recorded firms, only 6,760 are owned by a foreign multinational group (defined as a group with at least one affiliate and the headquarters abroad) and 9,482 are part of a French multinational group (with the headquarters in France and at least one affiliate abroad). The number of headquarters—that is, the number of multinational groups to which the affiliates belong—is 5,754 (either foreign or French), whereas the total figure for the worldwide affiliates to which French firms can be linked (either as headquarters or as domestic affiliates of French multinational groups) is about 690,500.

Thanks to the information provided by the Ownership Database, we are able to track the complete control chains of these groups, from the bottom of the network up to the final ultimate owner, considering also cross-participations and taking the majority of 50.01 percent as the threshold to identify corporate control. This last threshold is already adopted as an international standard to define MNEs' activities (OECD 2011), and by international accounting standards when attributing control on profits and hence tax liabilities across national borders.[1]

We then define a "trading firm" as a firm that exports and/or imports at least one product in a month in the period of analysis, with two thresholds provided by French Customs, according to which it is

mandatory to report trading activity only when exports to a non-EU country exceed 1,000 euro for each transaction and when exports to all EU-countries exceed 150,000 euro on a yearly basis. On the other hand, the only limitation of firm level sources is the selectivity of the mandatory presentation of a yearly balance sheet, which leaves out some 2,000 firms registered as trading from the French Customs. These firms, however, account for only 1.20 percent of the total number of trading firms and 0.55 percent of trade volumes.[2]

To better exploit the information at the product level, we have employed the correspondence tables provided by the United Nations (UN) Statistics Division and EUROSTAT, to convert the transactions of HS six-digit products into Classification of Products by Activity (CPA) categories. These are easily grouped in four-digit European Classification of Economic Activities (NACE) revision 2, which is the industrial classification we employ for firm-level analysis, and in Broad Economic Categories (BEC) reclassified according to System of National Accounts (SNA), which distinguishes between capital, consumption, and intermediate goods, according to the main end use of traded products. A further classification capturing the distinction between durable and nondurable goods has also been adopted: the Main Industrial Grouping (MIG) by EUROSTAT has allowed us to reclassify trade flows in order to account for the different demand shocks that those two categories of goods have suffered during the crisis.[3]

The sample covers all industries in manufacturing, services and primary sectors, as shown in table 9.1, where a matching of ownership and firm-level trade data provides a picture of the sectoral degree of internationalization. Firms pertaining to multinational groups, whether French or foreign, have the lion's share of trade: 65 percent of export and 62 percent of import flows (figure 9.1). In the sample, there is a prevalence of service firms, among which those involved in distribution activities (whether wholesale or retail) account for about 56 percent of the total service industry (43 percent of the whole sample).[4] Firms involved in the distribution industry are recognized to have an important role as intermediaries in trade (see, e.g., Bernard, Grazzi, and Tomasi 2010, Ahn, Khandelwal, and Wei 2011), establishing so-called indirect modes of exporting and importing. In our sample, wholesalers are prevalently both importers and exporters and retailers are prevalently importers. Whereas the vast majority (89 percent) of firms in the sample do not belong to any group, group affiliation (whether French or foreign) increases with firm size (figure 9.2).

Table 9.1
Sample coverage by macro sectors and ownership status, number of firms

	Ownership status (no. firms)				Trading status (no. firms)			
	Affiliates to French groups	Affiliates to foreign groups	Independent firms	Total	Exporters and importers	Only exporters	Only importers	Total
Primary sectors	185	51	2,454	2,690	437	1,693	560	2,690
	6.88%	1.90%	91.23%	100.00%	16.25%	62.94%	20.82%	100.00%
Manufacturing	2.869	2.065	31.847	36.781	18.113	10.997	7.671	36.781
%	7.80%	5,61%	86.59%	100.00%	49.25%	29.90%	20.86%	100.00%
Services	6.426	4.639	117.242	128,307	35.046	42.429	50.832	128.307
%	5.01%	3.62%	91.38%	100.00	27.31%	33.07%	39.62%	100.00%
of which	1.948	2,310	45.412	49,670	20.164	12.618	16.888	49,670
Wholesale trade								
%	3.92%	4.65%	91.43%	100.00%	40.60%	25.40%	34.00%	100.00%
Retail trade	547	224	21.579	22,350	4.191	6.185	11.974	22,350
%	2.45%	1.00%	96.55%	100.00%	18.75%	27.67%	53.57%	100.00%

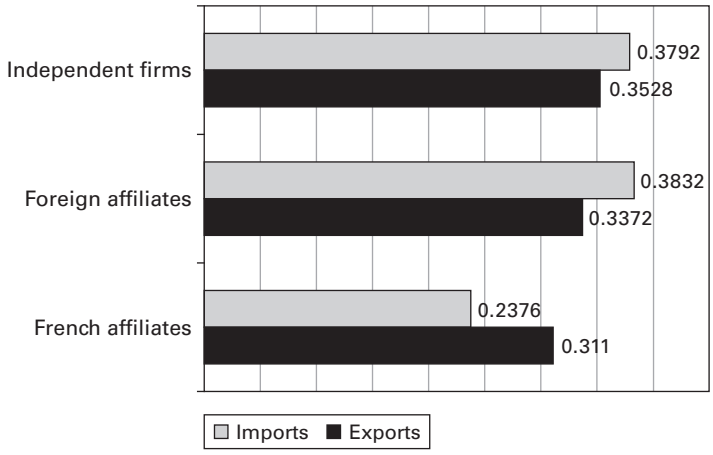

Figure 9.1
Trade volumes by ownership status.
Source: Author's elaboration from Bureau van Djik and French customs data.

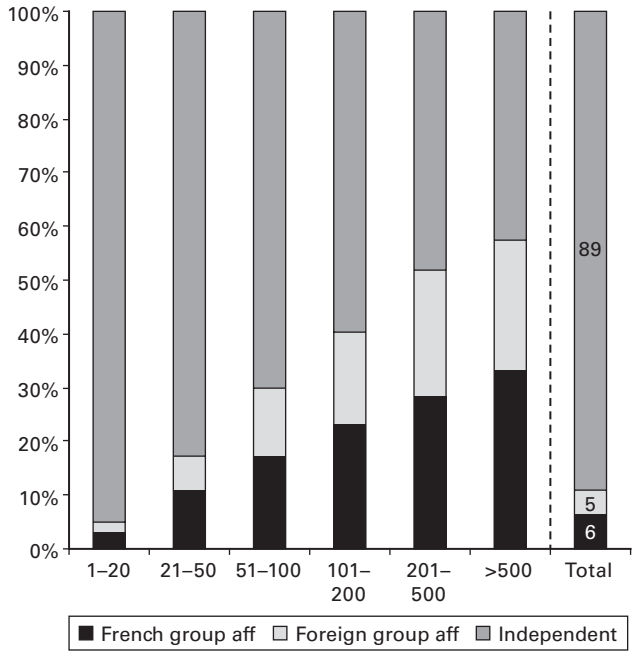

Figure 9.2
Ownership status by firm size (employment).
Source: Authors' elaboration on Bureau van Djik data.

In figure 9.3, we group affiliates by headquarters and plot their distribution in terms of size, where size is measured by number of affiliates. In this case, thanks to the coverage of our dataset, we are able to consider all foreign affiliates worldwide of foreign groups operating in France, as well as the total number of affiliates of French groups, thus drawing a more complete picture of the network of firms developed within multinational business groups. Recalling the definition provided earlier, a French group is included in our dataset if it has at least one affiliate abroad and its headquarters in France, whereas a foreign group (with foreign headquarters) owns at least one affiliate in France. In the graph and the table provided in figure 9.3, we report some descriptive statistics of the group size distribution by affiliates and locations of headquarters.

Group size is heterogeneous in terms of number of affiliates, resembling a Pareto distribution with a shape parameter of 6.61 for all groups and even higher for French groups. As illustrated in graph (a) in figure 9.3, multinational business groups operating in France are very dispersed, with a long right tail where a top 1 percent of headquarters control more than 1,000 affiliates and a median size of 10, while almost 40 percent of these groups are very simple organizations with one headquarter and only one affiliate. Groups with a French headquarters and a trading activity in France are on average smaller than foreign-owned trading groups, with a median size of four affiliates. In table (b) of figure 9.3, providing a geographical coverage of home economies, we observe that 4,637 headquarters are actually located in European Union (EU) members (2,964 in France), with a significant share in the United States and the rest in Europe and Japan. Considering the whole network to which affiliates in France can be connected through proprietary linkages, we have a total of 690,501 coaffiliates worldwide. In the fourth column of table (b) in figure 9.3, we collect them by home economy of the headquarters and calculate average and median size for some countries/regions. Here we note how, on average, groups originated in the rest of Asia (mainly Japan, Korea, and Taiwan) are usually very much concentrated in affiliates, followed at a distance by few African groups involved in extractive activities and U.S. groups. Brazil, Russia, India, and China (BRIC) altogether report only thirty-one multinational business groups with trading activity in France, and almost two-thirds of them (nineteen) are based in India.

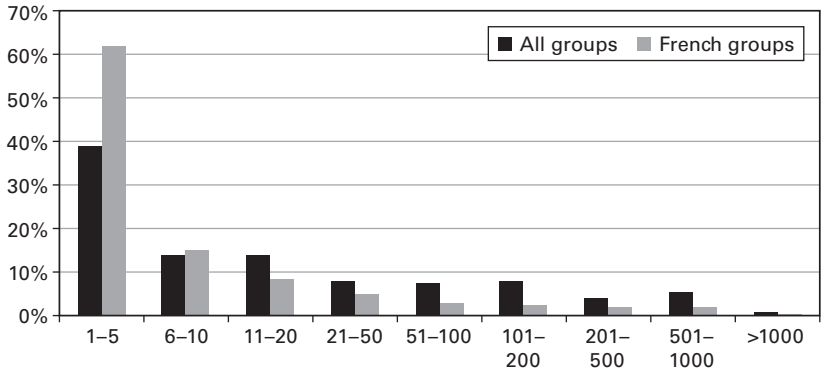

Figure 9.3
Group affiliation and worldwide networks, all groups vs. French groups.
(a) Group size distribution by no. affiliates (worldwide)
(b)

Home economy	No. headquarters	(%) on total headquarters	No. affiliates	Avg. affiliates per headquarters	Median no. affiliates
EU-27	4,637	80.59%	429,760	93	2
Of which France	*(2,964)*	*(51.51%)*	*(144,050)*	*(49)*	*(4)*
Rest of Europe	350	6.08%	46.239	132	13
NAFTA	638	11.09%	140,521	220	14
Of which United States	*(599)*	*(10.41%)*	*(135,881)*	*226*	*(15)*
BRIC	31	0.54%	5,880	190	10
ASEAN	9	0.16%	5,122	569	39
Rest of Asia	154	2.68%	49,244	319	13
Of which Japan	*(138)*	*(2.40%)*	*(40,690)*	*(295)*	*(13)*
Africa	10	0.17%	2,446	245	19
Middle East	44	0.76%	7,149	162	9
South America	8	0.14%	1,305	163	8
Oceania	23	0.40%	4,611	200	16
Total	5,754		690,501	120	10
Pareto k-parameter	6.61				
For French groups	*(9.36)*				

(c) Group home economies, average size and dispersion.

9.3 Global Value Chains, Organizational Modes, and Trade Collapse

9.3.1 The Great Trade Collapse in France

By now it has been acknowledged that the origin of the great trade collapse mostly lies in a huge demand shock (Baldwin and Taglioni 2009). Commodity prices tumbled when the price bubble burst in mid 2008 and continued to follow world demand in its downward spiral. The price movements and diminished demand sent the value and volume of commodities trade diving. The production and exports of manufacturing collapsed as the Lehman Brothers–induced shock-and-awe caused consumers and firms to wait and see. Private demand for all sorts of "postponeables" crashed. The large observed drop in trade-to-GDP ratio can be ascribed to the ensuing compositional effect as postponeable products represent a larger share in trade than in GDP and global supply chains may have played a role in synchronizing the demand shock to GDP and the demand shock to trade.

According to the finding by Alessandria, Kaboski, and Midrigan (2011), supply chains shaped the response to demand shock through an adjustment in inventories by single firms involved in complex buyer-supplier relationships. The shape would show a "bullwhip effect" (a V-shape, first dropping and then rebounding after a negative shock), explained by the reduction of stocks in times of crisis in order to adjust for new expectations about future demand. Forward and backward linkages within a supply chain and uncertainty about the real dimension of the demand shock would allow for its amplified transmission up the chain because each participant firm has a greater observed variation in demand for its production of (intermediate) goods. The bullwhip effect after a negative demand shock is depicted in figure 9.4, in which a simple value chain, composed of one retailer and two manufacturers, adjusts its orders exploiting previously stocked inventories as a buffer.

In our transaction-level data, we have a first confirmation of the postponement story (figures 9.5 and 9.6), as we plot growth rates calculated on a year-on-year basis from January 2007 to December 2009, with trends reported as moving averages of two lagged periods. A generalized drop of total trade flows is observed from September 2008, and an overall reversal begins from June 2009.

In an effort to capture compositional effects, we first show in figure 9.5 an aggregation by three broad categories of products (consumption

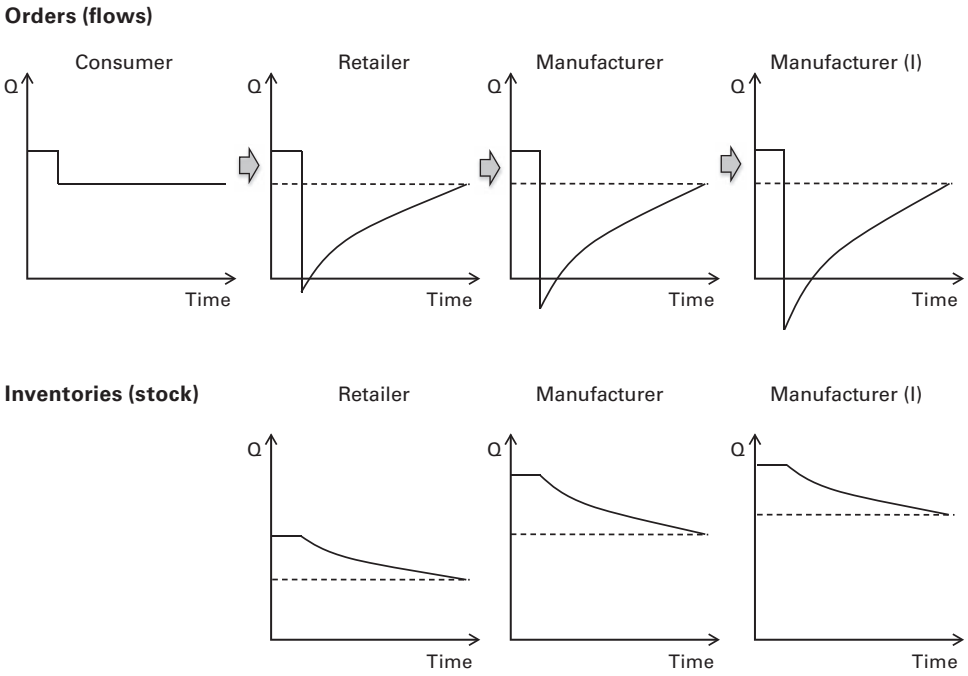

Figure 9.4
A bullwhip effect after a negative demand shock.

goods, intermediates, and capital goods) and then, in figure 9.6, we decompose consumption goods in durable and nondurable components, always for exports and imports.[5]

Assuming that trade in intermediate goods and capital goods is entirely driven by firm-to-firm relationships, whereas consumption goods are directed to final consumers (possibly through the mediation of firms involved in distribution activities), we observe that the first two categories react much more than the latter both along the export and the import dimensions. Indeed, although export and import growth rates of consumption register respectively an average of –6 percent and –4 percent in the middle of the crisis, the same averages for intermediates are –30 percent and –32 percent. On the other hand, capital goods show a different dynamics, sinking later and having yet to invert the ensuing downward trend in December 2009, while on the consumption side, the durable component hit exports harder, with negative rates reaching a peak of –23 percent in July 2009, when total export volumes were already recovering.

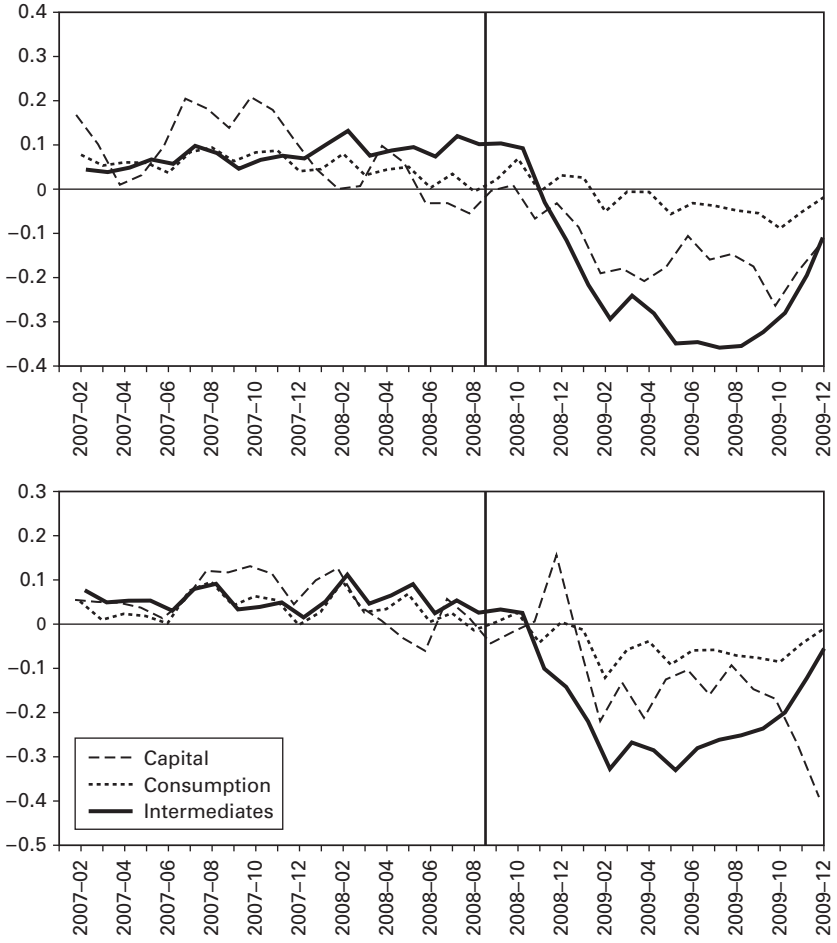

Figure 9.5
French trade in 2007–2009 by end-user (BEC-SNA) categories, year-on-year monthly flows.

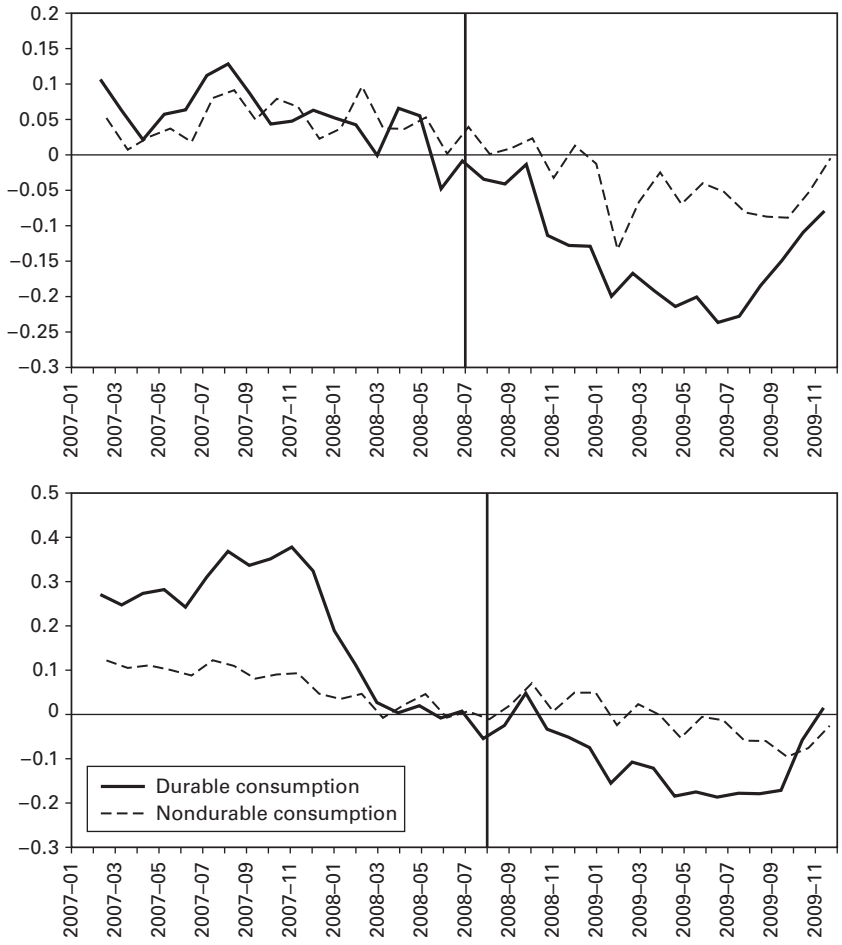

Figure 9.6
French trade in 2007–2009, durable vs. nondurable consumption, year-on-year monthly flows.

The final outcome on the overall change in total trade volumes is then the result of a compositional effect, with trade in intermediates being more important (about 58 percent of both import and export volumes) than trade in consumption goods (nowadays only 25 percent of total French trade). Hence the magnitude of the drop is clearly due to the exceptionally negative growth rates of both intermediates and capital goods, which are originated by the emergence of global value chains and have a higher weight on the overall export and import performance. Firms facing declining profits and uncertain demand have reduced their investment in capital goods and their acquisition of inputs; that is, they have reduced production capacity, waiting for better future prospects. Indeed, at this stage of the analysis we could already dismiss the hypothesis of a multiple accounting effect as proposed by Yi (2009), because if the magnitude of the drop would be due to the same intermediate component crossing national borders several times, also growth rates of all final goods should reflect this effect, without regard to the durability of consumption, once the intermediate component is transferred to their gross value.

In the following analysis, we assess the role of the different organizational modes of a value chain during the crisis.

9.3.2 The Role of Global Value Chains

The emerging importance of global value chains is recognized by the increasing trade in intermediate inputs that nowadays represents a share between 56 percent and 73 percent of overall trade flows in goods and services for developed economies (Miroudot, Lanz, and Ragoussis 2009). Indeed, trade in intermediate inputs is itself an indication that firms across national borders are engaged in backward and forward linkages, hence establishing global value chains where final goods or services undergo separate processing processes across different national borders before reaching the final consumer. From the point of view of a single firm, the decision is to relocate part of the production abroad with the establishment of affiliates or to license an unaffiliated supplier outside its own boundary of economic activity. Several theoretical models explain the choice between these two organizational modes (see, e.g., Antràs 2005; Grossman and Helpman 2005; Feenstra and Spencer 2005; Helpman 2006) that originate intrafirm (better, intragroup) trade in the first case and arm's-length trade in the second case.

In the end, the internalization of production processes leads to the emergence of multinational business groups that collect affiliates under

the coordinated direction of headquarters, that is, hierarchies of firms linked by complex control chains that organize their activities under a unique control rather than through market relationships. Although the analysis of the determinants of the internalization of production processes is beyond the scope of this chapter, the interested reader can refer to chapters 7 and 8. Moreover, chapter 1 provides a comparison of the economics and business literatures on the topic, highlighting that scholars in both fields can find a common ground derived from the seminal works by Coase (1937) on the one side and Penrose (1959) on the other.

As we have seen in the data presented in the previous section, in the case of France for the period 2006–2009, affiliates operating in France that are part of a multinational business group account for the majority of trade volumes, as they are responsible for about 65 percent of exports and 62 percent of imports even if they represent only 7 percent of the total number of firms. As we have seen, this concentration of trading activity among multinational business groups is paired with a relevant degree of heterogeneity in terms of size. Unfortunately, from our data we are still not able to directly measure intragroup trade via related parties, because exports and imports by affiliates located in France can include both a component of trade with related parties abroad (intragroup trade) and a complementary component of trade with nonrelated parties (arm's-length trade). On the contrary, in the case of trading activity by French nonaffiliates, we can be sure that international trade is exclusively at arm's length.

To solve this problem, we are able to proxy intragroup trade by building on the findings of Bas and Carluccio (2011), showing that 88 percent of trade by affiliates in France in a certain destination/origin is made either following a "pure outsourcing" (arm's-length, in our words) strategy or a "pure offshoring" (intragroup) strategy, with a mere 12 percent of cases following a mixed (outsourcing and offshoring) strategy.[6]

Henceforth, we assume that trade occurs within the boundary of the business group when transactions undertaken by French affiliates in a given partner country find in the same country a corresponding subsidiary that belongs to the same multinational business group. Although it allows us to bypass the lack of related-party data, such a proxying assumption could still bias our measure of intragroup trade because it might include a nonobserved share of arm's-length trade due to the mixed strategy of outsourcing and offshoring. This issue can be

considered an acceptable bias if one is willing to believe, as we do, that the latter is not correlated with any specific characteristic of the sample firms. On the other hand, we have no doubt that if transactions are undertaken by independent firms, or if they are not directed toward a country in which there are coaffiliates, those transactions are exclusively at arm's length because by construction they fall outside the boundaries of the multinational business group. Following our approximation, we can then estimate a total of 48 percent of exports and 46 percent of imports in 2007 being undertaken as intragroup trade.

To validate our measure, we can rely on a number of references against which to compare our proxy of French trade among related parties. In 1999, the "Enquête sur les échanges intra-groupe," a survey on firms representing 55 percent of French imports and 61 percent of French exports, estimated that 32 percent of transactions (not trade volumes) were among related parties. Among these 93 percent were transactions by firms located in developed countries (mainly the European Union and the United States). Given the spectacular increase of outsourcing/offshoring decisions over the last decade, our estimate of 48 percent does not seem inconsistent with these numbers. More interestingly, a partial direct validation is possible considering bilateral trade between France and the United States. Indeed, according to the Related Party Database by the U.S. Census Bureau (as reported by Lanz and Miroudot 2011), 55.9 percent of imports from France in 2009 are originated by intragroup trade, a figure not very distant from the 61.9 percent we find in our dataset in the same year (exports from France to the United States); in this case, the overestimation would be 10.7 percent, slightly less than what reported by Bas and Carluccio (2011) as a mixed strategy. Furthermore, using Census Bureau data as a cross-country reference, the amount of intragroup trade in the United States (46.8 percent of exports) is very similar to our estimation for France (48 percent).

In figure 9.7, we therefore report monthly growth rates of trade volumes distinguishing between end user categories (consumption goods, capital goods, and intermediates) as in figure 9.5, but now taking into account whether transactions are intragroup or arm's length, as proxied by our methodology. Consistent with our prior work, in both graphs of figure 9.7, trade originated by vertical integration—that is, intragroup, graph (a) in the case of intermediates and graph (d) in the case of total trade—drops faster at the outburst of the crisis but rebounds also faster once the recovery begins, when rates have become

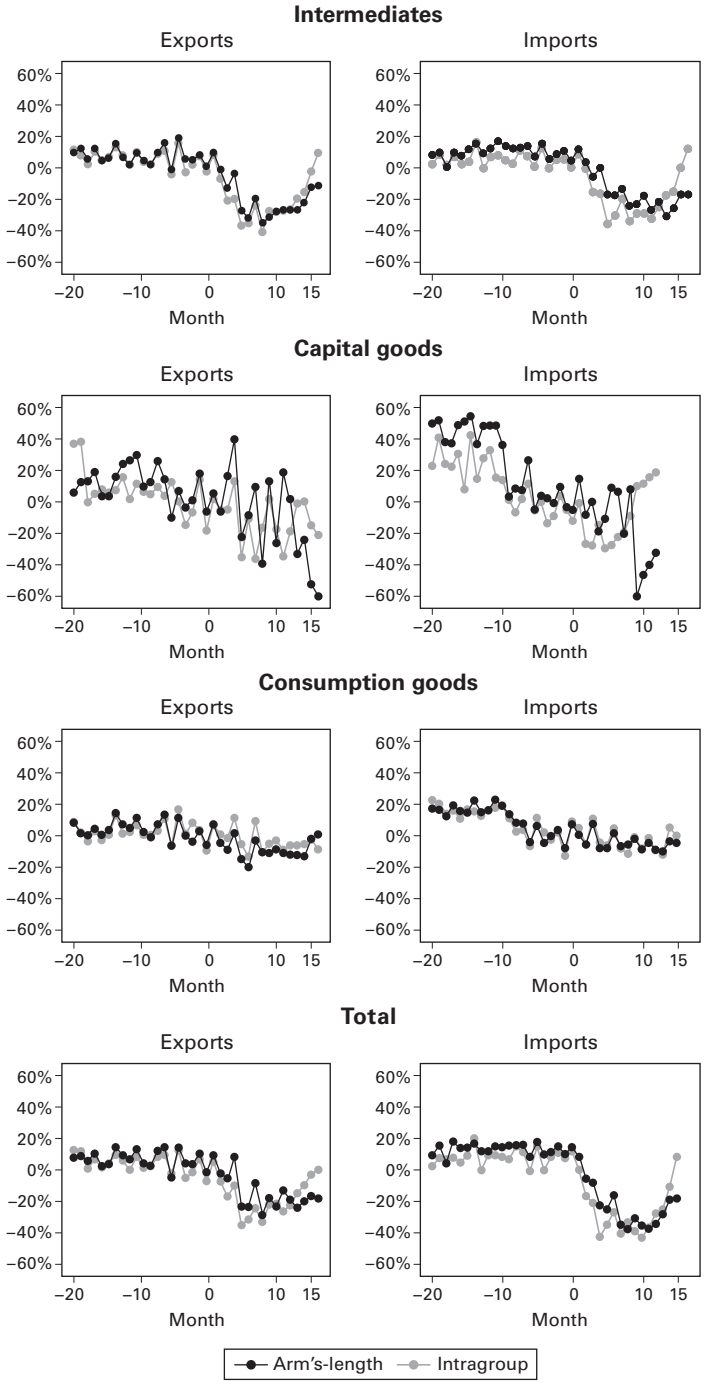

Figure 9.7
Organizational modes and trade collapse in 2007–2009, monthly growth rates, year-on-year basis.

positive again at the end of 2009, with values well above 10 percent; on the contrary, in the same period, arm's-length growth rates show still a consistent decline: –11 percent for export of intermediates and –17 percent for import of intermediates. The organizational modes of global value chains thus seem to show a different dynamic that was concealed when looking at more aggregate data. Total trade flows for both imports and exports are clearly driven by the trend in intermediates, as in graph (a) of figure 9.7, thus confirming the compositional effect of the trade collapse induced by the creation of complex supply chains and the fact that intermediates account for about 60 percent of total volumes. Also, the faster drop and faster rebound of intragroup trade is determined by the sole trade in intermediates, because in the case of consumption and capital goods such a different trend is not observed.

In the econometric analysis of section 9.4, we test whether the different behavior of multinational groups is confirmed by looking at disaggregated data and controlling for several compositional effects.

9.3.3 The Geography of the Trade Collapse

In the remainder of this section, we verify whether geography matters for the dynamics of trade flows during the crisis. In table 9.2, we provide a geographical dimension of the organizational modes before and after September 2008, showing the heterogeneity of intragroup and arm's-length growth by key partner countries/areas. In figures 9.8 and 9.9, we draw two maps, identifying only the performance after the beginning of the drop. The indicator we adopt here is an integration index that considers both imports and exports originated by, respectively, arm's-length and intrafirm trade averaging them from 2007M9 to 2009M12.[7]

In contrast with the finding of other authors (Kaplinsky and Farooki 2010; Cattaneo, Gereffi and Staritz 2010), we do not observe in our case that trade originated by value chains shifted substantially after the crisis toward emerging economies. Rather, quite the opposite, the integration of the BRIC nations seems to take place well before the crisis and to stop afterward, with negative growth rates. A notable exception is China, where we observe that even during the crisis, arm's-length trade was not disrupted (+0.1 percent) and intragroup trade fell considerably less than in the case of other French emerging partners (with the exception of some African countries that instead have registered positive growth rates for the whole period).

Table 9.2
Organizational modes and trade collapse, monthly growth rates, year-on-year basis, 2007–2009

	Arm's length		Intrafirm	
	Pre-crisis	Post-crisis	Pre-crisis	Post-crisis
OECD	4.08	–16.54	5.73	–16.16
Emerging economies	7.78	–11.77	9.57	–13.34
EU-27	6.05	–18.29	7.25	–15.15
EU-15	6.19	–16.61	2.68	–16.99
New EU members	5.9	–20.25	12.98	–12.83
NAFTA	2.8	–13.17	5.46	–13.20
United States	0.12	–7.00	–1.37	–11.98
Canada	6.53	–20.06	6.78	–0.83
BRIC	15.11	–12.20	17.4	–24.65
China	13.34	0.09	11.31	–5.67
Brazil	16.23	–17.94	14.53	–25.25
India	14.49	–13.58	23.5	–26.50
Russia	16.35	–17.38	20.26	–41.17
ASEAN	0.33	–11.34	27.9	–8.70
Africa	8.81	–2.83	10.85	–6.64
Middle East	9.53	–6.58	2.03	–3.41
South America	2.88	–4.07	3.89	–15.21

Vertical integration (intragroup) has on average fallen from September 2008 to December 2009 for both OECD High Income Countries and Emerging Economies, with a slightly different dynamic at the beginning of 2009, when recovery begun a quarter earlier for intermediates exported in emerging economies, until the end of the same year, when growth rates became positive again. In absolute terms, trade is more substantial in OECD countries (74.8% of export values and 74.6% of import values in 2007).[8] Among developed partners, French-based value chains with the European Union were severely hit, both in the case of historical EU-15 and in the case of new EU members, whereas intragroup trade with Canada was more resilient. With the United States, the negative trend began well before the crisis.

Summing up, in line with the worldwide synchronized nature of the demand shock, it seems that we can rule out a specific role of geography in affecting the dynamics of the trade flows differently across organizational modes. In any case, we also control for the latter possible compositional effect in our econometric specification, to which we now turn.

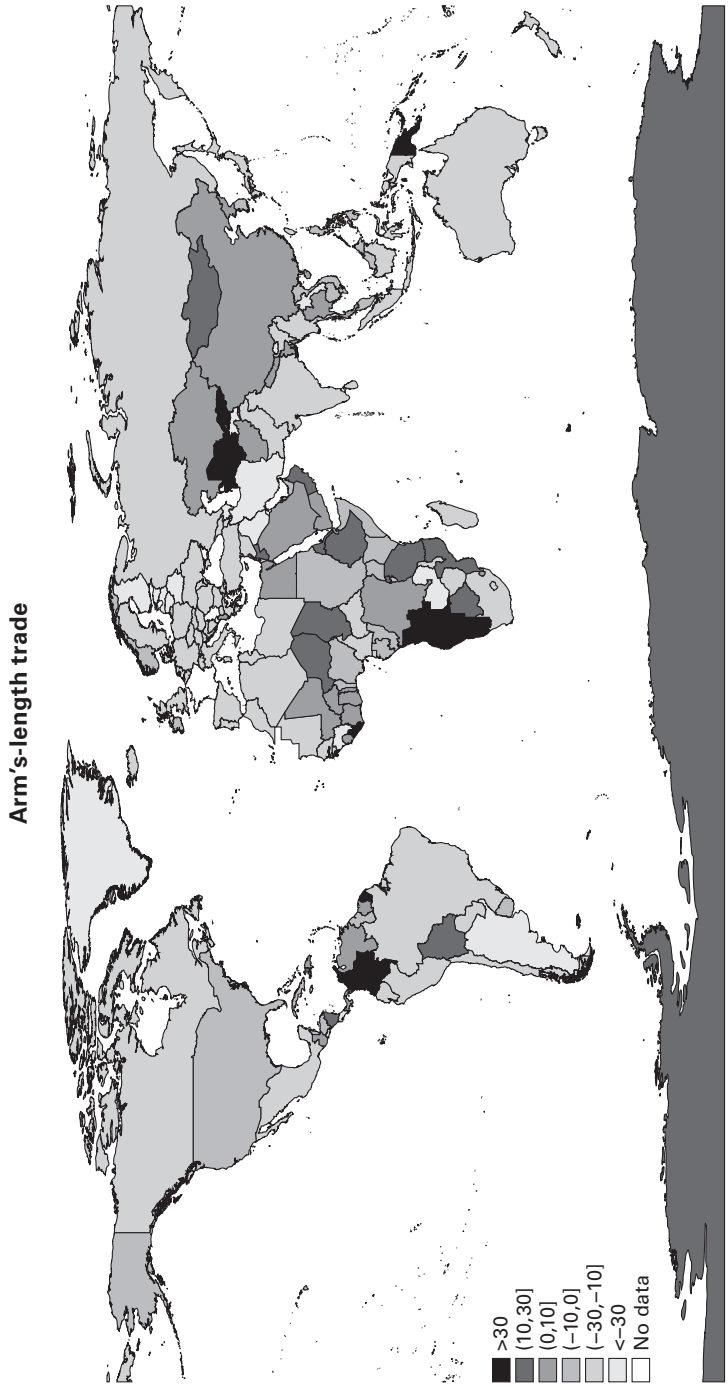

Figure 9.8
Arm's-length trade and trade collapse, average growth rates, year-on-year basis.

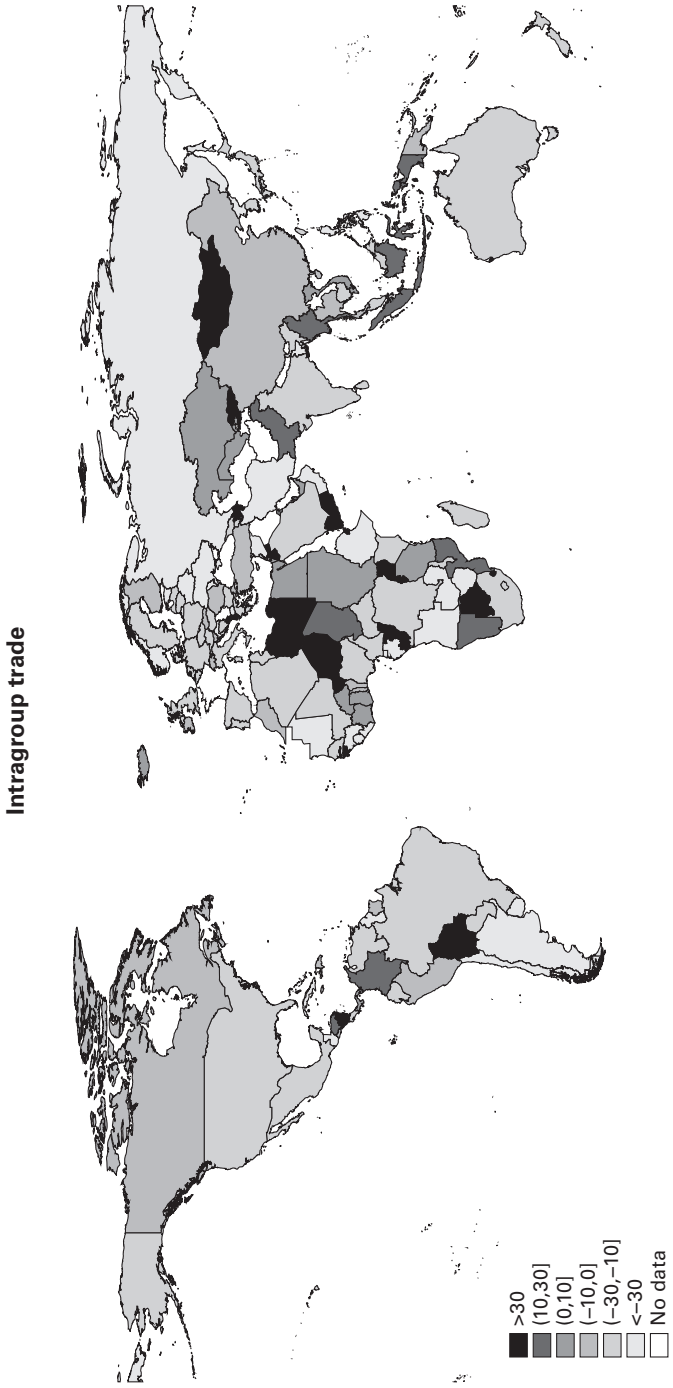

Figure 9.9
Intragroup trade and trade collapse, average growth rates, year-on-year basis.

9.4 Empirical Strategy and Results

In this section, we test whether trade performance due to participation to value chains has been responsible for the magnitude of the drop, and whether the two alternative modes of organization of interfirm linkages have shown a different resilience during the crisis for both imports and exports.

Our estimation strategy takes as dependent variable (g_{isct}), the midpoint growth rate of trade flows, specific for product s traded by firm i in country c of origin/destination and month t. The midpoint growth rate, already employed by Bricongne et al. (2012) for the French case during the crisis, correctly approximates the observed aggregate growth rates of exports but, unlike other methods, it controls for composition effects avoiding an attrition bias caused by the entry and exit of sample observations and for monthly seasonality.[9]

The latter is regressed against a number of relevant controls via the following specification:

$$g_{isct} = \beta_0 + \beta_1 \Lambda + \beta_2 \Lambda * recovery + \gamma_j + \varepsilon_{isct}$$

where

$$\Lambda = \alpha_1 \text{int}erm_{isct} + \alpha_2 \text{int}ragroup_{isct} + \alpha_3 (\text{int}erm * \text{int}ragroup)_{isct} + OECD_{isct}$$

Among the set of regressors in Λ, the term $interm_{isct}$ stands for a binary variable that equals 1 if the traded product is an intermediate good and 0 otherwise, and $intragroup_{isct}$ is another binary variable that equals 1 if the flow is traded intragroup and 0 otherwise, following our approximation of intragroup versus arm's-length trade introduced in the previous section. The interaction between the intermediate and the intragroup dummies $(interm * intragroup)_{isct}$ is to be interpreted as the subset of trade flows that involve the exchange of intermediate goods between affiliates belonging to the same headquarter, that is, a global value chain represented by a verticalized multinational group with backward and/or forward linkages. The binary variable $OECD_{isct}$ allows us to control for a geographic compositional effect induced by possibly different demand shocks registered in OECD countries after the financial crisis.

Taking into account the period from 2008M09 to 2009M12—that is, from the beginning of the trade collapse until the last available month of our data—we differentiate the impact of our set of regressors A in two subperiods through the dummy *recovery*, that is, before and after

2009M06. This is the month when overall trade flows began their recovery in France after a negative peak. More in general, this is the month in which conventionally the world economy starts to experience a generalized resumption of world trade. Finally, compositional effects potentially induced by a change in the sectoral pattern of trade flows are captured by a set of NACE four-digit industry fixed effects (γ_j).

In tables 9.3 and 9.4, we report the results for French exports and imports growth rates, respectively. In the first column of both tables 9.3 and 9.4, we confirm that once considering only the end use of products and controlling for sector compositional effects, the magnitude of the drop is due to trade in intermediates (inputs)—namely, to products that are exchanged by firms that establish backward and forward linkages either by proprietary or by buyer/supplier relationships, as observed in figure 9.5. In particular, although we have an average negative growth rate for the whole period of, respectively, –8.8 percent and –6.1 percent for exports and imports (the coefficient of the constant term), a further negative and significant effect is to be added for trade in intermediates. A bullwhip shape due to trade in intermediates is however detected from the estimation in the second column: at a negative premium for intermediates at the outburst of the crisis corresponds a positive premium once the recovery begins. Both the magnitude of the drop and the pattern of recovery are to be attributed to trade in intermediate goods that constitute already almost 60 percent of flows as we already know from aggregated data.

In the third column, we begin to control for the organizational mode of the value chain, that is, if products are exchanged by firms on the basis of proprietary or buyer/supplier relationships, regardless of their end use. In this case, on average over the entire period, intragroup trade shows no significant difference with respect to arm's-length trade in the case of exports, and a better performance in the case of imports. This finding shows that at least on the import side, trade flows within multinational groups (regardless of their end use) during the considered period have in general been more resilient than those undertaken by independent firms.

In the fourth column, we start controlling for the interaction between the organizational mode of the value chain and the end use of traded products. For exports flows, the positive and significant coefficient on the interaction implies that intragroup trade on the average of the entire period has grown more in intermediates than in other end use

Table 9.3
Exports and global value chains

Dependent variable: Midpoint growth rates	OLS (I)	OLS (II)	OLS (III)	OLS (IV)	OLS (V)	OLS (VI)
Intermediates	–0.009***	–0.013***	–0.009***	–0.012***	–0.012***	–0.012***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Intragroup			–0.001	–.007***	0.010***	0.012***
			(0.001)	(0.001)	(0.002)	(0.002)
Intermediates × intragroup				0.013***	–0.008**	–0.008**
				(0.002)	(0.003)	(0.003)
OECD						–0.022***
						(0.002)
recovery		–0.002			0.006***	0.008***
		(0.001)			(0.002)	(0.002)
Intermediates × recovery		0.010***			–0.000	–0.000
		(0.002)			(0.002)	(0.002)
Intragroup × recovery					–0.038***	–0.038***
					(0.003)	(0.003)
Intermediates × intragroup * recovery					0.048***	0.049***
					(0.005)	(0.005)
OECD × recovery						–0.003
						(0.002)
Constant	–0.088***	–0.088***	–0.088***	–0.087***	–0.089***	–0.073***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,985,900	11,985,900	11,985,900	11,985,900	11,985,900	11,985,900
Adjusted R^2	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010

Note: *, **, *** stand respectively for significance at 90%, 95%, and 99%. Robust standard errors in parentheses.

Table 9.4
Imports and global value chains

Dependent variable: Midpoint growth rates	OLS (I)	OLS (II)	OLS (III)	OLS (IV)	OLS (V)	OLS (VI)
Intermediates	–0.006***	–0.013***	–0.008***	–0.001	–0.006***	0.004**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Intragroup			0.026***	0.046***	0.064***	0.074***
			(0.001)	(0.002)	(0.002)	(0.002)
Intermediates * intragroup				–0.032***	–0.045**	–0.051**
				(0.002)	(0.003)	(0.003)
OECD						–0.083***
						(0.002)
Recovery		–0.007***			–0.001	–0.023***
		(0.003)			(0.001)	(0.002)
Intermediates × recovery		0.015***			0.012***	0.007***
		(0.002)			(0.002)	(0.002)
Intragroup × recovery					–0.043***	–0.047***
					(0.004)	(0.003)
Intermediates × intragroup × recovery					0.029***	0.032***
					(0.005)	(0.005)
OECD × recovery						0.031***
						(0.002)
Constant	–0.061***	–0.058***	–0.066***	–0.069***	–0.069***	–0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,432,528	15,432,528	15,432,528	15,432,528	15,432,528	15,432,528
Adjusted R^2	0.0009	0.0009	0.0009	0.0009	0.0010	0.0012

Note: *, **, *** stand respectively for significance at 90%, 95%, and 99%. Robust standard errors in parentheses.

categories. In the case of imports, the opposite effect holds. However, as observed in figure 9.7, these effects are the outcome of two very different dynamics over time, with trade in intermediates first dropping and then recovering. Hence it could well be the case that in the case of exports, intragroup trade in intermediates has recovered more than it originally dropped during the crisis, while such a recovery has not yet fully occurred in the case of imports. Our prior is instead more general, as it postulates only that intragroup trade in intermediates recovered more quickly (or fell faster) than all the other forms of trade (by end use or organizational form).

To test for the latter hypothesis, in the fifth column of both tables 9.3 and 9.4 we then split the effect between the crisis and the recovery period to test whether there is such a difference in dynamics. The sign of the dummy identifying the recovery period shows that exports indeed performed better after the through of the crisis, independently on end uses or organizational modes. Moreover, the positive and significant coefficient on the triple interaction term implies that during the recovery, exports of intermediates have performed better when taking place within multinational groups than at arm's length, thus confirming our hypothesis. Along the same lines, on average imports do not show any differential performance during the recovery across end uses or organizational modes, again consistent with the idea that the *overall* growth of intragroup trade in intermediates has been insufficient to absorb the effect of the collapse. However, once again, the positive and significant coefficient on the triple interaction term implies that during the recovery imports of intermediates have in any case performed *relatively* better when taking place within multinational groups than at arm's length, in line with our assumption.

In the sixth column, we finally check whether results are robust to a geographic compositional effect induced by the different (stronger) demand shocks coming from OECD countries. In general, we observe a negative premium for transactions that involve a developed partner at the beginning of the crisis. However, in the second period of our analysis there seems to be no difference in trends of exports between developed and developing partners, while imports from OECD countries recovered strongly. This result is in contrast with what suggested by Kaplinsky and Farooki (2010) and Cattaneo, Gereffi, and Staritz (2010), according to whom the trade drop entailed also a substantial shift of value chains toward emerging economies. More important

for our goals, our previous results on the triple interaction term are confirmed.

To sum up, for both exports and imports of intermediates, we find that trade flows have grown more when undertaken intragroup versus at arm's length, as soon as total trade begun its recovery. This result is consistent with the findings by Alessandria, Kaboski, and Midrigan (2011) for the United States, attributing in general the faster drop and rebound of intermediates to adjustment in inventories. More specifically, we show that the overreaction at the beginning of the period, then compensated by a faster recovery in the aftermath, is particularly pronounced for verticalized multinational groups versus arm's-length trade. This finding shows a different and faster response of value chains organized by multinational groups. Our explanatory hypothesis is that the internalization of activities within the boundary of a group allows for a better management of information flows coming from the bottom of the value chain so that production and inventories can be more swiftly adjusted to demand shocks.

9.5 Conclusions

In this chapter, we analyzed the trade performance of global value chains during the Great Trade Collapse. Exploiting a unique transaction-level dataset matching French monthly trade data with ownership information for the period 2007–2009, we have been able to distinguish the trade performance of two alternative organizational modes of the value chain: internalization of activities by multinational business groups, entailing trade among related parties, and the establishment of buyer/supplier contracts, entailing arm's-length trade.

We first provided some stylized facts on multinational business groups: affiliation to a headquarters is a concentrated phenomenon because affiliates in France account for about 65 percent of exports and 62 percent of imports even if they represent less than 10 percent of the total number of trading firms. Moreover, the distribution of multinational business groups by size, measured by number of affiliates worldwide, is very dispersed, resembling a Pareto distribution.

Second, in order to assess the role of global value chains at the outburst of the crisis, we have econometrically tested the differential performance of trade in intermediates. This factor has been shown to be the main determinant of the magnitude of the collapse. We have

also found that intragroup trade in intermediates exhibited specific dynamics, with a faster drop followed by a faster rebound than trade in other end categories. In other words, trade that originated within hierarchies of firms reacted faster to the negative demand shock but also recovered faster in the following months than did arm's-length trade. Among the alternative channels of transmission of the demand shock to trade performance proposed in previous studies, the adjustment in inventories seems the most consistent with these findings. As in the case of the United States, studied by Alessandria, Kaboski, and Midrigan (2011) for the general case of intermediates, amplified fluctuations of trade with respect to GDP could be associated to the so-called bullwhip effect (Forrester 1961; Stadtler 2008), that is, a magnification of the initial demand shock along the supply chain due to an adjustment of production and stocks to new expectations. In this case, the finding of a better performance of intragroup trade could also be explained by better handling of inventories, thanks to the ability to react faster and optimize management of stocks within the boundaries of the group.

At this stage of the analysis, we cannot exclude a role for trade credit constraints, as hierarchies of firms may have relied on an internal capital market that softened the crunch of external sources of financing. This result would, however, explain a faster recovery but not a faster drop. Hence although an interaction of both determinants (optimization of inventories management and softer financial constraints) may have been relevant as suggested by Escaith, Lindenberg, and Miroudot (2010), among others, softer financial constraints alone would not be able to account for the observed patterns of the data.

Appendix: End-User Categories of Trade Flows

BEC is a reclassification of traded goods according to their main end use. It was developed by the UN Statistics Division to be matched with the System of National Accounts. Our data, originally registered as HS six-digit flows, were converted first by BEC categories and then grouped by basic classes of the SNA following table 9A.1.

An alternative classification by end-use is MIG, proposed by Eurostat, which is based primarily on NACE rev. 2 industrial sectors and allows us to distinguish between durables and nondurables. Starting with HS product flows, we first converted them in NACE economic activities and then reclassified following table 9A.2.

Table 9A.1
Correspondence table, from BEC to the SNA

Basic classes SNA	Broad economic categories (BEC)
Capital goods	41. Capital goods (exc. transport)
	521. Transport equipment, other, industrial
Consumption goods	112. Food and beverages, primary, mainly for household consumption
	122. Food and beverages, processed, mainly for household consumption
	51. Transport equipment, passenger motor cars
	522. Transport equipment, other, nonindustrial
	61. Consumer goods, durable
	62. Consumer goods, semi-durable
	63. Consumer goods, nondurable
Primary (intermediates)	111. Food and beverages, primary, mainly for industry
	21. Industrial supplies, primary
	31. Fuels and lubricants, primary
Parts and components (intermediates)	42. Capital goods, parts and accessories
	53. Transport equipment, parts and accessories
Semifinished goods (intermediates)	121. Food and beverages, processed, mainly for industry
	22. Industrial supplies, processed
	322. Fuels and lubricants, processed, other

Source: United Nations

Table 9A.2
Correspondence table, from NACE rev. 2 to MIG

Main industrial groupings (MIG)	Nomenclature statistique des activités économiques dans la Communauté européenne (NACE), revision 2
Capital goods	251. – 252. – 253. – 254. – 262. – 263. – 265. – 266. – 28. – 29. – 301. – 302. – 303. – 304. – 325. – 33.
Consumer durable goods	264. – 267. – 275. – 309. – 31. – 321. – 322.
Consumer nondurable goods	101. – 102. – 103. – 104. – 105. – 107. – 108. – 11. – 12. – 139. – 14. – 15. – 18. – 204. – 21. – 323. – 324. – 329.
Intermediate goods	07. – 08. – 09. – 106. – 109. – 131. – 132. – 133. –16. – 17. – 201. – 202. – 203. – 205. – 206. – 22. – 23. – 24. – 255. – 256. – 257. – 259. – 261. – 268. – 271. – 272. – 273. – 274. – 279.
Energy	05. – 06. – 19. – 35. – 36.

Source: Eurostat

Notes

1. An advantage of this criterion is also to partition affiliates among groups while avoiding double counting by different headquarters. For a more complete reference on methodologies to track group control chains from affiliates to ultimate headquarters, see Altomonte and Rungi 2012.

2. The original source of Bureau van Djik's database for French firms are the Tribunaux de Commerce, which are responsible for collecting balance sheet data according to national legislation, according to which some smaller "sociétés de personne" and "sociétés cooperatives" are exempted from the obligation of a complete balance sheet.

3. MIG end-use categories are based on the NACE rev. 2 classification and are defined by the European Commission regulation (EC) no. 656/2007 of June 14, 2007.

4. According to NACE rev. 2, two-digit industry codes, firms involved in wholesale trade are classified as NACE code 46 and firms involved in retail trade are classified as NACE code 47.

5. Capital goods, consumption goods, and intermediates are main end user categories from BEC classification of traded products reclassified according to the System of National Accounts; see table 9A.1 in the appendix to this chapter for details. MIG allows for a reclassification of consumption goods among durables and nondurables on the basis of the end use of final consumer. For details, see table 9A.2 in the appendix to this chapter.

6. In the international trade and business studies literatures, the term "offshoring" is sometimes used indifferently to define either a general relocation of activities abroad (including both intragroup and arm's-length trade) or, more specifically, activities that are internalized by the firm (only intragroup). Bas and Carluccio (2011) prefer to use the term "(pure) offshoring" for trade originated by vertical integration only, hence "intragroup trade."

7. Our vertical integration indices are given by $(exports_{ijkt} + imports_{ijkt}) / (exports_{ijt} + imports_{ijt})$, where i is the home country, j is the partner country, k is either arm's-length trade or intrafirm trade to/from the partner country, and t is time. As the denominator, we have the sum of total imports and exports between home i and partner j in the same period. This indicator measures the degree of participation to value chains and can virtually range from [0,1], from economies that are completely closed to offshoring/outsourcing activities to economies that rely exclusively on value chains.

8. According to an OECD definition, its members can be distinguished between High-Income countries and Middle-Income countries. This latter category includes only Turkey, Chile, and Mexico, and we exclude it from our variable. The definition of emerging economies is more controversial. Here we have adopted the one provided by Dow Jones that lists 35 countries.

9. Applying the mid-point growth rate to our specific case, we have: $g_{isct} = (X_{isct} - X_{isc(t-12)}) / (0.5 \times (X_{isct} + X_{isc(t-12)}))$. The rate is bounded in the range [–2, +2] with the extremes of the interval indicating the emergence (+2) or the disappearance (–2) of flows in month t with respect of the same month of the previous year ($t - 12$). For other applications of this methodology, see also Davis and Haltiwanger 1992 and Buono, Fadinger, and Berger 2008.

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