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VALUE CHAINS AND THE GREAT RECESSION: EVIDENCE FROM ITALIAN AND GERMAN FIRMS

by Antonio Accetturo* and Anna Giunta#

Abstract

Global Value Chains (GVCs) have been one of the main transmission mechanisms of 2009 the Great Trade Collapse. Our paper provides a description of the effects of the crisis from a perspective that is both country-comparative (Germany and Italy) and on firm level. Two are the main conclusions: i) intermediate firms were hit by the crisis more than final firms; ii) firms' position in GVCs and their strategies explain part of the performance gap between Italian and German firms.

JEL Classification: D230, L220, F140, F230.
Keywords: Global Value Chains, Germany, Italy, Industrial Firms, Firm Organization, World Trade.

Contents

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1 Introduction

A sizeable body of literature over the past twenty-five years suggests that a structural change in the productive economy has occurred as a consequence of the ICT revolution, the steady lowering of trade barriers and transport costs (Feenstra, 1998), and the changing nature of multinational enterprises (Saliola and Zanfei, 2009).[1] The outcome is a new international division of labor in which the production of final products is fragmented in Global Value Chains (GVCs). Under this interpretation (Gereffi and Fernandez-Stark, 2011, for an overview of GVCs), the production process for any given good can be seen as a continuum of tasks assigned to the various productive units; these tasks can be performed in several different places around the world. The organization of production varies continually, with each task offshored to the country where the production and international transaction costs are lowest.

In the face of the 2008-09 great recession, the systemic importance of GVCs proved to be significant. According to several studies, GVCs rapidly transmitted real and financial shocks throughout different channels, thus amplifying the national fluctuations of demand for final goods. Baldwin (2009) holds that the synchrony of the collapse in world trade was directly caused by the input-output linkages in GVCs.

What happened to firms operating inside the value chains? Did their position in the value chain play a role in their performance during the crisis? Were firms' individual characteristics and strategies relevant determinants of their resilience? The aim of this paper is to answer these questions by taking a look at the firm-level evidence.

Relying on data from the EU-EFIGE/Bruegel-UniCredit survey (EFIGE), we first outline firms' main modes of participating in a GVC. We then assess the interactions between firms' position in the value chains and their performance by looking at sales dynamics during the 2008-09 crisis.

In this study we concentrate on the German and Italian part of the EFIGE dataset. Germany and Italy are somewhat paradigmatic countries and are an interesting area of analysis for several reasons: both are highly industrialized countries and leaders in EU manufacturing exports; industrial firms of both countries are substantially involved in and affected by globalization; and a large share of firms (higher in the Italian industry) work exclusively as intermediate firms, a key factor in our analyses in explaining the heterogeneous resilience to the crisis.

The 2008-09 crisis is a particularly interesting case. First, it was quite unexpected as it originated from the US financial crisis of the summer of 2007. This implies that it can be considered exogenous to the German and Italian economic conditions. Second, the downturn was particularly severe. German and Italian GDP fell by 4 and 7 per cent, respectively, in two years; in this light, the crisis can be considered a serious ‘stress test’ for firm’s strategic decisions.

This paper contributes to the existing literature under at least three points of view. First, we make a cross-country analysis of two developed and highly industrialized economies, an important issue since most of the existing literature focuses on emerging market firms and their possibility of accessing GVCs. Second, unlike developing countries in which intermediate firms prevail, advanced economies are characterized by the coexistence of both final and intermediate firms; this implies that they are on the verge of becoming either a ‘headquarters’ or a ‘factory economy’ (Baldwin, 2011). By analyzing firm performance during a period of great economic shock, we are able to identify a country’s ‘best’ specialization under ‘extreme’ economic conditions. Third, with regard to heterogeneity, the analysis of micro dynamics at firm-level is particularly relevant in terms of assessing firms’ strategies and their ability to face a major macroeconomic shock. It is also important from a policy maker’s point of view as one can learn which types of firm are more vulnerable to crisis. This is truly an under-researched issue as there are only two papers that analyze this topic, albeit from a different perspective (Altomonte et al., 2012; Bekes et al., 2011; see the next section on literature review).

The structure of the paper is as follows. Section 2 analyzes the recent debate on the role of GVCs as transmission mechanisms of the 2008-09 financial crisis and the firm-level impact, comparing Italy and Germany in terms of differences, similarities and firms' involvement in GVCs. Section 3 presents the data. Section 4 contains the descriptive analysis. Section 5 analyzes firm performance during the crisis by establishing the estimation methods and presenting the main results. Section 6 concludes.

2 Firms in GVCs and the great recession

2.1 Literature review

'World trade experienced a sudden, severe, and synchronized collapse in late 2008 – the sharpest in recorded history and deepest since WWII' (Baldwin, 2009). World trade in manufactures fell by about 30 per cent between the first half of 2008 and the first half of 2009 (WTO, 2009). The fall in trade during the crisis was also quite homogeneous across all countries: more than 90 per cent of OECD countries simultaneously exhibited a decline in exports and imports exceeding 10 per cent (Martins and Araújo, 2009). European Union countries were severely affected, with marked declines in both industrial production and merchandise trade.

According to the recent work of several researchers, GVCs played a leading role in the transmission of the shocks of the 2008-09 crisis, causing the Great Trade Collapse. Why were GCVs regarded as the main source of propagation of the global downturn? What were the transmission mechanisms? According to Freund (2009) and Cheung and Guichard (2009), this happened because the share of intermediate products in international trade has greatly increased over recent decades. The main idea is that vertical specialization and links among firms led to a sharper reduction in intermediate demand than the one that would have been implied by the ‘standard trade channel’ (Bems *et al*., 2010). In Yi (2009), this happened because the same component might be exchanged several times (and cross several national borders) before it is finally incorporated in the final product. A slightly different point of view is taken by the literature that singles out ‘the cascading effects of disruption along the supply chain’ (Carvalho et al., 2014: 12). They suggest that the origin of aggregate fluctuations can be traced back to any shock taking place at a specific unit operating along the chain. Because of the firms’ interconnectedness, such a disturbance will cascade down to firms, impacting aggregate behavior.[2] Alessandria *et al*. (2011) test another likely channel of transmission based on the inventory adjustments firms adopt to face a demand reduction. As a consequence of a reduction in final demand, final firms decreased orders across GVC firms; the decrease being amplified for firms located far from the final customer. Such an inventory adjustment mechanism resembles the well-known bullwhip effect (Forrester, 1961). While Altomonte *et al*. (2012), working on a the firm-level, confirm that inventory adjustments along GVCs greatly contributed to the great trade decrease, Escaith *et al*. (2010) only partially agree on the role played by the ‘inventory effect’, underlining that other factors might also be at work.

The GVCs’ role as a transmission mechanism of the great crisis raises a series of important questions. What happened inside the GVCs? Which types of firm were most hit? To what extent did their position in the GVC (intermediate or final) and their individual characteristics (such as size) and strategies (innovation, imports, human capital) play a role in their performance during the crisis? Surprisingly enough, given the policy relevance of the issue, the evidence here is very scant as there are few studies based on firm-level analysis.

In particular, we can recall just two contributions. Altomonte *et al*. (2012) introduce modes of organization of inter-firm linkages as a key factor in explaining firms' different levels of resilience during the crisis. In their analyses, based on a representative sample of French firms, they single out two organizational forms: one adopted by multinational firms that entails trade among related parties and one where the buyer and supplier trade at arm's length. They found that firms whose trade originated within 'hierarchies of firms' (i.e., transactions among firms belonging to a group) reacted faster to a negative demand shock and recovered faster in the following months than firms who traded at arm's length: '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' (Altomonte *et al*., 2012: 22).

In a highly comprehensive report on European firms, Békés *et al*. (2011) shed some more light on the link between firms' heterogeneity and their reaction to the crisis. One of their key findings is that firms' positioning in GVCs does matter. On the basis of the EFIGE dataset they show that, on average, intermediate firms suffer the most in terms of greater sales reduction, while outsourcers mitigate the effects of the crisis. Firms' characteristics also played a role as large and controlling firms fared better.

2.2 Italian and German firms in the GVCs

Germany and Italy are similar under many respects.[3] Manufacturing is prominent in both countries: in 2010, it accounted for 25.3 per cent of total value added in Germany and 23.3 per cent in Italy. Both countries have high levels of manufacturing exports: in Germany, the share of exports to GDP is 39.9 per cent, 23.4 per cent in Italy. The production structure is quite similar as well: family-owned German firms represent almost 90 per cent of total firms, 86 per cent of Italian firms (Bugamelli *et al.,* 2012).

There is a starker difference in firm size: in 2009, the average number of employees in Italian firms was 9, in Germany 37. As highlighted by Barba Navaretti *et al*. (2011), such structural, dimensional differences and industry invariants represent a strong advantage for Germany in terms of productivity, internationalization, and innovation strategies.

Both countries are heavily involved in GVCs. Largely as outward processing trade, German firms started operating globally early on (Helg and Tajoli, 2005), to a greater extent around the 1990's after the unification process owing to increasing commercial integration with Poland, Slovakia, the Czech Republic, and Hungary. Foreign outsourcing started somewhat later in Italy, in the second half of the '90s, in response to stronger competitive pressure from Eastern European and Asian producers, exchange rate constraints before the introduction of the single European currency, and the development and spread of ICT (Giunta *et al*., 2012).

As underlined by Breda and Cappariello (2012), if the direct and indirect import content of the production of goods and services is taken as an indicator of international outsourcing, there is another similarity between the two countries. In 2007, this indicator was around 17 per cent for both the Italian and the German economies: 'on this basis and from a static viewpoint, also Italy could be defined as a "bazaar economy" (Breda and Cappariello, 2012: 133).[4] Further proof of both countries' involvement in GVCs comes from the participation index (Oecd, 2012):[5] Italy's participation index value in 2009 appears to be slightly lower than Germany's. Another important question concerns whether Germany and Italy share the same position in the value chain; in fact, a country can be upstream or downstream depending on its specialization. Here the evidence is inconclusive, as a country's position varies considerably according to the data used. However, some hints come from the firm-level analysis in the next section.

3 Data and descriptive statistics

3.1 The EFIGE dataset

For the comparative analysis of Italian and German firms in GVCs, we use data from the EFIGE survey. The data was collected within the EFIGE project ('European firms in a global economy: internal policies for external competitiveness') supported by the Research Directorate General of the European Commission. The EFIGE survey was conducted in 2009. The sample includes around 3,000 firms from France, Germany, Italy and Spain, more than 2,200 firms from the UK, and 500 firms from Austria and Hungary.

The sampling is stratified by sector and firm size and induces an oversampling for large firms.

The survey questionnaire contains both qualitative and quantitative data on firms' characteristics and activities, split into six: the structure of the firm; the workforce; investment; technological innovation and R&D; internationalization; finance; market and pricing.[6] Data from the survey was then matched with balance sheet information from Amadeus (Bureau Van Dijk).[7]

As this paper focuses on Italy and Germany, , we only make use of the data on Italian and German firms. While this should have left us with slightly less than 6,000 firms, the number of firms actually used in the analysis is much lower (slightly more than 4,000, roughly 2,000 for each country) due to the presence of several missing values in the balance sheet data.

3.2 Variables and descriptive statistics

In order to analyze the impact of the participation in a value chain on firm performance during the crisis, we first have to qualify how to measure firm participation.

Finding a firm-level proxy for participation in a value chain is not an easy task. In principle, we should use a dataset that contains information on all firm-to-firm linkages including the type of products bought and sold by each firm. To the best of our knowledge, this kind of data is not available for European countries;[8] therefore, by using our firm-level dataset, we proxy the participation in a value chain with two variables.

The first variable indicates whether a firm participates in a value chain as a supplier (i.e., in an upstream position). We use the data on sales of produced-to-order goods as a share of total turnover (share of produced-to-order, or SPTO). Produced-to-order strategies allow customers to purchase products that are specific to their needs. This is likely to best approximate the strict vertical relationships that are usually established in a VC. In the paper we use a discretized version of SPTO, that is a dummy variable equal to one if the firm is fully intermediate (INT; SPTO equal to 100). There are three reasons for this. First, it allows for easy interpretation of the coefficient when it interacts with other dummy variables. Second, other available measures of the positioning in GVCs are discrete, creating an undesired asymmetry between the measurement of upstreamness and downstreamness. Third, discretizing SPTO does not generate a very large loss of information. The distribution of SPTO is bimodal, with a mass of firms on zero and another mass on 100.[9]

The EFIGE data also allows us to detect whether the main customers of the produced-to-order goods reside within the national borders or abroad: in the first case the firm participates in a national value chain (INT-DMC); in the second in a GVC (INT-FMC). As we will see, these types of firms differ in terms of strategies and characteristics.

The second variable proxies firm participation in a GVC as a purchaser (i.e. in a downstream position). We use a dummy equal to one if the firm buys customized intermediate goods abroad (customized purchases of intermediaries, or CPI), that is, components which are exclusively manufactured for the firm.

The reference year for all the variables is 2008.

The descriptive statistics are reported in Table 1.

It should be noted that the average number of employees is 55; this means that the EFIGE dataset is, as already mentioned, representative of medium and large firms. In the face of the crisis, on average, sales dropped dramatically (-17.9 per cent); however the standard deviation is also quite high, thus reflecting a large heterogeneity in firm performance. Table 1 also shows that SPTO is quite large. On average, more than three-fourths of a firm's sales consist of customized intermediate goods to other firms. The share of fully intermediate firms (INT) is quite high (50.3 per cent) and equally split between those with national main customers (INT-DMC) and foreign main customers (INT-FMC). Conversely, only a small portion of firms (5.6 per cent) purchase customized intermediaries (CPI); this means that the actual number of firms in a downstream position is very limited in the dataset.

A small share of intermediate firms (4.8 per cent) are also engaged in the purchase of specialized intermediate goods (INT&CPI): these are a group of intermediate companies (INT) that, apparently, succeeded in developing their own supply chain.

4 Descriptive analysis

4.1 How do Italian and German firms participate in value chains?

Table 2 shows the sample size for each category of firms in the dataset and allows for a comparison between Italian and German firms. As a reference group, we use firms which operate outside a value chain, that is, they do not buy customized intermediaries and do not sell produced-to-order goods. We label these firms as 'generic' firms.

Turning to the comparison between Italian and German firms, Table 2 shows the positioning of German and Italian firms along the value chains. The share of fully intermediate (INT) firms skims the 60 per cent mark in Italy, while it is much lower in Germany (35 per cent). Instead, CPI or INT&CPI firms are relatively more common in Germany, hinting at the fact that German firms are more structured, thus able to organize their own value chains and are, on average, located more downstream on the value chains.[10]

Such a positioning is confirmed by the analysis shown in Table 3 that highlights the difference in the frequency of each type of firm controlling for industry composition. This is done by regressing a dummy equal to one for each type of firm over a country dummy (Italy) and a set of industry dummies (2-digit Nace). Italy's relative specialization in intermediate firms is confirmed: within each sector the probability of an Italian firm being in an intermediate position in the GVC is on average 21.8 percentage points higher than for a German firm. Similarly, controlling for sector, German firms outnumber Italian firms in a downstream position by 4.2 percentage points.

4.2 Firms in the value chains: characteristics and performance

Table 4 contains descriptive statistics on firms' characteristics and performance. Each dependent variable (reported at the top of Table 4) is regressed over a set of dummies for each type of firm. The constant, at the bottom of each boxed table, is represented by 'generic' firm, not involved in vertical linkages. Intermediate (INT) firms in the dataset are smaller both in terms of sales and employment; in the period 2008-09, they also reported a larger decrease in total sales compared with 'generic' companies. Firms that purchase specialized intermediate goods (CPI) and, less strikingly, firms that are both INT and CPI are, instead, larger and their performance in this period was somewhat comparable with the reference group.

Yet the set of fully intermediate firms is far from homogeneous. Compared with intermediate firms whose main customer is domestic (INT-DMC), INT companies with a foreign main customer (INT-FMC) are larger both in terms of sales and employment. Notwithstanding such heterogeneity, their performance during the crisis is instead quite similar.

These patterns are also largely confirmed within each country. The discount in terms of size and performance is less dramatic for the INT group in Germany; the premium for CPI firms is also slightly smaller. In both countries, the ranking between INT-FMC and INT-DMC is also preserved.

The cross-country comparison also highlights the weaknesses of the Italian productive structure and its disappointing performance in the crisis period (Brandolini and Bugamelli, 2009). The gap is particularly wide in terms of employees and, in our dataset, in the differential in the 2008-09 performance.[11]

4.3 Detecting heterogeneity

So far, the EFIGE dataset has shown that intermediate firms are usually smaller and, during the recent crisis, also experienced a more dramatic fall in sales.

However, a recent stream of literature has highlighted the heterogeneous nature of both suppliers and final firms (Accetturo *et al*., 2011, 2012; Agostino *et al*., 2014; Giovannetti *et al*., 2014). Companies operating along the GVCs tend to differ from each other in terms of the strategic choices they make to better compete in the market.

In order to deduce different characteristics, we start by analyzing firms' choices in terms of innovation, internationalization and human capital accumulation.

We consider five variables:

- share of employees with a university degree;
- share of employees in training activities;
- dummy for the introduction of product innovation;
- dummy for the introduction of process innovation;
- share of exports over total turnover.

Table 5 presents some descriptive statistics according to the positioning in the GVC; the table has the same structure as Table 4 and presents the regression result of each characteristic over a set of dummy variables for each type of firm. Intermediate firms (INT) have less human capital and tend to be engaged more frequently in process rather than product innovation. Downstream firms (CPI) have a statistically significant higher level of human capital, product and process innovation and international exposure. Once again the group of intermediate firms (INT) presents relevant internal differences especially in terms of innovation and international projection. INT companies with a foreign main customer (INT-FMC) tend to be engaged in process innovation and have a share of exported sales comparable to the one registered for CPI.

These patterns are also confirmed within each country.

5 Econometric analysis

5.1 Performance during the crisis

We now look at the relationship between firm performance and its positioning in GVCs. We estimate the following equation:

(1) $$\Delta y_i = \alpha + \beta_1 INT_i + \beta_2 CPI_i + \beta_3 INT_i \,\&\, CPI_i + \gamma X_i + \phi_1 D_s + \phi_2 D_c + \phi_3 D_g + \varepsilon_i$$

Where Δy_i is the cumulated growth rate (in log scale) of sales between 2007 and 2009 for firm *i*. INT_i is a dummy variable equal to one if SPTO sales is 100 per cent and the firm does not buy customized intermediaries. CPI_i is a dummy equal to one if the firm purchased customized intermediaries and has SPTO sales lower than 100 per cent. $INT_i \,\&\, CPI_i$ is a dummy equal to one if the firm is both intermediate and purchased customized intermediaries from abroad. By construction, INT_i, CPI_i, and $INT_i \,\&\, CPI_i$ are mutually exclusive. This implies that β_3 can be interpreted as the discount (premium) in growth rate for $INT_i \,\&\, CPI_i$ firms, without other manipulations.

X_i is a set of covariates aimed at capturing firms' heterogeneity; it includes a control for the initial (log) level of sales and the number of employees, both measured in 2007; it also includes the variables described in section 4.2 (human capital and innovation) aimed at detecting firms' heterogeneous behaviours and the share of purchases of both total and imported intermediaries over turnover.[12] D_s and D_c are sets of, respectively, sector and country dummies. D_g is a set of dummies equal to one if the firm belongs to a national or foreign group.

The coefficients of interest are β_1, β_2, and β_3. β_1 captures the correlation between the performance during the crisis and the intermediate status of a firm in a GVC. β_2 indicates the influence of a firm's downstream positioning in a GVC on the dynamics of sales in the period 2008-09. β_3 is the effect of being an intermediate firm buying customized intermediaries, that is the effects of an intermediate firm that has organized its own value chain.

Equation (1) is estimated by OLS, and standard errors are robust to take into account the heteroskedasticity concerns. We also exclude from the regressions the first and the 99th percentile of the dependent variable to minimize the impact of outliers.

Before showing the results, it is worth making a cautionary note. Coefficients β_1, β_2, and β_3 cannot be interpreted causally but rather as conditioned statistical associations. This is due to the possible presence of endogeneity problems: there can be a number of omitted variables (such as entrepreneur's ability) that affect both the firm's decisions (to be an intermediate or a final firm) and its performance during a period of crisis. Unfortunately, this problem cannot be easily solved; there are no obvious instruments that correlate with companies' positioning in the GVC but not with its performance. For this reason, we should consider the estimates of equation (1) as multivariate stylized facts on the microeconomics of GVCs.

The results are shown in Table 6.

Column (1) reports a simple specification with just INT, CPI, and INT&CPI with country and sector dummies. The coefficient of INT is negative and significant, thus confirming that being intermediate is associated with a negative performance during the crisis. Intermediate firms witnessed, on average, an additional fall in sales by 3.1 percentage points (in log scale). The coefficients of CPI and INT&CPI are, instead, positive; their point estimates indicate that firms engaged in the purchase of customized intermediaries (i.e. in a downstream position in a GVC) succeeded in limiting the drop in sales during the crisis by 1.7-2.2 percentage points (in log scale). However, standard errors look pretty large, probably due to small sample sizes in these groups, and this cannot rule out the possibility that the performance of this kind of firm is statistically different from the reference group (generic firms).

Column (2) adds firm-level controls: the initial (log) levels of sales and employment, the share of total and imported intermediaries over sales, and group dummies. The initial levels of sales and employment aim at controlling for the possible presence of mean reversion or scale effects in firm growth; the share of total and imported intermediaries over sales controls for the structure of firm purchases that may, in principle, affect the downstream status of the firm; group affiliation proved particularly relevant in the face of the crisis (Altomonte *et al.*, 2012). The coefficient for 2007 turnover is negative and significant thus showing a process of mean reversion; instead, larger firms (measured in terms of employment force) attenuated the fall in sales during the crisis. The coefficient of INT is now slightly larger in modulus, while the positive but not significant estimates for β_2 and β_3 are confirmed.

In column (3) we insert controls for firm strategies and characteristics. While the three coefficients of interest confirm the previous results, human capital and product innovation variables turn out to be positive and significant. This implies that, controlling for sector, country, firms' characteristics and positioning in the GVC, having a qualified workforce or introducing new products attenuated the negative effect of the crisis.

For all specifications, the country dummy for Italy is larger than 20 percentage points and highly significant; this implies that the performance gap between Italian and German firms was huge. We analyze the issue in section 5.3.

5.2 Heterogeneous effects

As we have seen in section 4, intermediate firms (INT) display a very relevant heterogeneity when we look at the types of main customers. Intermediate firms with a foreign main customer (INT-FMC) are generally larger and more innovative than those with a domestic main customer (INT-DMC). We now investigate whether these characteristics had an impact on firm performance during the crisis. This is done by allowing different coefficients for INT-DMC and INT-FMC:

$$\begin{aligned} &\Delta y_i = \alpha + \beta_{1F} INT - FMC_i + \beta_{1D} INT - DMC \\ (2) \quad &+ \beta_2 CPI_i + \gamma X_i + \phi_1 D_s + \phi_2 D_c + \phi_3 D_g + \varepsilon_i \end{aligned}$$

The results are displayed in Table 7.

The first column reports the coefficients for the most parsimonious specification without firm level controls. It is apparent that intermediate firms were hit similarly during the crisis, regardless of the geographical location of the main customer. Both β_{1D} and β_{1F} are negative and statistically significant and their point estimates are quite similar. Downstream firms (CPI) confirm their positive coefficient even if, once again, standard errors are too large to reject their difference from zero.

The second column contains the results obtained when we inserted all firm-level controls, with results largely in line with the previous estimate.

5.3 Do GVCs explain the Italy-Germany performance gap?

As clearly shown so far, both in the descriptive and econometric analyses, during the 2008-09 crisis Italian and German firms presented divergent dynamics, as sales growth for Italian firms was more than 20 percentage points lower than the one registered by German companies.

The Italian structural problems are well known (see Brandolini and Bugamelli, 2009, for a comprehensive review; Federico, 2012) and they range from the small size of the firms to backward labor market institutions, and include inefficiencies of public administration as well as rigidities in the service markets.

In the descriptive statistics of the paper, we have also shown that, contrary to Germany, Italian industry is characterized by a very large number of small, fully intermediate firms that performed very badly during the crisis, while the share of firms engaged in the purchase of customized intermediaries is comparatively small.

In this section, we try to understand whether the high number of intermediate firms in Italy contributed to their performance gap.

To do so, we proceed as follows. We calculate how much of the Italy-Germany performance gap is explained by our econometric models and then we compute the contribution of each set of regressors to the explained gap.

In practice we run the following five regressions:

$$\Delta y_i = \alpha_1 + \kappa_1 D_{Italy} + \varepsilon_i^1$$

$$\Delta y_i = \alpha_2 + \kappa_2 D_{Italy} + \text{Sectors} + \varepsilon_i^2$$

$$\Delta y_i = \alpha_3 + \kappa_3 D_{Italy} + \text{Sectors} + \text{Firm characteristics} + \varepsilon_i^3$$

$$\Delta y_i = \alpha_4 + \kappa_4 D_{Italy} + \text{Sectors} + \text{Firm characteristics} + \text{Strategies} + \varepsilon_i^4$$

$$\Delta y_i = \alpha_5 + \kappa_5 D_{Italy} + \text{Sectors} + \text{Firm characteristics} + \text{Strategies} + \text{Positioning} + \varepsilon_i^5$$

The total *explained* performance gap between German and Italian firms is given by $\kappa_5 - \kappa_1$.

The accounting is made by comparing κ_j with κ_{j+1}, with j=1,…,4. If $\kappa_{j+1} - \kappa_j$ is positive, part of the performance gap between Germany and Italy is explained by the variables added in the *j+1th* regression. Percentage contributions to the total explained gap are computed as $\frac{\kappa_{j+1} - \kappa_j}{\kappa_5 - \kappa_1}$.

Table 8 reports the results for these estimates.

First we should observe that most of the Italy-Germany performance gap is left unexplained by the model. In the best specification (number 5), the performance gap still remains huge (-21 per cent). The explained performance gap is just 13 per cent of the total gap ((24.25-21)/24.25 = 13 per cent). We concentrate on the explained performance gap keeping in mind that this still represents a minority of the total difference.

Most of the total *explained* performance gap (70 per cent) is attributable to firm characteristics such as size, human capital or innovative activity. However, positioning in the GVC plays an important role as it explains almost one-fifth of the gap. This is not a small number, considering that this explanation of the Italy-Germany performance gap has so far been overlooked both by analysts and policy makers.

6 Concluding remarks

According to recent papers (Baldwin, 2011, 2009; Bems *et al*., 2010; Yi, 2009), GVCs have been one of the main transmission mechanisms of the great trade collapse that severely and simultaneously hit all OECD countries in 2009, thus amplifying the national fluctuations in demand for final goods. Notwithstanding the severity, to the best of our knowledge there is very scant evidence on the micro impact of the crisis on firms involved in GVCs. The aim of this paper is to remedy to this gap by exploiting a rich and novel dataset, EFIGE, that contains both qualitative and quantitative data on firms' characteristics and activities; the data has been coupled with balance sheet information from Amadeus (Bureau Van Dijk). We perform our analysis by comparing German and Italian industrial firms. As previously underlined, these two countries prove to be an interesting area of application for several reasons, the first being German and Italian firms' great involvement in GVCs.

We investigate whether firms' position along the GVCs, whether intermediate or final firms, as well as some of their strategies, such as whether to increase the level of human capital, their innovation propensity and foreign markets penetration, play a significant role in their performance in 2008-09.

The descriptive investigation shows that, within each country, intermediate firms are smaller than final firms both in terms of sales and employment. Their strategies are also somewhat less ambitious in terms of human capital accumulation and innovation. They are also highly heterogeneous: intermediate firms with foreign main customers are generally much larger and more innovative that intermediate companies mostly involved in national value chains.

The relevance of firms' position in the GVCs is further confirmed by our econometric analysis which shows that the crisis hit firms in GVCs asymmetrically. Intermediate firms observed a more severe contraction of sales, while firms in a more downstream position (i.e. purchasers of specialized intermediaries) registered a less critical turnover reduction. The reduction for intermediate firm was similar in magnitude for both domestic and international suppliers.

Going to the cross-country comparison, we find that firms' position within the GVC and their characteristics help in explaining part of the difference in performance between German and Italian firms.

In comparison with German firms, a higher percentage of Italian industrial firms are fully intermediate; instead, German firms more frequently purchase customized intermediaries, thus hinting at the fact that they are usually located in a downstream position in the GVCs.

The cross-country comparison sheds more light on the well-known weaknesses of the Italian industry in terms of average firm size and strategies. In particular, the small size of Italian firms constrains their strategies. This severely undermines successful participation in the GVCs, casting a shadow over Italy's role in the current and future international division of labor as Italy risks becoming a 'factory country', to use Baldwin's (2011) taxonomy. On the contrary, the higher share of final firms and the larger firm size partly explain German firms' capacity to face the crisis and recover.

While some limitations in the methodology of this paper have to be addressed in our future research, the correlation we found between firms' position in the GVCs, their strategy and the ability to face the crisis has relevant implications on competitiveness. Implications that seem, so far, overlooked by policy makers.

[1] For a survey of GVCs drivers, see Amador and Cabral (2014).

[2] Carvalho et al., 2014 specifically refer to the supply chain disruption caused by the 2011 Great East Japan earthquake. However, their work is closely related to the literature, here reviewed, that analyses the role of the supply chain in propagating exogenous shocks.

[3] For an overview that compares structural similarities and differences between Italy and Germany, see Arrighetti and Ninni (2012). Here we report 2010 data. However, because of the prolonged economic crisis in Italy, differences among the two countries have widened since then.

[4] The label 'bazaar economy' comes from Sinn (2003), suggesting that Germany sells products that were not produced in the country.

[5] The participation index is proposed by Koopman *et al*. (2010). It is expressed as a percentage of gross exports and indicates the share of foreign input (backward participation) and domestically produced inputs used in third countries' exports (forward participation). See also De Backer and Miroudot (2014).

[6] The questionnaire can be found at www.efige.org.

[7] We consider all manufacturing firms, excluding food and beverage firms due to the countercyclical nature of these industries.

[8] Carvalho et al. (2014) uses a proprietary dataset on transactions among Japanese firms to analyse the macroeconomic effects of the Fukushima earthquake.

[9] In the EFIGE dataset, almost 70 per cent of firms have an SPTO equal to either 100 or zero.

[10] On the greater chances lead firms have in capturing more value along the value chain, see Dedrick et al. (2010).

[11] According to Eurostat, Industry and Trade Statistics, between 2007 and 2009, industrial production fell by 22.2 per cent in Italy and 16.9 per cent in Germany. This suggests that the EFIGE dataset for Germany is skewed toward more successful firms.

[12] We have excluded the export share as it is highly collinear with INT-FMC and CPI.

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Table 1

DESCRIPTIVE STATISTICS

	Type of variable	No. Obs.	Mean	Standard Deviation
SPTO	Continuous (0-100)	4,117	73.2	38.9
INT	Binary (0-1)	4,117	0.503	0.500
Foreign main customer (INT-FMC)	*Binary (0-1)*	*4,117*	*0.242*	*0.428*
Domestic main customer (INT-DMC)	*Binary (0-1)*	*4,117*	*0.261*	*0.439*
CPI	Binary (0-1)	4,117	0.056	0.231
INT&CPI	Binary (0-1)	4,117	0.048	0.214
Sales in 2007 (1)	Continuous	4,117	11,282	87,288
Employees in 2007	Continuous	4,117	55.2	194.1
Log percentage change of sales 2008-09 (X100)	Continuous	4,117	-17.9	34.5

Source: Authors' calculations on EFIGE dataset. Weighted averages according to the sample design.
SPTO: share of produced-to-order sales; INT: dummy equal to one if SPTO=100; INT-FMC: dummy equal to one if an INT firm has its main customer outside the country (INT-FMC+INT-DMC=INT); INT-DMC: dummy equal to one if an INT firm has its main customer inside the country (INT-FMC+INT-DMC=INT); CPI: dummy equal to one if the firm buys a customized intermediate good from abroad; INT&CPI: dummy equal to one if an intermediate firm buys a customized intermediary from abroad. Sales in 2007: value of sales in thousands of euros in 2007; Employees in 2007: number of employees in 2007; Log percentage change of sales 2008-09: difference between the log of sales in 2009 and the log of sales in 2007.
INT, CPI, and INT&CPI are mutually exclusive.

Table 2

ITALIAN AND GERMAN FIRMS IN GVCS

	Total sample	Italy	Germany
INT	1,996	1,358	638
	(48.5%)	(58.7%)	(35.4%)
INT-FMC	*991*	*688*	*303*
	(24.1%)	*(29.7%)*	*(16.8%)*
INT-DMC	*1,005*	*670*	*335*
	(24.4%)	*(29.0%)*	*(18.6%)*
CPI	264	105	159
	(6.4%)	(4.5%)	(8.8%)
INT&CPI	212	104	108
	(5.1%)	(4.5%)	(6.0%)
Generic	1,645	746	899
	(40.0%)	(32.2%)	(49.8%)
Total	4,117	2,313	1,804
	(100%)	(100%)	(100%)

Source: Authors' calculations on EFIGE dataset.

INT: dummy equal to one if SPTO=100; INT-FMC: dummy equal to one if an INT firm has its main customer outside the country (INT-FMC+INT-DMC=INT); INT-DMC: dummy equal to one if an INT firm has its main customer inside the country (INT-FMC+INT-DMC=INT); CPI: dummy equal to one if the firm buys a customized intermediate good from abroad; INT&CPI: dummy equal to one if an intermediate firm buys a customized intermediary from abroad; Generic: residual class.

INT, CPI, and INT&CPI are mutually exclusive.

Table 3

ITALIAN AND GERMAN FIRMS IN GVCS
(CONTROLLING FOR SECTORS)

	Value for the dummy: Italy
INT	0.218***
	(0.015)
INT-FMC	*0.118****
	(0.013)
INT-DMC	*0.100****
	(0.013)
CPI	-0.042***
	(0.007)
INT&CPI	-0.012*
	(0.007)
Generic	-0.164***
	(0.015)

Source: Authors' calculations on EFIGE dataset. Weighted regressions according to the sample design.
OLS regression. Dependent variables are on rows. Explanatory variables: industry and country dummies.
INT: dummy equal to one if SPTO=100; INT-FMC: dummy equal to one if an INT firm has its main customer outside the country (INT-FMC+INT-DMC=INT); INT-DMC: dummy equal to one if an INT firm has its main customer inside the country (INT-FMC+INT-DMC=INT); CPI: dummy equal to one if the firm buys a customized intermediate good from abroad; INT&CPI: dummy equal to one if an intermediate firm buys a customized intermediary from abroad; Generic: residual class.
INT, CPI, and INT&CPI are mutually exclusive.

Table 4

CHARACTERISTICS OF THE FIRMS

	Log sales in 2007	Log empl. in 2007	Log percentage change of sales 2008-09 (X100)
		Total sample	
INT	-0.134***	-0.125***	-9.380***
	(0.036)	(0.026)	(1.132)
INT-FMC	*0.171****	*0.016*	*-10.347****
	(0.042)	*(0.032)*	*(1.373)*
INT-DMC	*-0.417****	*-0.256****	*-8.483****
	(0.041)	*(0.031)*	*(1.343)*
CPI	0.531***	0.386***	2.928
	(0.075)	(0.083)	(2.390)
INT&CPI	0.332***	0.225***	-0.052
	(0.081)	(0.061)	(2.568)
Generic (constant)	8.373***	3.454***	-13.363***
	(0.027)	(0.020)	(0.849)
		Italy	
INT	-0.156***	-0.075**	-4.788**
	(0.046)	(0.030)	(1.601)
INT-FMC	*0.141***	*0.044*	*-4.624***
	(0.052)	*(0.034)*	*(1.864)*
INT-DMC	*-0.446****	*-0.190****	*-4.948***
	(0.052)	*(0.035)*	*(1.852)*
CPI	0.626***	0.437***	1.727
	(0.111)	(0.072)	(3.859)
INT&CPI	0.299**	0.269***	3.835
	(0.109)	(0.061)	(3.808)
Generic (constant)	8.367***	3.292***	-24.957***
	(0.037)	(0.024)	(1.294)
		Germany	
INT	-0.068	0.002	-2.786**
	(0.060)	(0.050)	(1.414)
INT-FMC	*0.266***	*0.232****	*-5.197****
	(0.078)	*(0.064)*	*(1.849)*
INT-DMC	*-0.342****	*-0.187***	*-0.807*
	(0.073)	*(0.059)*	*(1.718)*
CPI	0.460***	0.315***	1.444
	(0.105)	(0.086)	(2.446)
INT&CPI	0.347***	0.197**	-2.801
	(0.122)	(0.099)	(2.835)
Generic (constant)	8.378***	3.608***	-2.308**
	(0.039)	(0.032)	(0.912)

Source: Authors' calculations on EFIGE dataset.
OLS weighted estimates according to sample design. Dependent variables are in columns. Explanatory variables: INT: dummy equal to one if SPTO=100; INT-FMC: dummy equal to one if an INT firm has its main customer outside the country (INT-FMC+INT-DMC=INT); INT-DMC: dummy equal to one if an INT firm has its main customer inside the country (INT-FMC+INT-DMC=INT); CPI: dummy equal to one if the firm buys a customized intermediate good from abroad; INT&CPI: dummy equal to one if an intermediate firm buys a customized intermediary from abroad; Generic: residual class.
INT, CPI, and INT&CPI are mutually exclusive. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 5

HETEROGENEITY ACROSS FIRMS

	Share w/ univ. Degree	Share in training	Product innovation	Process innovation	Export share
			Total sample		
INT	-4.252***	-4.026***	-0.078***	0.056**	1.042
	(0.404)	(0.838)	(0.016)	(0.016)	(0.869)
INT-FMC	*-3.103****	*-5.064****	*0.036**	*0.099****	*16.331****
	(0.489)	*(1.017)*	*(0.019)*	*(0.019)*	*(0.958)*
INT-DMC	*-5.319****	*-3.063***	*-0.185****	*0.017*	*-13.147****
	(0.478)	*(0.994)*	*(0.019)*	*(0.019)*	*(0.937)*
CPI	1.894**	4.138**	0.282***	0.134***	16.630***
	(0.853)	(1.770)	(0.034)	(0.034)	(1.834)
INT&CPI	0.833	1.990	0.142***	0.168***	14.821***
	(0.916)	(1.902)	(0.037)	(0.037)	(1.971)
Generic (constant)	10.388***	17.765***	0.496***	0.379***	17.906***
	(0.303)	(0.629)	(0.012)	(0.012)	(0.652)
			Italy		
INT	-2.337***	-0.903	-0.079***	0.048**	-2.150*
	(0.436)	(1.009)	(0.022)	(0.022)	(1.272)
INT-FMC	*-1.269***	*-1.534*	*0.049**	*0.088***	*14.695****
	(0.507)	*(1.175)*	*(0.026)*	*(0.026)*	*(1.302)*
INT-DMC	*-3.377****	*-0.289*	*-0.206****	*0.008*	*-18.565****
	(0.503)	*(1.167)*	*(0.025)*	*(0.026)*	*(1.293)*
CPI	3.492**	4.648*	0.284***	0.138**	15.217***
	(1.152)	(2.434)	(0.054)	(0.054)	(3.067)
INT&CPI	2.648**	4.644*	0.143**	0.103*	14.610***
	(1.039)	(2.402)	(0.053)	(0.053)	(3.027)
Generic (constant)	7.298***	11.150***	0.501***	0.393***	23.323***
	(0.353)	(0.816)	(0.018)	(0.018)	(1.028)
			Germany		
INT	-4.237***	-1.528	-0.084***	0.055**	0.599
	(0.763)	(1.434)	(0.025)	(0.025)	(1.149)
INT-FMC	*-2.580***	*-2.854*	*0.012*	*0.100***	*11.057****
	(0.996)	*(1.877)*	*(0.032)*	*(0.032)*	*(1.443)*
INT-DMC	*-5.596****	*-0.441*	*-0.134****	*0.017*	*-7.979****
	(0.926)	*(1.745)*	*(0.030)*	*(0.030)*	*(1.342)*
CPI	0.063	2.397	0.281***	0.135***	18.801***
	(1.320)	(2.482)	(0.043)	(0.043)	(1.988)
INT&CPI	-0.738	-0.048	0.140**	0.235***	14.375***
	(1.529)	(2.877)	(0.050)	(0.050)	(2.304)
Generic (constant)	13.334***	24.074***	0.491***	0.365***	12.740***
	(0.492)	(0.925)	(0.016)	(0.016)	(0.741)

Source: Authors' calculations on EFIGE dataset.

OLS weighted estimates according to sample design. Dependent variables are in columns. Explanatory variables: INT: dummy equal to one if SPTO=100; INT-FMC: dummy equal to one if an INT firm has its main customer outside the country (INT-FMC+INT-DMC=INT); INT-DMC: dummy equal to one if an INT firm has its main customer inside the country (INT-FMC+INT-DMC=INT); CPI: dummy equal to one if the firm buys a customized intermediate good from abroad; INT&CPI: dummy equal to one if an intermediate firm buys a customized intermediary from abroad; Generic: residual class.

INT, CPI, and INT&CPI are mutually exclusive. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 6

POSITIONING IN THE GVC AND FIRM PERFORMANCE IN 2008-09

	(1)	(2)	(3)
INT	-3.051**	-3.496**	-3.071**
	(1.098)	(1.111)	(1.111)
CPI	2.212	3.430	2.924
	(2.244)	(2.306)	(2.318)
INT&CPI	1.701	2.360	2.172
	(2.582)	(2.615)	(2.618)
Log(employment)-2007	-	4.486***	4.603***
		(1.085)	(1.089)
Log(sales)-2007	-	-4.677***	-4.996***
		(0.881)	(0.901)
Share of intermediaries over		0.032	0.030
turnover (sh_int)		(0.027)	(0.027)
Share of intermediaries from		-0.085	-0.089
abroad (sh_int_abr)		(0.075)	(0.074)
Share w/university degree	-	-	0.113**
			(0.040)
Share in training	-	-	0.070***
			(0.020)
Product innovation	-	-	1.776*
			(1.061)
Process innovation	-	-	-0.439
			(1.048)
National Group	-	-0.374	-1.222
		(2.048)	(2.045)
Foreign Group	-	-0.994	-1.916
		(2.542)	(2.550)
No. industry dummies	21	21	21
Country dummy: Italy	-23.218***	-22.236***	-20.998***
	(1.588)	(1.179)	(1.215)
Constant	-1.341	21.548***	20.852***
	(2.217)	(1.179)	(5.182)
R^2	0.15	0.17	0.17
No. Obs.	4,117	4,117	4,117

Source: Authors' calculations on EFIGE dataset.
OLS weighted estimates according to sample design. See eq. (1). Dependent variable: percentage change in sales in the period 2008-09. All estimates exclude the 1st and the 99th percentile of the dependent variable. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.
INT: dummy equal to one if SPTO=100; CPI: dummy equal to one if the firm buys a customized intermediate good from abroad; INT&CPI: dummy equal to one if an intermediate firm buys a customized intermediary from abroad; log(employment) – 2007: log of employment in 2007; log(sales) – 2007: log of sales in 2007; sh_int: share of the purchase of intermediaries over total sales; sh_int_abr: share of the purchase of intermediaries from abroad over total sales; share w/university degree: share of employees with a university degree; share in training: share of employees in training; product innovation: dummy equal to one if the firm carried out product innovations; process innovation: dummy equal to one if the firm carried out process innovations; National group: dummy equal to one if the firm belongs to a national group; Foreign group: dummy equal to one if the firm belongs to a foreign group.

Table 7

GLOBAL OR LOCAL VALUE CHAINS?

	(1)	(2)
INT-FMC	-3.429**	-2.861**
	(1.365)	(1.375)
INT-DMC	-2.710**	-3.271**
	(1.300)	(1.319)
CPI	2.204	2.957
	(2.245)	(2.322)
INT&CPI	1.691	2.195
	(2.582)	(2.621)
Log(employment)-2007	-	4.606***
		(1.090)
Log(sales)-2007	-	-5.019***
		(0.906)
Share of intermediaries over	-	0.029
turnover (sh_int)		(0.027)
Share of intermediaries from	-	-0.088
abroad (sh_int_abr)		(0.074)
Share w/university degree	-	0.112**
		(0.040)
Share in training	-	0.070***
		(0.019)
Product innovation	-	1.743
		(1.059)
Process innovation	-	-0.448
		(1.049)
National Group	-	-1.218
		(2.046)
Foreign Group	-	-1.897
		(2.548)
No. industry dummies	21	21
Country dummy: Italy	-23.209***	-20.999***
	(1.058)	(1.215)
Constant	-1.290	21.031***
	(2.216)	(5.211)
R^2	0.16	0.17
No. Obs.	4,117	4,117

Source: Authors' calculations on EFIGE dataset.
OLS weighted estimates according to sample design. See eq. (1). Dependent variable: percentage change in sales in the period 2008-09. All estimates exclude the 1st and the 99th percentile of the dependent variable. White-robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%.
INT-FMC: dummy equal to one if an INT firm has its main customer outside the country (INT-FMC+INT-DMC=INT); INT-DMC: dummy equal to one if an INT firm has its main customer inside the country (INT-FMC+INT-DMC=INT); CPI: dummy equal to one if the firm buys a customized intermediate good from abroad; log(employment) – 2007: log of employment in 2007; log(sales) – 2007: log of sales in 2007; sh_int: share of the purchase of intermediaries over total sales; sh_int_abr: share of the purchase of intermediaries from abroad over total sales; share w/university degree: share of employees with a university degree; share in training: share of employees in training; product innovation: dummy equal to one if the firm carried out product innovations; process innovation: dummy equal to one if the firm carried out process innovations; National group: dummy equal to one if the firm belongs to a national group; Foreign group: dummy equal to one if the firm belongs to a foreign group.

Table 8

DECOMPOSITION OF ITALIAN-GERMAN FIRMS' PERFORMANCE

	Dummy Italy	Total performance gap explained (in %)
Overall difference	-24.25	
Sectors	-24.02	7%
Characteristics	-22.79	38%
Strategies	-21.69	34%
Positioning	-21.00	21%

Source: Authors' calculations on the EFIGE dataset.
The column 'Dummy Italy' reports the point estimate of the country dummy for Italy in each regression after inserting each set of variables. OLS weighted estimates (according to sample design). Dependent variable: percentage change in sales in the period 2008-09. All estimates exclude the 1st and the 99th percentile of the dependent variable. List of regressors. *Overall difference*: Dummy Italy. *Sectors*: Dummy Italy, Sector dummies. *Characteristics*: Dummy Italy, Sector dummies, log employment and log sales in 2007. *Strategies*: Dummy Italy, Sector dummies, log employment and log sales in 2007, sh_int, sh_abr, share of workers with tertiary education, share of workers in training programs, dummy for process and product innovation group dummies. *Positioning*: see strategies + INT, CPI, INT&CPI.