International division of labour and countries' competitiveness: the case of Italy and Germany

Garbellini, Nadia

Università degli Studi di Bergamo, Dipartimento di Ingegneria

9 June 2014

International division of labour and countries' competitiveness: the case of Italy and Germany

Nadia Garbellini

Abstract The paper is going to use the WIOD to analyse the structure, extent and evolution of production processes outsourcing in Italy and Germany from 1995 to 2011 by means of global vertically integrated sectors, in order to single out and compare the different sources of gains/losses in competitiveness.

Secondly, global vertically integrated sectors are going to be employed to get a measure of labour productivity changes in the two countries.

By comparing the trends of these two sets of indicators, it is possible to shed light on the evolution of international competitiveness in the two countries, to assess the extent to which competitiveness gains/losses are associated to actual productivity increases/decreases and to what extent they are simply due to a different geographical allocation of production stages.

Keywords

1 Introduction

Multi-sectoral structures emerge as the natural analytical setting to analyse the connection between activity levels, trade patterns and income and production interdependencies between (European) economies. Several insights from Regional Input-Output Analysis (Leontief, 1953; Leontief and Strout, 1963) can be re-oriented towards the study of inter-national inter-industry networks of commodity and money flows. In this respect, early explicit attempts at exploiting multi-regional Input-Output models in order to study European integration and interdependence (Rampa, 1986; Rampa and Lanza, 1988; Rampa and Bertoletti, 1990) can be brought to the fore thanks to the availability of new datasets—such as the World Input-Output Database—WIOD (Timmer, 2012)—and new computing techniques.

In fact, such earlier attempts have been embedded, to a certain extent, in the literature on vertical specialisation of production—(triggered by Hummels and Yi, 2001)

Nadia Garbellini
E-mail: nadia.garbellini@unibg.it

and international transmission of business cycles (see for example Ayhan Kose and Yi, 2001; Johnson, 2012). Indeed, the interaction of these two areas for the study of some of the effects of the 'Global Recession' has been recently addressed by Bems, Johnson and Yi (Bems, Johnson, and Yi, 2010, 2011).

Moreover, the consequences of the crisis upon income, wages and employment rendered apparent the connections between trade and value added components of national economies. Exploring this issue recently gave rise to a growing strand of literature on trade in value added and global value chains (Johnson and Noguera, 2012; Wang et al, 2009; Koopman et al, 2010).

Different decomposition techniques have been adopted to uncover the contribution of factors and regions to aggregate indicators of vertical specialisation (Meng and Inomata, 2009; Meng et al, 2011), exploiting the analytical advantages of an international Input-Output framework.

The present paper aims at exploring a relevant, and very much debated, feature of international trade performance of different countries—the dynamics of productivity—in the light of the above mentioned phenomenon, i.e. international fragmentation of production chains. The analysis is carried out in terms of vertically integrated (national and international) sectors (see Pasinetti, 1973).

It is a quite common belief, or purported opinion, that Germany's high trade surpluses, sustaining its GDP growth notwithstanding the European crisis, are due to its higher competitiveness in the production and export of high value added products. According to this argument, such a higher competitiveness is the consequence of higher productivity growth, in turn made possible by a more flexible labour market than the Italian one. The conclusion is drawn that Italy should follow Germany's example and implement the corresponding 'structural reforms'.

In particular, reference is made to the set of new regulations proposed by the so called Hartz Commission, which were implemented between 2003 and 2005, with the objective of improving the efficiency of the German labour market. Current political debate in Italy is actually dominated by this kind of claims; the argument is that more flexibility is going to improve labour productivity and therefore to increase the international competitiveness of Italian firms—and thus exports—and attract foreign direct investments.

An obvious set of question therefore arises. First of all, is it true that German labour productivity strongly increased after the introduction of the Hartz reforms? Moreover, is it true that labour productivity in Germany increased more than in Italy, and if so, in which sectors? Is there any relationship between increased labour productivity and and increasing trade surpluses?

Usually, answers to these questions are based on a definition of labour productivity growth as changes in unit labour costs. This definition is inappropriate for a number of reasons.

First of all, changes in unit labour costs are not a measure of the extent of technical progress, but they also involve institutional factors like taxes and income distribution.

Secondly, it must be stressed that changes in labour productivity are an intrinsically sectoral phenomenon, which cannot be reliably analysed from an aggregated point of view. Moreover, aggregated measures—even if computed at constant prices—

cannot avoid incorporating the effect of price changes via the changing composition of GDP itself.

Finally, productivity changes are of course induced by technical progress, not only in the form of technological innovations, but also, and most of all, of improved *division of labour*. Therefore, the fact cannot be denied that such a division of labour takes place not only within each single country, but across national borders too. Hence, in order to provide a consistent analysis of productivity changes, it is necessary to take into account changes in the quantity of *total*—both national and foreign—labour embodied in each item of final demand.

The present paper is organised as follows. Section 2 provides an overview of the structure of Italian and German imports and exports, and their evolution through time. Section 3 presents a set of indicators to evaluate the performance of both national and international labour productivity, in order to assess the role played by off-shoring, i.e. by the displacement of production stages outside the national borders. In Section 4, a set of standard indicators of off-shoring are computed for both countries, for the time period 1995-2008. Section 5 provides some concluding remarks, and Appendix A details the empirical methodology for the computation of all the above mentioned indicators.

2 Overview: Italian and German imports and exports

Italy and Germany are often compared as to their external trade performance, in order to single out the structural differences and the corresponding determinants. As stated in the Introduction, it is often argued that Germany's better performance is due to a higher competitiveness, in turn triggered by a better productivity dynamics. Before going into the details of these issues, a few words are worth being spent on the structure of Italy's and Germany's exports and imports during the period 1995-2011.[1]

Table 1 shows the evolution of exports—disaggregated by activity group—and real wages from 1995 to 2011 for both Italy and Germany. We can immediately see by looking at the first column of the Table that German exports underwent a sharp increase in 2003 and 2004; the same pattern characterised Italian exports.

Overall, German exports grew more than Italian over the period considered (+177.4% versus +125.9%); the same pattern emerges by looking at the decomposition by activity, revealing that—with the exception of the industries in the *minengy* group—in all sectors Germany over-performed Italy in terms of exports growth. The two industries groups in which Italy's performance was closer to Germany's are the *medtech* (+157.0% versus +194.0%) and the *hitech* (+133.7% versus +150.2%) ones.

The most impressive figure emerging from Table 1 is the huge increase of German exports as a proportion of Gdp: starting from 24.8% in 1996—almost the same level as in Italy: 24.7%—the corresponding proportion was 48.2% in 2008, right before the 'big recession' (28.5% in Italy) and 50.6% in 2011 (28.8% in Italy). Moreover, it clearly appears that the increase in the export-to-Gdp ratio started increasing faster since 2005.

[1] The classification is shown in Table 12.

Table 1: Exports and real wages, Italy and Germany (1996-2011)

	Italy									
	Total (E)	const	agro	minengy	lowtech (1)	medtech	hitech	vehicles	tertiary	E/Y
1996	7.6	4.3	2.9	18.8	7.1	3.1	9.5	6.4	9.1	24.7
1997	-3.7	4.8	-6.0	4.1	-5.6	-3.7	-4.0	-5.4	0.5	25.2
1998	2.0	25.7	0.4	-13.2	0.1	2.5	1.7	14.2	0.1	25.2
1999	-4.2	-38.2	-2.1	-0.5	-4.6	-6.5	-2.4	-4.7	-4.4	24.3
2000	1.6	-14.5	-9.2	41.5	-0.3	1.4	2.3	4.5	-1.0	26.8
2001	2.5	1.9	7.0	-5.3	2.2	-0.8	2.8	-4.9	10.9	26.9
2002	4.0	7.4	3.2	-3.6	3.8	5.9	3.4	11.7	0.5	25.5
2003	17.9	27.1	20.7	36.8	14.3	21.5	18.4	15.4	18.1	24.4
2004	18.7	35.9	4.4	24.4	12.2	28.8	18.3	17.6	21.0	25.2
2005	5.7	11.7	8.0	50.1	1.3	7.3	5.6	0.6	6.5	25.9
2006	12.5	6.8	7.2	15.7	8.1	19.1	10.9	16.1	12.8	27.6
2007	19.3	17.1	23.5	27.6	15.9	21.5	19.9	26.0	14.6	28.9
2008	7.9	1.3	16.0	27.8	7.5	8.2	8.3	6.5	3.1	28.5
2009	-24.6	-18.6	-19.2	-41.6	-20.9	-32.5	-23.4	-30.6	-14.9	23.7
2010	9.9	1.3	15.1	44.2	6.9	14.4	8.5	10.9	4.8	26.6
2011	16.0	6.1	9.0	18.6	14.9	24.9	16.2	11.1	11.0	28.8
Total	125.9	69.7	102.2	563.5	73.3	157.0	133.7	120.8	132.6	4.1
	Germany									
	Total (E)	const	agro	minengy	lowtech (1)	medtech	hitech	vehicles	tertiary	E/Y
1996	0.1	-10.4	-3.2	-0.5	-1.3	-2.1	0.1	3.0	5.1	24.8
1997	-2.1	-20.4	-5.5	-6.7	-3.5	-3.4	-2.1	0.5	-1.1	27.4
1998	5.8	11.1	10.0	-5.8	5.4	2.9	3.8	12.7	3.5	28.6
1999	-0.5	63.8	-2.2	6.0	-2.1	-4.7	-1.1	4.1	1.9	29.4
2000	1.5	-11.0	10.1	45.1	1.2	3.9	1.1	-1.9	10.5	33.4
2001	3.1	27.8	-5.5	4.4	1.4	1.4	1.4	8.7	5.8	34.8
2002	8.1	-10.8	5.8	30.5	9.1	8.8	4.8	10.9	19.9	35.7
2003	22.4	6.3	15.7	35.0	23.3	22.3	21.9	21.8	8.8	35.7
2004	20.0	9.2	12.9	34.4	16.7	27.1	21.3	14.2	21.1	38.5
2005	8.5	19.6	13.0	27.0	8.0	9.9	7.5	7.0	10.8	41.3
2006	14.7	5.6	11.0	31.5	11.7	24.0	13.7	9.5	16.5	45.5
2007	19.7	16.0	25.2	3.2	21.1	22.1	19.9	19.8	22.1	47.2
2008	10.5	19.1	24.7	22.4	12.4	10.3	12.1	4.0	11.9	48.2
2009	-26.4	6.1	-16.2	-30.4	-17.6	-31.0	-24.7	-31.6	-9.4	42.5
2010	11.5	-5.3	5.9	-2.4	2.2	17.8	9.9	20.4	0.9	47.6
2011	16.6	4.5	19.3	21.2	11.2	19.4	14.9	20.8	5.7	50.6
Total	177.4	179.9	193.1	476.6	143.4	194.0	150.2	190.5	245.0	25.8

Legend (1) % rate of change; E Total exports at current prices; Y Gdp at current prices
Source Own computations based on WIOD and AMECO

In order to go deeper into the issue of our interest, it is necessary Table 2 reports the composition of Italian and German exports and imports by technological classification of the industries of origin.

As can be seen from the Table, the industries that export the most both in Italy and in Germany are those in the hi-tech group, representing in 2011 the 32.5% of exports in the case of Italy, and the 37.0% in the case of Germany. It is interesting to notice that while in Italy such proportion sightly increased from 1995 to 2011, in Germany it

Table 2: Composition of Exports/Imports by technological classification of industries of origin, Italy and Germany

Exports									
	Italy					Germany			
	1995	2000	2008	2011		1995	2000	2008	2011
agro	1.6	1.3	1.3	1.4	agro	0.9	0.9	0.8	0.9
const	0.3	0.2	0.3	0.2	const	0.3	0.4	0.3	0.3
minengy	1.5	2.3	4.3	4.5	minengy	1.5	1.9	3.6	3.1
low	26.4	24.7	20.1	20.3	low	13.8	12.9	12.4	12.1
med	15.3	14.3	17.3	17.4	med	14.2	12.9	14.9	15.1
hi	31.4	32.6	32.4	32.5	hi	41.1	39.3	37.4	37.0
vehicles	8.7	9.6	9.5	8.5	vehicles	18.6	20.9	18.8	19.5
tertiary	14.8	14.9	14.8	15.2	tertiary	9.6	10.9	11.8	11.9
Total	100.0	100.0	100.0	100.0	Total	100.0	100.0	100.0	100.0
Imports									
	Italy					Germany			
	1995	2000	2008	2011		1995	2000	2008	2011
agro	4.5	3.2	2.6	2.9	agro	4.3	3.1	2.7	3.3
const	0.4	0.2	0.3	0.3	const	0.9	0.7	0.5	0.5
minengy	8.2	11.2	16.2	19.0	minengy	5.7	8.0	13.0	7.0
low	19.6	16.8	15.4	15.5	low	21.5	17.8	14.1	15.3
med	14.0	11.9	13.6	12.3	med	13.4	11.8	14.5	15.7
hi	28.6	29.0	24.9	24.9	hi	29.5	31.0	29.2	32.2
vehicles	9.2	11.6	10.3	8.1	vehicles	10.9	12.1	11.6	12.3
tertiary	15.5	16.2	16.7	17.0	tertiary	13.8	15.4	14.5	13.7
Total	100.0	100.0	100.0	100.0	Total	100.0	100.0	100.0	100.0

Source Own computations based on WIOD

sharply decreased, with an overall loss of almost 4 p.p. While the differences between the two countries are small in the medium-tech sector, they become relevant in the case of low-tech and vehicles industries, the former being the second exporting group for Italy and the latter for Germany. This difference is showing that the production and delivery of cars industries play in Germany a symmetrical role to that played in Italy by the textile and food processing sectors.

Table 2 also shows that the highest proportion of imports consists, both in Italy and Germany, of the products of hi-tech industries—in 2011, the 24.9% of the total in Italy and the 32.2% in Germany. Such proportion decreased in Italy since 1995, while increased in Germany. The greatest difference between the two countries is given by energetic imports, which represent the 19% of Italian imports and only the 7% of Germany's.

The composition of international trade for the two countries is inspected in some more detail in Tables 3 and 4.[2]

Table 3 shows that in 2008 the 32.5% of Italian hi-tech exports consisted of final goods for fixed capital formation, the corresponding proportion being 27.2% in Germany, while the 19.6% consisted in intermediates for other countries hi-tech industries, versus the 24.0% in Germany. In both cases, the proportion of exports to fixed capital formation decreased from 1995 to 2008, while that of exports of inter-

[2] In what follows, we will concentrate on the years from 1995 to 2008, for which both current and constant prices data are available.

mediates to other countries' hi-tech industries increased. In both countries, the great majority of commodities exported as final consumption goods are produced by the low-tech-group industries. As to the Transport equipment industry, in both countries exports mainly consist of final consumption commodities, both for consumption and for capital formation, and of intermediates for the same activities in other countries, i.e. components to be assembled elsewhere.

Turning to imports, Table 4 shows that in 2008 the 27.8% of German hi-tech imports consisted of intermediates for hi-tech industries and the 23% of fixed capital formation; in Italy the situation was the opposite, with 22.2% of hi-tech imports consisting of intermediates for the hi-tech activities and the 27.3% of fixed capital. Moreover, the most apparent difference in the imports structure of Italy and Germany concerns the energetic sector: while the 77.4% of Italy's imports consist of intermediates for the production of energy itself, and only the 6.4% goes to final consumption, in Germany the corresponding proportions are 37.9% and 25.1%. The second most relevant difference concerns the imports of products of the vehicles industry: while Italy mainly imports for final consumption purposes, Germany's imports mainly consist of intermediates for the automobile industries itself—presumably in the form of components produced elsewhere and then assembled within the borders.

Table 3: Composition of exports by delivering and purchasing technological categories, Italy and Germany

	1995																			
	Germany										Italy									
	agro	const	en	low	med	hi	veh	tert	C	K	agro	const	en	low	med	hi	veh	tert	C	K
hitech	2.3	4.2	2.4	4.6	5.5	20.5	3.2	11.2	12.1	34.0	2.1	3.8	2.4	3.8	4.4	16.7	3.3	9.7	14.3	39.5
lowtech	1.7	1.9	0.4	25.7	1.8	2.4	0.9	12.9	51.1	1.1	0.5	1.4	0.2	18.5	1.2	1.4	1.2	6.8	67.0	1.7
medtech	0.8	15.4	1.6	8.0	28.9	16.3	9.1	8.3	5.9	5.7	1.1	20.8	1.7	6.7	22.3	13.6	8.9	8.1	10.0	6.9
minengy	3.6	7.5	12.8	5.9	10.9	11.7	1.3	22.5	19.9	4.1	3.3	9.4	11.7	3.9	7.9	6.5	0.9	24.6	29.4	2.5
tertiary	1.8	4.6	3.4	8.9	4.8	7.2	2.1	45.6	18.0	3.8	1.7	4.4	3.5	8.3	5.4	7.6	2.6	37.3	23.2	6.0
vehicles	0.3	0.6	0.5	0.7	0.8	2.1	21.4	12.7	26.8	34.0	0.3	0.4	0.3	0.5	0.5	1.3	25.9	11.8	30.6	28.4
	2000																			
	Germany										Italy									
	agro	const	en	low	med	hi	veh	tert	C	K	agro	const	en	low	med	hi	veh	tert	C	K
hitech	1.8	3.9	2.2	3.9	5.0	22.3	3.6	11.7	13.0	32.6	1.7	3.9	2.3	3.7	4.4	17.7	3.8	10.0	16.8	35.6
lowtech	1.1	2.3	0.4	25.2	1.8	2.7	1.1	13.3	50.6	1.7	0.5	1.3	0.2	18.3	1.1	1.4	1.5	6.8	67.0	1.9
medtech	0.7	15.7	1.4	7.9	28.3	17.3	9.7	8.9	5.7	4.5	0.8	19.8	1.7	6.8	22.5	14.9	10.0	8.6	8.4	6.6
minengy	3.1	6.4	16.2	4.1	7.2	10.1	0.9	25.0	23.5	3.6	3.1	7.6	12.8	3.2	5.1	7.3	0.7	27.5	30.8	1.9
tertiary	1.6	4.4	3.8	7.7	4.2	8.2	2.0	47.0	16.7	4.4	1.2	4.4	3.1	8.0	4.0	7.6	2.4	40.8	23.3	5.1
vehicles	0.3	0.5	0.4	0.6	0.6	1.7	23.7	11.8	28.0	32.4	0.3	0.4	0.3	0.5	0.5	1.4	30.9	14.4	26.7	24.6
	2008																			
	Germany										Italy									
	agro	const	en	low	med	hi	veh	tert	C	K	agro	const	en	low	med	hi	veh	tert	C	K
hitech	1.7	4.2	3.4	3.4	5.9	24.0	3.7	11.9	14.6	27.2	1.6	4.5	3.4	3.0	5.2	19.6	4.2	10.4	15.5	32.5
lowtech	1.0	2.6	0.6	19.1	1.9	2.7	0.8	13.3	55.5	2.4	0.4	1.4	0.4	14.4	1.1	1.5	1.3	7.1	69.8	2.6
medtech	0.6	16.4	1.8	6.2	31.6	18.4	8.7	7.8	4.9	3.6	0.7	18.0	2.1	5.4	27.5	16.9	9.8	7.4	5.6	6.7
minengy	3.0	4.2	12.2	5.0	8.2	12.7	1.2	25.4	25.9	2.3	2.6	4.5	15.8	3.0	5.0	5.4	0.5	27.3	35.0	0.8
tertiary	1.2	5.0	3.7	6.0	4.6	10.4	2.1	47.5	15.8	3.7	1.0	4.8	2.8	7.4	3.9	8.4	2.2	43.8	21.8	4.1
vehicles	0.4	0.9	0.6	0.6	1.0	2.2	24.6	12.0	28.7	29.2	0.4	0.7	0.6	0.5	0.6	1.6	29.4	13.1	25.1	28.0

Source Own computations based on WIOD

Table 4: Composition of imports by delivering and purchasing technological categories, Italy and Germany

	1995																			
	Germany										Italy									
	agro	const	en	low	med	hi	veh	tert	C	K	agro	const	en	low	med	hi	veh	tert	C	K
hitech	1.5	3.8	1.5	4.1	6.5	25.1	3.7	10.0	15.6	28.3	0.7	2.7	0.9	6.4	8.2	26.3	2.2	13.2	13.2	26.3
lowtech	0.5	2.9	0.2	17.6	1.8	3.2	1.4	7.5	63.7	1.3	0.9	1.7	0.2	28.5	2.3	2.6	0.7	11.2	51.2	0.7
medtech	0.5	14.8	1.3	3.6	32.1	19.6	12.3	4.8	6.7	4.2	0.1	10.3	0.6	8.2	37.1	23.5	6.5	7.1	4.2	2.5
minengy	1.3	3.0	26.4	3.9	13.9	7.3	1.1	11.4	31.3	0.4	0.9	1.8	56.6	2.6	10.0	3.9	0.3	11.3	12.3	0.2
tertiary	0.8	3.3	5.9	6.2	4.8	9.4	2.7	44.6	19.8	2.6	0.6	4.8	9.7	8.5	5.1	6.8	1.4	45.2	16.4	1.5
vehicles	0.1	0.2	0.1	0.2	0.6	1.0	23.6	4.2	29.1	41.0	0.2	0.4	0.0	0.3	1.0	1.6	8.7	11.2	31.4	45.2
	2000																			
	Germany										Italy									
	agro	const	en	low	med	hi	veh	tert	C	K	agro	const	en	low	med	hi	veh	tert	C	K
hitech	0.9	3.0	1.1	3.5	5.3	26.0	4.1	8.8	16.5	30.8	0.5	2.2	1.3	5.1	6.9	23.4	2.2	12.4	15.5	30.5
lowtech	0.5	2.4	0.2	16.6	1.7	3.2	1.9	7.5	63.9	2.1	0.6	1.5	0.3	26.4	2.1	2.5	0.7	10.9	53.9	1.1
medtech	0.4	13.4	1.2	3.7	30.3	19.4	15.9	4.3	7.2	4.1	0.1	9.8	0.8	8.2	35.3	23.5	6.9	7.5	4.9	3.0
minengy	1.2	2.5	32.7	3.2	10.1	6.9	1.1	12.2	29.8	0.2	0.5	1.3	72.3	1.5	5.9	2.3	0.2	6.5	9.4	0.2
tertiary	0.4	2.1	5.7	4.8	3.9	9.0	3.9	48.2	18.9	3.1	0.4	4.0	10.1	8.1	4.6	6.4	1.5	46.9	16.0	1.9
vehicles	0.1	0.1	0.1	0.2	0.4	1.1	29.3	7.0	22.9	38.7	0.1	0.3	0.1	0.3	1.0	1.6	10.5	13.0	30.3	42.9
	2008																			
	Germany										Italy									
	agro	const	en	low	med	hi	veh	tert	C	K	agro	const	en	low	med	hi	veh	tert	C	K
hitech	1.1	2.7	1.5	3.2	6.3	27.8	4.8	8.2	21.5	23.0	0.6	1.9	2.2	4.7	6.5	22.2	2.6	12.2	19.8	27.3
lowtech	0.8	1.6	0.3	17.4	2.3	3.7	2.3	7.6	62.1	1.9	0.6	1.4	0.4	18.8	2.0	2.0	0.6	9.4	64.0	0.9
medtech	0.4	8.4	1.2	3.2	37.5	20.3	17.0	3.5	5.4	3.0	0.1	8.5	0.8	6.9	44.2	20.0	6.0	7.1	4.1	2.3
minengy	1.0	1.4	37.9	3.5	11.1	6.6	1.2	11.8	25.1	0.3	0.4	0.8	77.4	1.0	5.6	2.0	0.1	6.2	6.4	0.1
tertiary	0.5	1.8	9.0	4.6	4.6	9.4	4.1	45.7	17.2	3.3	0.4	4.0	13.8	7.0	4.9	6.0	1.5	47.6	13.6	1.3
vehicles	0.1	0.2	0.1	0.3	0.5	1.6	35.5	7.0	18.5	36.2	0.3	0.4	0.1	0.5	3.1	3.2	14.0	18.3	33.0	27.1

Source Own computations based on WIOD

Table 5: Evolution of national vertically integrated labour productivity, Italy and Germany (1995-2007). Yearly averages

	Italy					Germany				
	95-98	98-01	01-04	04-07	95-07	95-98	98-01	01-04	04-07	95-07
					lowtech					
Food	3.9	2.9	1.9	1.3	2.5	2.3	2.9	1.5	2.9	2.4
Leather	0.7	2.7	-0.4	1.7	1.2	3.1	3.1	3.3	4.8	3.6
Manufacturing nec	1.0	2.2	0.1	1.2	1.1	3.6	2.4	1.6	3.4	2.7
Paper, Printing	2.8	1.8	0.9	1.2	1.7	3.2	4.1	2.4	3.9	3.4
Textiles	2.1	3.5	-0.6	1.7	1.7	4.3	3.3	3.7	5.4	4.2
Wood	3.8	5.3	-0.2	1.7	2.6	4.3	3.3	2.4	2.0	3.0
					medtech					
Basic, Fabr.Metal	1.7	2.6	0.1	0.8	1.3	3.9	3.0	1.7	3.2	3.0
Non-Metal Mineral nec	1.5	1.8	0.7	0.2	1.1	2.7	2.1	3.2	2.6	2.7
Rubber and Plastics	2.5	1.2	2.2	0.4	1.6	3.9	1.4	3.7	3.5	3.1
					hitech					
Chemicals	3.5	1.0	2.3	0.7	1.9	4.7	3.7	2.5	3.2	3.5
Machinery nec	0.3	2.1	1.2	1.7	1.3	3.8	2.3	1.6	5.1	3.2
Optical Equipm.	1.7	2.9	2.0	0.8	1.9	5.1	5.1	6.1	11.0	6.8
					vehicles					
Transport Equipm.	2.0	2.5	0.2	1.4	1.5	4.3	2.1	2.9	5.9	3.8
Source	Own computations based on WIOD									

3 Changes in vertically integrated labour composition and productivity

As stated in the Introduction, Germany's high trade surpluses are often explained by the dynamics of its labour productivity, growing faster than in other countries, and especially Italy, also due to the flexibilisation of its labour market which was introduced in the first half of the last decade. The obvious question therefore arises of whether productivity in Germany actually increased more than in Italy, and in which sectors.

The issue can be looked at from different perspectives, since the complexity of production structures, within—but most of all *across*—national borders considerably increased over the period under analysis.

To begin with, Table 5 shows the evolution through time of (national) vertically integrated labour productivity in both Italy and Germany for all manufacturing sectors. Even without considering 2008—when the crisis made productivity to decrease due to the sharp decline in output—the difference between Italian and German productivity performance is apparent: German productivity increased much more, on average and over the whole period, in all manufacturing sectors with the exception of *Food*. In particular, Italian productivity growth started to decline from 2001 onwards, while Germany's performance has been positive over the whole period. After the introduction of the Hartz reforms, in the period 2004-2007, national labour productivity actually grew faster than before, on average, in almost all sectors, with the exception of *Wood*, *Non-Metal Mineral nec*, and *Rubber and Plastics*.

However, looking at the evolution of (national) labour productivity only can be misleading in evaluating a country's performance; in order to have a complete pic-

Table 6: Labour productivity and employment dynamics, Italy and Germany (1996-2007)

	$\varrho > 0, r_E > 0$		$\varrho > 0, r_E < 0$		$\varrho < 0, r_E > 0$		$\varrho < 0, r_E < 0$	
	ITA	DEU	ITA	DEU	ITA	DEU	ITA	DEU
				lowtech				
Food	4	4	6	8	1	0	1	0
Leather	2	3	5	7	1	0	4	2
Manufacturing nec	4	8	2	2	1	1	5	1
Paper, Printing	4	3	7	7	0	0	1	2
Textiles	1	0	8	12	0	0	3	0
Wood	5	1	6	9	0	2	1	0
				medtech				
Basic, Fabr.Metal	9	3	1	9	1	0	1	0
Non-Metal Mineral nec	4	1	5	10	2	1	1	0
Rubber and Plastics	5	5	6	6	1	1	0	0
				hitech				
Chemicals	4	1	6	11	1	0	1	0
Machinery nec	7	6	0	5	4	1	1	0
Optical Equipm.	8	3	2	8	1	1	1	0
				vehicles				
Transport Equipm.	4	8	4	4	1	0	3	0

Legend ϱ rate of change of labour productivity. r_E rate of change of employment
Source Own computations based on WIOD

ture, it is important to observe the evolution of employment too. In fact, *productivity increases* can be coupled with either increasing or decreasing employment levels; in the second case, productivity increases might cover phenomena of labour expulsion, which can in turn be due to the fact that the sector under analysis is a declining one, or that processes with above-average labour-intensity are being outsourced. In the same way, *productivity reductions* can be accompanied by either increasing or decreasing employment. While in the second case we clearly are in front of a lagging sector, in the former we might observe the outcome of an expanding activity which might lead to following productivity increases.

In order to assess this phenomenon, Table 6 reports, for each country and manufacturing sector, the number of periods in which each of the four possible combinations of productivity/employment dynamics did prevail.

Productivity *and* employment growth was a more frequent pattern in Italy than in Germany, for all manufacturing sectors with the exception of *Transport Equipment*, *Manufacturing nec* and *Rubber and plastics*. In particular, the sectors *Basic and Fabricated Metal* (9 vs 3 periods), *Optical Equipment* (8 vs 3 periods) and *Machinery nec* (7 vs 6 periods) have been particularly dynamic in Italy. In Germany all sectors—with the exception of *Manufacturing nec*, *Machinery nec* and *Transport Equipment*—show as the most common pattern the pair increasing productivity/decreasing employment.

These results suggest that German productivity might have been increasing more than in Italy not only—or not always—due to technological change, but rather to a modification of its international division of labour. This interpretation may be tested by inspection of Table 7, showing the dynamics of *international* vertically integrated labour productivity. In other words, for each item of final demand, we are computing

Table 7: Evolution of international vertically integrated labour productivity, Italy and Germany (1995-2007). Yearly averages

	Italy					Germany				
	95-98	98-01	01-04	04-07	95-07	95-98	98-01	01-04	04-07	95-07
					lowtech					
Food	3.3	5.3	-0.1	1.8	2.6	-1.3	5.1	0.2	2.1	1.5
Leather	1.8	0.2	-0.6	0.8	0.5	3.0	0.7	-8.3	1.6	-0.9
Manufacturing nec	-0.3	2.8	-1.7	0.7	0.4	2.3	1.7	-2.7	2.8	1.0
Paper, Printing	3.5	2.1	0.3	1.0	1.7	2.9	2.0	1.3	2.9	2.3
Textiles	1.6	1.4	-2.6	1.6	0.5	1.2	3.1	-5.5	1.8	0.1
Wood	1.6	6.6	-2.5	2.1	1.9	1.7	3.8	0.1	0.3	1.5
					medtech					
Basic, Fabr.Metal	1.7	3.1	-3.0	-1.5	0.0	4.2	3.0	-2.8	-1.6	0.7
Non-Metal Mineral nec	1.0	1.5	-0.7	0.9	0.7	2.1	2.0	1.1	1.8	1.8
Rubber and Plastics	1.9	2.0	0.2	-0.3	0.9	2.5	2.0	0.2	1.4	1.5
					hitech					
Chemicals	1.8	1.8	0.7	-0.3	1.0	2.3	3.3	0.3	0.5	1.6
Machinery nec	0.1	2.4	-0.6	0.2	0.5	3.3	1.4	-2.3	1.9	1.0
Optical Equipm.	1.6	2.9	-0.5	0.0	1.0	4.4	1.9	-0.9	7.3	3.1
					vehicles					
Transport Equipm.	1.1	1.0	-2.0	-0.3	-0.1	2.2	2.1	-2.7	3.1	1.2
Source	Own computations based on WIOD									

the quantity of labour necessary for the production of one single unit of output, whose reciprocal gives the corresponding labour productivity, the dynamics of which we are interested in investigating in order to uncover the characteristics global production chains ending up in each of the two countries under consideration.

It is immediately apparent from direct inspection of Table 7 that the differences between Italy's and Germany's performance in terms of labour productivity are quite different from those emerging when considering national labour productivity only.

On average, i.e. over the whole period from 1995 to 2007, there are three sectors characterised by Germany's labour productivity growing *more* than Italy's in national terms, and *less* when the whole international labour content is taken into account: *Leather*, *Textiles* and *Wood*. To some extent, the *Food* sector displays a similar pattern, with Italian productivity growing faster in both cases, but in a much more marked way in international terms. In all other sectors, productivity is growing faster in Germany looking at both national and international labour, though the difference being much smaller in the latter case than in the former. This divergence is particularly huge in two hi-tech sectors: *Machinery nec*—where national productivity growth was on average 1.4% each year in Italy versus 3.5% in Germany in national terms; +0.6% in Italy versus 1.1% in Germany in international terms—and *Optical Equipment*—+2.0% in Italy versus 7.4% in Germany for the case of national labour, 1.1% in Italy versus 3.4% in Germany for international labour.

A similar pattern in the comparison of the two kinds of labour productivity also characterised the four sub-periods considered; however, it can be noted that the huger divergence in the performance gap between Italy and Germany—in terms of national labour productivity on the one side and of international labour productivity on the

Table 8: Evolution of the proportion of domestic to total international vertically integrated labour, Italy and Germany (1995-2007). Yearly averages

	Italy						Germany					
	95-97	98-00	01-03	04-06	2007	Diff (1)	95-97	98-00	01-03	04-06	2007	Diff (1)
						lowtech						
Food	65.6	64.5	68.3	64.8	65.5	0.6	59.4	55.6	58.8	56.4	55.2	-6.3
Leather	65.4	65.2	60.4	59.5	58.3	-4.6	48.0	47.2	44.5	29.6	28.2	-19.2
Manufacturing nec	69.0	65.3	65.6	62.5	61.7	-5.9	61.6	57.0	56.2	49.9	49.7	-10.7
Paper, Printing	70.5	69.0	69.3	68.5	67.8	0.1	70.3	66.1	64.9	62.5	61.2	-8.3
Textiles	61.3	58.4	55.1	51.3	51.7	-7.7	43.8	39.6	38.5	28.7	27.1	-16.5
Wood	70.8	66.4	67.9	64.3	64.5	-5.7	61.1	54.5	55.6	51.9	50.6	-9.7
						medtech						
Basic, Fabr.Metal	68.8	66.7	66.6	60.4	57.2	-8.8	57.2	55.6	55.0	47.2	43.0	-12.6
Non-Metal Mineral nec	72.5	69.4	68.4	67.2	67.7	-3.2	68.3	65.0	65.4	61.9	61.0	-6.5
Rubber and Plastics	63.5	61.8	61.7	58.8	58.0	-4.2	59.9	56.5	56.8	51.6	49.8	-9.7
						hitech						
Chemicals	56.6	53.7	54.0	51.8	50.6	-5.5	54.4	49.2	49.7	46.1	43.7	-10.5
Machinery nec	69.6	67.5	67.0	63.8	61.5	-5.9	61.1	57.9	56.5	50.2	47.0	-13.0
Optical Equipm.	67.9	65.9	65.6	61.3	59.8	-6.2	59.6	55.2	50.9	42.1	39.0	-19.6
						vehicles						
Transport Equipm.	67.1	63.1	60.1	56.9	54.3	-11.1	50.8	47.2	46.3	40.2	38.1	-12.6

Legend (1) Absolute change in p.p.
Source Own computations based on WIOD

other—was registered in the sub-periods 2001-2004 and 2004-2007—i.e. after the introduction of the common currency and the implementation of the Hartz reforms. In other words, in these two sub-periods the relative importance of off-shoring in determining productivity increases *within* the borders was particularly strong in Germany.

The conclusion which can be drawn by the previous analysis is that over the whole period considered here, both Germany and Italy were interested by a progressive change in their productive structures, with the most labour intensive stages being off-shored. However, this process was faster, and more marked, in Germany than in Italy, and further accelerated with the introduction of the common currency and with the liberalisation of German labour market.

A further piece of evidence which can reinforce these conclusions is provided by Table 8, showing the ratio of own to total international vertically integrated labour for manufacturing.

The main feature emerging from inspection of Table 8 is that the *domestic* component of German international vertically integrated labour coefficients is on average lower than the Italian one. Differences were specially huge in two low-tech sectors (*Leather* and *Textiles*, the average difference being, in the period 2004-2007, 30.0 and 23.1 p.p., respectively) in two hi-tech sectors (*Machinery nec*, 13.8 p.p., and *Optical Equipment*, 19.6 p.p.) and in the *Transport Equipment* sector (16.6 p.p.).

Moreover, data reveal that in both countries this proportion has been decreasing, during the period considered, in almost all sectors, though at a much sharper pace in Germany with respect to Italy. For the case of Italy, the highest decrease in domestic labour proportion was registered in the *Transport Equipment sector* (-11.1 p.p. from 1995 to 2007), followed by *Basic and Fabricated Metals* (-8.8 p.p.). In Germany, the

decline interested almost all manufacturing sectors in the same way, but was particularly strong in *Optical Equipment* (-19.6 p.p.) and *Leather* (-19.2 p.p.).

When disaggregating the dynamics into sub-periods, it is possible to see that in 1998-2000 and in both countries a decrease in the proportion of domestic to total labour with respect to 1995-1997 took place which slowed down in 2001-2003, and again accelerated from 2004 and 2007. In the latter sub-period, i.e. the one immediately after the Hartz reforms, Germany was characterised by a particularly strong reduction of its domestic labour component in all its manufacturing sectors, and especially in the *Leather* and *Textiles* sectors—but also in the *Machinery nec*, *Optical Equipment* and *Transport Equipment* ones.

As an overall result, we can say that in 2007 all manufacturing sectors in Italy, though having underwent a process of off-shoring of production processes, were characterised by a domestic component of total labour greater than 50%. On the contrary, in Germany this was the case of four sectors only (*Food*, *Paper and Printing*, *Wood* and *Non-Metal Mineral nec*. In all other sectors, the domestic component was in 2007 well below 50%, with *Optical Equipment* and *Transport Equipment* being even below 40%.

4 Standard indicators of off-shoring

Before concluding, it is worth discussing the results of computing three standard indicators of off-shoring and internationalisation of manufacturing,[3] computed at the activity rather than aggregated, economy-wide level: (i) the ratio of imported to total (ITT) inputs, (ii) the import content of domestic production (ICP), and (iii) the import content of exports (ICE). Results are shown in Tables 10-11.[4]

The ITT (see Feenstra and G.H., 1996, 1999) gives the ratio of imported to total direct requirements for gross output. It can be seen from Table 10 that Italy's and Germany's ITT show a very different structure and dynamics: for Italy, the average proportion went from 20.5% in the sub-period 1995-1997 to 25.1% in 2007 (+3.8 p.p. from 1995 to 2007); in Germany, from 34.3% to 48.4% (+15.1 p.p. from 1995 to 2007), with a constantly increasing trend.

While in the first sub-period the index was below 25% in Italy for almost all activities—with the exception of *Chemicals* (43.7%), *Optical Equipm.* (33.7%) and *Transport Equipment* (26.7%)—in Germany the ratio of imported to total inputs was much higher for almost all activities. This generalised divergence became huger in the following sub-periods; however, while on average variations of the ITT in Italy were almost constant in each sub-period with respect to the previous one—with the notable exception of *Transport Equipment*, where the proportion of imported to total inputs increased much more than average, especially in the period 2001-2003, with an overall increase of 20.6 p.p. from 1995 to 2007—in Germany the increase was quite fast in 1998-2000 with respect to 1995-1997 (+3.4 p.p. on average), decelerated in 2001-2003 (+1.9 p.p. with respect to 1998-2000), underwent a strong increase in

[3] See e.g. Breda and Cappariello (2012) for a review.

[4] For analytical details on how these indicators have been computed, see Appendix A.

Table 9: ITT, Italy and Germany (1995-2008), yearly averages

	Italy						Germany					
	95-97	98-00	01-03	04-06	2007	95-07 (1)	95-97	98-00	01-03	04-06	2007	95-07 (1)
						lowtech						
Food	9.2	8.0	8.9	8.2	8.8	-0.9	10.0	12.2	14.1	15.7	19.3	9.8
Leather	15.7	14.6	15.9	14.7	16.9	0.4	58.9	60.5	63.3	90.4	94.1	34.7
Manufacturing nec	12.4	12.3	12.0	11.9	12.6	-0.3	37.2	39.9	43.3	46.2	41.4	4.2
Paper, Printing	19.1	18.9	18.2	18.2	18.8	-2.6	22.7	26.4	31.2	34.3	36.8	13.6
Textiles	18.8	19.3	19.6	19.5	20.3	1.7	73.0	68.1	66.1	85.3	87.6	16.6
Wood	17.9	18.6	19.0	22.1	23.3	4.5	22.6	26.3	27.3	28.2	29.4	8.2
						medtech						
Basic, Fabr.Metal	22.4	23.6	23.6	27.9	32.6	8.6	31.1	33.9	37.1	43.6	47.8	17.6
Non-Metal Mineral nec	9.1	8.9	8.5	8.8	9.5	-0.2	16.1	19.3	22.2	24.5	26.8	11.5
Rubber and Plastics	16.4	17.2	18.3	21.6	24.2	7.3	24.1	29.1	32.8	37.4	41.4	18.5
						hitech						
Chemicals	43.7	44.8	47.1	50.1	51.5	6.9	52.9	65.9	60.7	69.5	75.6	25.5
Machinery nec	21.6	21.8	23.6	23.3	26.9	5.7	22.2	28.5	31.2	32.9	35.1	14.7
Optical Equipm.	33.7	34.3	31.8	33.8	33.0	-2.9	39.0	43.0	49.2	54.6	54.1	16.0
						vehicles						
Transport Equipm.	26.7	33.0	42.5	47.4	48.3	20.6	36.0	36.9	36.1	40.1	40.2	6.0
						Average						
	20.5	21.2	22.2	23.6	25.1	3.8	34.3	37.7	39.6	46.4	48.4	15.1

Legend (1) Absolute change in p.p.
Source Own computations based on WIOD

2004-2006 (+6.8 p.p.) with an increase of 2.1 p.p. in 2007 only with respect to the average prevailing in 2004-2006.

The ICP (see Egger and Egger, 2003) measures, for each commodity produced, the value of total imports as a proportion of its domestic gross production. In this case, in the sub-period 1995-1997 the differences between Italy and Germany are less wide than for ITT, though Germany being characterised by a higher level of ICP than Italy in all sectors. The gap, however, became wider in the following periods. Over the whole period going from 1995 to 2007, the ICP increased by 2.7 p.p. in Italy, and by 7.5 p.p. in Germany, with some activities displaying an above-average increase: *Transport Equipment* (+12.1 p.p.), *Basic and Fabricated Metal* (+6.5 p.p.) and *Chemicals* (+6.5 p.p.) in Italy; *Basic and Fabricated Metal* (+16.1 p.p.), *Rubber and Plastics* (+12.0 p.p.) and *Chemicals* (+11.6 p.p.) in Germany.

Also in this case, looking at the disaggregation by sub-periods reveals a quite stable and moderate increase in Italy (on average, between 0.5 and 1.3 p.p. in each sub-period with respect to the previous one). The case of Germany, on the contrary and in line with the dynamics of ITT, shows a stronger increase in the two sub-periods 1998-2000 (+2.1 p.p. on average with respect to 1995-1997) and 2004-2006 (+2.7 p.p. on average with respect to 2001-2003).

Finally, the ICE (Hummels and Yi, 2001; Dietzenbacher, 2010) provides a measure of total imports embodied in total exports. More precisely, it expresses, for each industry, the value of gross output directly and indirectly required for the delivery of the corresponding total exports as a proportion of the value at current prices of exports themselves. With respect to ITT and ICP—which are computed in terms of gross output and hence only quantify direct requirements—this latter indicator is built with reference to exports, which are an item of final demand, and hence imply

Table 10: ICP, Italy and Germany (1995-2008), yearly averages

	Italy						Germany					
	95-97	98-00	01-03	04-06	2007	95-07 (1)	95-97	98-00	01-03	04-06	2007	95-07 (1)
						lowtech						
Food	3.7	3.3	3.6	3.4	3.6	-0.3	2.9	3.3	3.6	4.2	5.2	2.5
Leather	5.5	5.3	6.1	5.3	6.2	0.6	16.0	17.4	17.5	25.9	28.2	12.3
Manufacturing nec	3.0	3.2	3.4	3.9	4.1	1.0	8.5	9.6	11.4	13.9	14.3	6.2
Paper, Printing	13.6	13.8	13.5	13.6	14.1	-1.7	14.5	16.6	19.2	19.8	21.3	6.1
Textiles	7.0	7.2	7.2	7.1	7.4	0.2	21.9	21.2	19.9	25.1	25.3	4.0
Wood	15.8	16.4	16.6	19.8	21.4	4.5	20.4	22.5	20.8	21.2	22.3	3.1
						medtech						
Basic, Fabr.Metal	19.9	20.7	20.5	24.1	28.2	6.5	24.0	26.5	27.7	33.8	39.6	16.1
Non-Metal Mineral nec	6.5	6.4	6.4	6.9	7.5	0.6	13.3	15.5	17.0	17.7	18.8	6.0
Rubber and Plastics	11.8	12.5	13.0	14.8	16.5	4.3	17.0	20.4	21.9	24.8	28.1	12.0
						hitech						
Chemicals	33.5	33.9	35.1	38.8	41.3	6.5	25.1	32.1	29.9	33.2	36.1	11.6
Machinery nec	5.6	6.3	7.0	6.9	7.8	2.1	7.1	8.8	9.6	10.2	11.4	4.8
Optical Equipm.	19.5	20.4	19.0	20.6	19.3	-1.8	21.4	23.9	26.4	28.6	28.3	7.3
						vehicles						
Transport Equipm.	9.4	12.4	18.4	21.2	21.9	12.1	9.3	11.0	11.7	13.2	13.2	5.1
						Average						
	11.9	12.4	13.1	14.3	15.3	2.7	15.5	17.6	18.2	20.9	22.5	7.5

Legend (1) Absolute change in p.p.
Source Own computations based on WIOD

considering *circularity*, since both direct and indirect requirements, both imported and domestically produced, are considered.

In this case, table 11 shows that, in the sub-period 1995-1997, the ICE was higher in Italy and in Germany for all activities with the exception of the low-tech ones. However, during the whole period from 1995 to 2007, the situation reversed, and in 2007 the same indicator was higher in Germany than in Italy with the exception of few activities—*Wood*, 66.0% in Italy versus 31.0% in Germany; *Chemicals*, 42.5% versus 29.4%; *Paper and Printing*, 33.8% versus 27.5%; *Transport Equipment*, 16.6% versus 14.5%.

The time profile of the changes in ICE is in this case similar in both countries, with an acceleration in the sub-period 2004-2006. However, differences between Italy and Germany are smoother in the case of this third indicator, confirming that the gap between the two countries appears as being smaller when the whole circular flow of direct and indirect requirements is taken into account.

5 Conclusions

The analysis carried out in the previous sections shows that labour productivity, when measured at the sectoral level taking into account the fragment of production chains taking place *within* the borders, grew in Germany more than in Italy in almost all manufacturing sectors, over the whole period under consideration and in particular after the introduction of the so called Hartz reforms.

However, further investigation of the determinants of such a higher increase in labour productivity revealed that, in Germany more than in Italy, sectors displaying

Table 11: ICE, Italy and Germany (1995-2008), yearly averages

	Italy						Germany					
	95-97	98-00	01-03	04-06	2007	95-07 (1)	95-97	98-00	01-03	04-06	2007	95-07 (1)
						lowtech						
Food	5.7	4.9	5.1	4.5	4.8	-1.3	3.4	3.7	3.8	4.3	5.2	2.0
Leather	6.3	6.0	7.1	6.0	7.2	0.8	14.1	14.8	14.1	18.6	21.7	7.6
Manufacturing nec	2.9	3.1	3.4	4.5	4.9	1.8	12.8	14.5	16.1	19.2	18.5	6.1
Paper, Printing	31.7	32.7	32.3	32.0	33.8	-3.0	22.1	24.6	26.7	25.5	27.5	4.8
Textiles	9.1	9.3	9.2	8.9	9.2	-0.4	18.9	18.1	16.9	20.1	20.3	1.5
Wood	53.3	55.2	52.7	61.1	66.0	8.0	38.5	34.3	28.9	29.0	31.0	-8.9
						medtech						
Basic, Fabr.Metal	44.1	45.4	43.9	44.5	50.3	2.1	38.3	42.8	43.5	50.1	57.7	19.2
Non-Metal Mineral nec	5.4	5.7	6.6	7.4	8.3	2.6	15.5	17.5	18.6	18.8	20.8	5.5
Rubber and Plastics	16.6	17.9	17.9	18.5	20.2	3.2	19.1	22.7	24.0	26.7	29.5	11.2
						hitech						
Chemicals	42.5	39.9	36.9	39.8	42.5	-2.4	20.5	26.2	25.7	26.8	29.4	9.2
Machinery nec	4.5	5.3	5.8	5.8	6.7	2.0	6.9	8.7	9.8	10.4	12.1	5.6
Optical Equipm.	20.8	21.1	19.4	20.6	20.2	-2.2	18.4	20.8	23.0	25.6	26.1	7.8
						vehicles						
Transport Equipm.	7.4	9.6	14.1	15.9	16.6	9.0	9.7	11.8	12.5	14.0	14.5	6.2
						Average						
	19.2	19.7	19.6	20.7	22.4	1.6	18.3	20.0	20.3	22.2	24.2	6.0

Legend (1) Absolute change in p.p.
Source Own computations based on WIOD

faster productivity increases were most of the times showing a sharp decrease in employment. This kind of dynamics might be the consequence of a process of offshoring of the most labour intensive stages of the production chains, via the import of intermediates which are then assembled domestically.

In fact, looking at labour productivity growth from the perspective of international production chains, i.e. taking into account labour employed not only within the borders, but also outside for the production of components, reveals a much smoother difference between the two countries. Hence, German out-performance with respect to Italy is conspicuously due to a different organisation of *international* division of labour rather than two a process of technological progress.

This conclusion is further confirmed by looking at the evolution through time of the the domestic component of international vertical integrated labour to the total, which were higher in Germany over the whole period, with an increasing gap whose amplitude widened the most during the 2004-2006 period, i.e. after the introduction of the Hartz reforms. In the same way, Germany show, with respect to Italy, a higher proportion of imported to total intermediate inputs (ITT) and a higher import content of production (ICP), the gap between the level of the two series of indicators widening over the whole period and particularly after the Hartz reforms. The same can be said with respect to the evolution through time of the import content of exports (ICE), though this indicator was on average higher in Italy in 1995-1997, in Germany in 2007.

Even though the present analysis is not meant to assess the presence or direction of a specific causal relation, we can conclude that the introduction of the Hartz reforms in Germany coincided with the acceleration of a process of outsourcing of production stages which further reduced the—already relatively low—contribution of

domestic labour to the overall (international) production chains for final commodities. This led to an increase in national labour productivity much faster than the overall one, indicating that off-shoring mainly concerned labour-intensive, low-value-added stages of the production processes.

We are now in a position to answer the question asked in the Introduction: is it desirable for Italy to mimic the 'German model', in an attempt to boost exports and hence growth? In the opinion who is writing, the answer is no, for a series of reasons.

The first, and most general, concerns the sustainability of such a model. A group of countries systematically off-shoring labour-intensive, low-value-added production stages implies the presence of another group of countries actually carrying them out. If such a dynamics might be initially advantageous for the latter if they are at a lower stage of development, with the passing of time it implies the consolidation of a centre-periphery relation. Of course, this is not a model which can be implemented on a global basis. The same holds for export-led growth, which is a model of development which, in order to be implemented, requires trade partners to incur into trade deficits. The realisation of this kind of development strategy has already created the disequilibria which, among the other things, fueled the European crisis. Trying to deepen such disequilibria is clearly not a way out.

Secondly, in the last decade Germany, in order to obtain its substantive trade surpluses, implemented a model of labour flexibilisation and wage moderation. In fact, it is the reduction of production costs—an important part of which is given by wages—more than labour productivity increase alone what boosts countries' competitiveness. Outsourcing labour-intensive and low-value-added production stages implies a reduction in employment which particularly affects the less specialised, and generally less paid, workers. In Italy, where unemployment is already very high, especially among the youngest segment of population, this strategy would unlikely trigger recovery, which would now require improving domestic demand.

A Methodology

In what follows, bold lower case letters indicate vectors, bold upper case matrices. A vector with a hat indicates a diagonal matrix with the elements of the vector on the main diagonal. Unless explicitly transposed, all vectors are to be intended as column vectors. The symbol $\mathbf{e}$ denotes a vector of ones, or sum vector.

The main data source used for the present the empirical exercise is the World Input-Output Database (WIOD) (Timmer, 2012),[5] which provides a times-series of square[6] industry $\times$ industry Input-Output tables at basic current (and past-year) prices for the period 1995-2009.[7] The WIOD setting consists in 40

[5] The WIOD Project has been funded by the EC as part of the 7th. Framework Programme, and it has been developed and deployed by a Consortium of European institutions from the Netherlands, Spain, Austria, Germany, Belgium, France and Greece. See http://www.wiod.org/ for details. The database can be accessed for free.

[6] The fixed product sales structure assumption has been used in the WIOD Project to obtain a square Input-Output system from a set of International Supply and Use Tables. See Timmer (2012) for details.

[7] The latest release also includes tables for 2010 and 2011. However, it does not include the socio-economic accounts and the tables at past-year prices, which are necessary for computing labour productivity. The table for 2009 from the previous release has not been used here because it is based on an update of the 2008 one. While the procedure is in general accurate, given the peculiarities of the post-crisis years using such a table could have led to misleading results.

regions,[8] with 35 industries each, obtaining $40 \times 35 = 1400$ geo-industries, with an additional residual region for the Rest of the World (RoW).[9]

The multi-regional Input-Output framework can be written as $\mathbf{Xe} + \mathbf{f}$, i.e.:

$$\begin{bmatrix} \mathbf{q}^1 \\ \vdots \\ \mathbf{q}^r \\ \vdots \\ \mathbf{q}^s \end{bmatrix} = \begin{bmatrix} \mathbf{X}^{11} & \cdots & \mathbf{X}^{1r} & \cdots & \mathbf{X}^{1s} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{X}^{r1} & \cdots & \mathbf{X}^{rr} & \cdots & \mathbf{X}^{rs} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{X}^{s1} & \cdots & \mathbf{X}^{sr} & \cdots & \mathbf{X}^{rs} \end{bmatrix} \begin{bmatrix} \mathbf{e} \\ \vdots \\ \mathbf{e} \\ \vdots \\ \mathbf{e} \end{bmatrix} + \begin{bmatrix} \mathbf{f}^{11} & \cdots & \mathbf{f}^{1r} & \cdots & \mathbf{f}^{1s} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{f}^{r1} & \cdots & \mathbf{f}^{rr} & \cdots & \mathbf{f}^{rs} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{f}^{s1} & \cdots & \mathbf{f}^{sr} & \cdots & \mathbf{f}^{ss} \end{bmatrix} \begin{bmatrix} 1 \\ \vdots \\ 1 \\ \vdots \\ 1 \end{bmatrix}$$

where s is the number of countries, $\mathbf{q}^r$ is the vector of country r's gross output, $\mathbf{X}^{rr}$ country r's matrix of inter-industry transactions, $\mathbf{X}^{r1}$ the matrix of country r's intermediate exports to country 1, $\mathbf{X}^{1r}$ the matrix of country r's intermediate imports from country 1, $\mathbf{f}^{r1}$ the vector of country r's final exports to country 1, and $\mathbf{f}^{1r}$ the vector of country r's final imports from country 1.

Hence, from country r's perspective, the matrix of intermediate imports, total exports, total imports, final demand and gross output can be computed as, respectively:

$$\begin{aligned} \mathbf{X}^r_m &= \sum_{j \neq r} \mathbf{X}^{jr} \\ \mathbf{x}^r &= \sum_{j \neq r} \mathbf{X}^{rj}\mathbf{e} + \sum_{j \neq r} \mathbf{f}^{rj} \\ \mathbf{m}^r &= \mathbf{X}^r_m\mathbf{e} + \sum_{j \neq r} \mathbf{f}^{jr} \\ \mathbf{d}^r &= \mathbf{x}^r + \mathbf{f}^{rr} \\ \mathbf{q}^r &= \mathbf{X}^{rr}\mathbf{e} + \mathbf{d}^r \end{aligned}$$

Moreover, the matrices of domestic and imported input-output coefficients are given by, respectively:

$$\begin{aligned} \mathbf{A}^{rr} &= \mathbf{X}^{rr}(\widehat{\mathbf{q}}^r)^{-1} \\ \mathbf{A}^{rj} &= \mathbf{X}^{rj}(\widehat{\mathbf{q}}^j)^{-1} \\ \mathbf{A}^{jr} &= \mathbf{X}^{jr}(\widehat{\mathbf{q}}^r)^{-1} \\ \mathbf{A}^r_m &= \sum_{j \neq r} \mathbf{A}^{jr} \\ \mathbf{A}^r &= \mathbf{A}^{rr} + \mathbf{A}^r_m \end{aligned}$$

With this notation, the expressions for the standard indicators of outsourcing in section 4 can be written as:

$$\begin{aligned} ITT_r &= (\widehat{\mathbf{A}^r\mathbf{q}^r})^{-1}\mathbf{A}^r_m\mathbf{q}^r \\ ICP_r &= (\widehat{\mathbf{q}}^r)^{-1}\mathbf{A}^r_m\mathbf{q}^r \\ ICE_r &= (\widehat{\mathbf{x}}^r)^{-1}\mathbf{A}^r_m(\mathbf{I} - \mathbf{A}^{rr})^{-1}\mathbf{x}^r \end{aligned}$$

The two basic measures used in Section are national and international vertically integrated labour, and the corresponding labour productivity changes.

Denoting by $\mathbf{a}^T_n = [\mathbf{a}^{rT}_n]$ $(r = 1, \ldots, s)$ the vector of direct labour coefficients, the vector of vertically integrated labour coefficients for each country r is given by:

$$\mathbf{v}^{rT} = [v^r_i] = \mathbf{e}^T\widehat{\mathbf{a}}^r_n(\mathbf{I} - \mathbf{A}^{rr})^{-1} = \mathbf{e}^T\mathbf{V}^r$$

[8] The 40 regions included are: each of the EU27 countries, US, Canada, Mexico, Brazil, China, India, Japan, South Korea, Australia, Taiwan, Turkey, Indonesia and Russia.

[9] The Multi-regional Input-Output accounting framework provided by this database conforms to the methodology discussed in Garbellini et al (2014).

Each column of matrix $\mathbf{V}^r$ represents the corresponding expanded vertically integrated labour coefficient, disaggregated by industry of origin.

In the same way, the vector of international vertically integrated labour coefficients is given by:

$$\mathbf{v}^T = [v^{i,r}] = \mathbf{e}^T \widehat{\mathbf{a}}_n (\mathbf{I} - \mathbf{A})^{-1} = \mathbf{e}^T \mathbf{V}$$

where

$$\mathbf{A} = \mathbf{X}\widehat{\mathbf{q}}^{-1}$$

and each column of matrix $\mathbf{V}$ is the corresponding expanded vertically integrated labour coefficient, disaggregated by industry and country of origin.

Though the analytical expressions for the national and international vertically integrated labour coefficients is formally analogous, the meaning of the two sets of indicators is different. While v_i^r (vertically integrated labour for subsystem i in country r) is the quantity of country i's labour directly and indirectly necessary to produce one unit of commodity i as final demand—including intermediate exports—$v^{i,r}$ (vertically integrated labour for subsystem $\{i, r\}$) is the quantity of labour directly and indirectly needed, *independently of the country of origin*, for country i to deliver one unit of commodity i as a *final consumption and investment commodity only*. In other words, while in the first case production chains are vertically integrated throughout industries but *within* national borders, in the second case subsystems are vertically integrated *both* throughout industries *and* national borders.

Finally, labour productivity changes are computed as:

$$\varrho_{i,t}^r = \frac{\varrho_{i,t}^r - \varrho_{i,t-1}^r}{\varrho_{i,t-1}^r}$$

$$\varrho_t^{i,r} = \frac{\varrho_t^{i,r} - \varrho_{t-1}^{i,r}}{\varrho_{t-1}^{i,r}}$$

It can be shown[10] that when labour coefficients are computed using tables at constant prices, changes in labour productivity does not depend on relative prices.

Acknowledgements I wish to thank Andrea Salanti and Joseph Halevi for useful discussions, as well as the participants to the IIOA conference in Lisbon. Usual disclaimer applies.

[10] See Garbellini and Wirkierman (2014) for a formal proof.

Table 12: Classification of activities by technological group

Technological group	Code	Short description	Description
agro	AtB	Agriculture	Agriculture, Hunting, Forestry and Fishing
const	F	Construction	Construction
hitech	24	Chemicals	Chemicals and Chemical Products
	29	Machinery nec	Machinery, Nec
	30t33	Optical Equipm.	Electrical and Optical Equipment
lowtech	19	Leather	Leather, Leather and Footwear
	20	Wood	Wood and Products of Wood and Cork
	15t16	Food	Food, Beverages and Tobacco
	17t18	Textiles	Textiles and Textile Products
	21t22	Paper, Printing	Pulp, Paper, Paper , Printing and Publishing
	36t37	Manufacturing nec	Manufacturing, Nec; Recycling
medtech	25	Rubber and Plastics	Rubber and Plastics
	26	Non-Metal Mineral nec	Other Non-Metallic Mineral
	27t28	Basic, Fabr.Metal	Basic Metals and Fabricated Metal
minengy	23	Coke, Ref.Petr	Coke, Refined Petroleum and Nuclear Fuel
	C	Mining	Mining and Quarrying
	E	Electricity, Gas, Water	Electricity, Gas and Water Supply
tertiary	50	Trade: Vehicles	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
	51	Wholesale Trade	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
	52	Retail Trade	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
	60	Inland Transport	Inland Transport
	61	Water Transport	Water Transport
	62	Air Transport	Air Transport
	63	Auxiliary Transp. Act.	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
	64	Post and Telecomm.	Post and Telecommunications
	70	Real Estate	Real Estate Activities
	71t74	Renting of M&Eq	Renting of M&Eq and Other Business Activities
	H	Hotels, Restaurants	Hotels and Restaurants
	J	Financial Intermediation	Financial Intermediation
	L	PA and Defence	Public Admin and Defence; Compulsory Social Security
	M	Education	Education
	N	Health	Health and Social Work
	O	Social Services	Other Community, Social and Personal Services
	P	Private HH	Private Households with Employed Persons
vehicles	34t35	Transport Equipm.	Transport Equipment

References

Ayhan Kose M, Yi K (2001) Trade and business cycles: Is vertical specialization the missing link? The American Economic Review 91(2):371–375

Bems R, Johnson R, Yi K (2010) Demand spillovers and the collapse of trade in the global recession. IMF Economic Review 58(2):295–326

Bems R, Johnson R, Yi K (2011) Vertical linkages and the collapse of global trade. American Economic Review: Papers and Proceedings 101(3):308–312

Breda E, Cappariello R (2012) A tale of two bazaar economies: an input-output analysis of germany and italy. Economia e Politica Industriale 39(2)

Dietzenbacher E (2010) Vertical specialization in an intercountry input-output framework. Lett Spat Resour Sci 3:127–136

Egger H, Egger P (2003) The impact of outsourcing and high-technology capital on wages: estimates for the united states, 1979-1990. Applied Economics Quarterly 1(49):49–64

Feenstra R, GH H (1996) Globalization, outsourcing, and wage inequality. AEA Papers And Proceedings 2(86):240–245

Feenstra R, GH H (1999) The impact of outsourcing and high-technology capital on wages: estimates for the united states, 1979-1990. Quarterly Journal of Economics 3(114):907–940

Garbellini N, Wirkierman A (2014) Productivity accounting in vertically (hyper-)integrated terms: Bridging the gap between theory and empirics. Metroeconomica 65(1):154–190

Garbellini N, Marelli E, Wirkierman A (2014) Domestic demand and global production in the eurozone: A multi-regional input-output assessment of the global crisis. International Review of Applied Economics (forthcoming)

Hummels J Dand Ishii, Yi K (2001) The nature and growth of vertical specialization in world trade. Journal of International Economics 54:75–96

Johnson R (2012) Trade in intermediate inputs and business cycle comovement. Working Paper 18240, NBER

Johnson R, Noguera G (2012) Accounting for intermediates: Production sharing and trade in value added. Journal of International Economics 86:224–236

Koopman R, Powers W, Wang Z, Wei S (2010) Give credit where credit is due: Tracing value added in global production chains. Working Paper 16426, NBER

Leontief W (1953) Interregional theory. In: Studies in the Structure of the American Economy — Theoretical and Empirical Explorations in Input-Output Analysis, Oxford University Press

Leontief W, Strout A (1963) Multiregional Input-Output Analysis. In: Barna T (ed) Structural Interdependence and Economic Development, St-Martin's Press, New York, pp 119–150

Meng B, Inomata S (2009) Production networks and spatial economic interdependence: An international input-output analysis of the asia-pacific region. IDE Discussion Paper 185, Institute of Developing Economies

Meng B, Yamano N, Webb C (2011) Application of factor decomposition techniques to vertical specialisation measurements. IDE Discussion Paper 276, Institute of Developing Economies

Pasinetti LL (1973) The notion of vertical integration in economic analysis. Metroeconomica 25:1–29

Rampa G (1986) Effetti reali dell'integrazione fra italia e resto della cee. Studi e Informazioni 3:101–116

Rampa G, Bertoletti P (1990) Integrazione, interdipendenza e vincolo estero in un modello multiregionale per la cee. In: Cimoli M, Musu I (eds) Cambiamento strutturale ed asimmetria nell'economia italiana, F. Angeli, Milano, pp 313–372

Rampa G, Lanza A (1988) A model for assessing the growth opportunities of eec countries when interdependence is not ruled out. In: Ciaschini M (ed) Input Output Analysis: Current Developments, Chapman & Hall, London, pp 367–390

Timmer M (ed) (2012) The World Input-Output Database (WIOD): Contents, Sources and Methods, wIOD Working Paper Nro. 10, available at: http://www.wiod.org

Wang Z, Powers W, Wei S (2009) Value chains in east asian production networks — an international input-output model based analysis. Working Paper 2009-10-C, U.S. International Trade Commission