October 6, 2006
First draft

Quantifying the productivity counterpart of outsourcing in the Italian manufacturing industries

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We quantify the extent of domestic and international outsourcing in the Italian manufacturing sector using recently released symmetric input-output tables. We also evaluate the productivity counterpart of our and previous outsourcing indicators. Our empirical analysis indicates that only the international outsourcing of intermediates is positively related to productivity growth, while the other forms of outsourcing are not robustly related to productivity growth. It also turns out that the results obtained from our indicator of outsourcing are quite different from those arising from the commonly used Feenstra-Hanson measures of outsourcing.

This paper was prepared for the OECD Productivity Workshop to be held in Bern (October 16-18, 2006). Francesco Daveri gratefully acknowledges funding from the University of Parma and MIUR.

1. Introduction

In the US, both domestic and international outsourcing of services and intermediate activities on the part of manufacturing firms has been at the center-stage of the political arena. Concern has in particular been raised that outsourcing "has gone too far" creating more hardships than necessary for low-skill workers in the US labor market over the last few years.[1] Yet the prominently electoral worries have somehow overlooked that the very reason that pushes a company to delocalize is its search for efficiency gains. And indeed, in parallel with its potentially adverse implications for blue-collar employment, the offshoring of activities has probably been a crucial ingredient to enable the American economy to take full advantage of the potential gains brought about by the celebrated IT revolution. Among others, Amiti and Wei (2006) have provided evidence that both offshoring of services and of material inputs are associated with productivity gains.

The evidence for European countries is more scant. For UK firms, Girma and Gorg (2004) and Criscuolo and Leaver (2005) find that there is a positive relationship between international outsourcing and both labor productivity and total factor productivity growth at the establishment level. Additional evidence is available for the Netherlands, Denmark, and Austria as well (Griffith et al (2005), and Jensen et al (2006)).

Italy was largely missing from previous research on this topic. Exceptions are Helg and Tajoli (2005), who, however, did not investigate the issue as such and restricted their attention to the relation between outward processing of inputs to be re-exported back to the country of origin and labor demand. Yet the potential productivity gains of outsourcing activities within or outside the domestic borders go well beyond that and involve such diverse things as the contracting out of engineering and drafting as well as accounting, computer and janitorial services, which are not included in a narrow measure of off-shoring activities. It is therefore useful to provide a more comprehensive picture of the phenomenon at hand.

Moreover, this seeming lack of attention is a shame for the analysis of Italy's data provides interesting insight. For sure, the picture for Italy may be seen as mirroring in reverse the American or the UK picture. First, in the last few years, as documented in a number of studies,[2] Italy has been on a declining productivity path. Second, very little IT diffusion has occurred in Italy so far. Third, the little diffusion that has occurred took place well into the 2000s. This immediately gives us a

[1] Offshoring was a particularly hot topic in the Bush vs. Kerry Presidential election. It was so hot that a mere and - with hindsight – commonsensical sentence on the part of Gregg Mankiw, well known Harvard economist and then Chief of the Council of Economic Advisers, was enough to trigger a fierce debate on this topic.

[2] A recent detailed study with industry data is in Daveri and Jona-Lasinio (2005). Other studies include Bassanetti, Iommi, Jona-Lasinio and Zollino (2004), where evidence has been provided on aggregate and industry productivity developments in the Italian economy, with the goal of computing the growth contributions of the different factors of production.

working hypothesis: given productivity stagnation and little IT diffusion, we expect to see in the data that little outsourcing and, to an even greater extent, off-shoring has taken place as well. Moreover, the little or much we see should be in the 2000s and not before then.

In other words, the undertaking we are after is to document whether outsourcing occurred on a commensurately smaller scale in Italy compared to other countries. This is not the only possibility, though: another, perhaps more puzzling, option would be that delocalization did occur in Italy against all odds but it has not brought about the expected productivity gains. This would open the question of why this was the case. In both cases, useful lessons may be learned for other countries as well.

To answer these questions, we take advantage of a data set inclusive of symmetric input-output (I-O onwards) tables to present industry evidence on the extent of domestic and international outsourcing in the Italian manufacturing industries. Then we contrast our direct measures of outsourcing with industry productivity growth data.

Compared to previous studies, our empirical analysis has a methodological twist of novelty, though, for we quantify outsourcing and off-shoring using *direct* data on imported and domestically produced goods and services. This is preferable than using the Feenstra and Hanson (1999; FH from here onwards) methodology employed in previous studies. The FH method of computing international outsourcing assumed that any manufacturing industry would resort to intermediates or services in the same proportion. On the other hand, by means of symmetric I-O tables, we do not have to rely on such restrictive assumptions and can thus provide evidence of the extent of the bias in the calculation of outsourcing and off-shoring entailed by the FH methodology.

Providing a direct measure without having to rely on untested assumptions is a useful undertaking in itself. But the real meat of our paper is in its econometric part, where we compute the partial correlation of our constructed measures of outsourcing with productivity growth. We do that through industry value added per worker regressions where the growth rate of value added per full time equivalent employed is regressed on a set of industry and period fixed effects, a catching up variable, R&D spending shares and outsourcing indicators. As a result, the estimated coefficients of outsourcing and off-shoring capture the partial correlation between these variables and the growth of labor productivity.

We find that (1) as expected, not all manufacturing industries outsource production to the same extent either inside or outside the country; (2) again in line with expectations, off-shore outsourcing took off in 1999-2003, not before; (3) only the international outsourcing of intermediates is positively related to productivity growth, while the other forms of outsourcing are not robustly related to productivity growth; (4) the results obtained from our indicator of outsourcing are quite different from those arising from the commonly used Feenstra-Hanson measures of outsourcing.

The structure of the paper is as follows. In section 2, we describe the data, we provide evidence of outsourcing in the Italian manufacturing industries and we compare our estimates with those obtained according to Feenstra-Hanson methodology. In section 3, the model specification and the empirical results are presented while section 4 concludes

2. Measurement and facts on outsourcing in the Italian manufacturing industries

2.1 Measurement issues

Definition "Outsourcing" is the purchase of intermediates and services outside a manufacturing company which were previously performed by in-house employees. In turn, outsourcing may take place in various guises, within or outside the country. If the outsourced inputs or services are produced outside the country, this is labeled "off-shoring" (or "off-shore outsourcing").[3]

Data Our basic data source consists of Italian symmetric input-output tables (industry by industry matrix) obtained rearranging both supply and use tables in a single matrix with identical classification of industries (or products respectively) applied for both rows and columns. The input-output tables are at basic prices, at the 60-sector level (according to the NACE Rev1.1 classification) for years 1995-2003[4]. We start from the 60-industry tables and aggregate them to thirty-industries, thus including fourteen manufacturing industries, so as to make them compatible with published productivity and R&D data. This enables us to present industry evidence over 1995-2003 on the extent of both internal and international outsourcing of intermediates and market services as well as their productivity counterpart for Italy's manufacturing industries. Intermediate purchases is obtained adding up the purchases of each industry i from the other manufacturing industries inclusive of industry *i*. Purchases of market services includes the purchases of each manufacturing industry from market service providers that belong to "transports, storage and communications", "finance and insurance", "real estate and other business services". A finer disaggregation of services will be provided in the next draft of this paper.

[3] The trade-related aspects of outsourcing have also attracted increasing attention in the literature. In line with traditional trade theory most papers find that international outsourcing (moving low skill intensive production to low skill abundant countries) leads to increased demand and increases in the wage premium for high skilled workers in the US and the UK. Egger and Egger (2001) investigate the effect of outsourcing on the productivity of low skilled labour in the EU using industry level data. They find that increases in outsourcing have a negative effect on low skilled labour productivity in the short run, but a positive effect in the long run. In this paper we are not concerned with the international trade dimension of outsourcing.

[4] Istat (2006)

Measurement methods As mentioned in the introduction, our empirical analysis has a methodological twist of novelty compared to previous studies, for – thanks to symmetric I-O tables - we are able to quantify domestic and international outsourcing using *direct* data on imported and domestically produced goods and services. This is at variance with most studies undertaken before (the only exception being the exercise by Bracci, 2006) where the international component of outsourcing was only indirectly measured from standard input-output tables where the imported and the domestically produced components of the various inputs were not separately accounted. Absent primary information on imported inputs, standard practice is the methodology of Feenstra and Hanson (1999; FH from here onwards). According to the FH methodology, the international outsourcing (or offshoring) of, say, manufacturing intermediates of the electronics industry would be equal to the share of the various intermediate purchases of electronics from other manufacturing industries over total non-energy input purchases of electronics corrected by the import share of each intermediate over total absorption *for the entire economy*. Hence this definition embodies the hard-to-swallow assumption that any manufacturing industry would resort to intermediates to the same extent in a particular year. The same would clearly apply when international outsourcing of services is to be computed.

Symmetric I-O tables obtained from Supply and Use tables permit to distinguish between imported and domestic purchased intermediate inputs thus allowing to directly imputing international and domestic outsourcing. Therefore our evidence is not based on such restrictive assumptions and we can also provide an indication of the extent of the bias in the outsourcing measures obtained according to the indirect methods. As shown below, it is not nil.

In the end, we measure domestic outsourcing as the share of domestically produced intermediate inputs (or market services) over total non-energy inputs bought by any given industry. By the same token, international outsourcing is instead the share of imported intermediate inputs (or market services) over total non-energy inputs.

2.2 Facts on outsourcing in Italy's manufacturing

As recently documented in Daveri and Jona-Lasinio (2005), since 1995, the Italian economy has displayed disappointing productivity trends, both in manufacturing and services. Actually, in the last ten years, the decline has been particularly abrupt for manufacturing. This is at odds with the former decade: the mild (with today's eyes) productivity slowdown in the 1970s was mainly driven by the productivity slowdown in market services (and construction), with labor productivity in manufacturing steadily growing at solid rates (3% per year or so).

Manufacturing productivity growth first declined to one per cent per year in 1995-2000 and then turned negative by one percentage point in 2000-2003, with the data for the more recent years (2004 and 2005) confirming such negative trends.

This is startling for such a declining path manifested itself rather uniformly in the whole manufacturing sector, although slightly scattered around over time. In 1995-2000, labor productivity growth fell first and substantially in non-durable goods industries from 3.1% to 0.7%, while labor productivity for durable producers slowed down just a bit (from 2.7% to 1.7%). In the more recent years, productivity growth collapsed for durable producers as well (-2.7% in 2000-2003) and further slowed down by another percentage point for non-durable producers (from 0.7% to -0.2%).

Non-durable production includes textiles, wearing and leather – all landmarks of the "Made-in-Italy" production. If the productivity of non-durable producers declines, this is particularly worrisome, because fast-growing productivity is the only means to restore profits and maintain jobs in such industries threatened by low-cost production from Asia and Eastern Europe.

Durable production, in turn, is meant to be the most likely vehicle of introduction of technical change and new modes of production (and therefore the industry with the potentially highest productivity growth rate). Depending on the availability of such things as human capital, R&D investment and the like, we may expect to see these industries to make a bigger or a smaller share of value added and employment in a given country. But they are anyway supposed to grow fast, no matter what. If this is not the case (and the negative productivity growth rate of about 3% per year in 2000-03 indicates that this is really not being the case in Italy), there are good reasons to be worried. Moreover, this contrasts with secular growth rates in these industries in the order of (positive) three per cent per year in the 1970s and the 1980s through 1995.

In 1995-2003, manufacturing total factor productivity (TFP) declined by about half a percentage point per year, equally for non-durable and durable producers, and not too dissimilarly from constructions and market services. Such a decline was particularly sizable for the industries producing non-durable goods in 1995-00: in these industries, TFP growth fell to -0.2% per year in 1995-2000 from +1.9% in 1980-95. TFP growth stayed instead roughly constant at about +1.3% in 1995-2000 for durable producers, but then markedly fell to -3.4% in 2000-03. This scattered timing of declines quite closely matches labor productivity developments in these industries.

Non-durable goods producing industries include producers of consumer and intermediate goods, with the production of intermediates (notably chemicals and pharmaceuticals) being the fastest growing industries in the Italian economy in 1980-95. This was no longer the case in 1995-03, when TFP growth zeroed in chemicals (from 6% in the previous years). More generally, the growth debacle has been striking in all the Made-in-Italy consumer industries, such as “Textiles and Wearing”, “Leather, leather products and Footwear”, “Wood and wood products”, although timing and intensity of the growth reduction was somehow different in the various industries. The decline in “Leather and Footwear” has been unusually abrupt in 1995-00 (falling to -1.7%, from 2.5% in 1980-95) and much deeper than in the other “Made-in-Italy” industries in 2000-03, where a decline of 4.3% per year was recorded.

In industries producing durable goods, as mentioned above, TFP kept growing in the second half of the 1990s, but then it fell more dramatically than in the rest of the manufacturing sector in the first years of the 2000s. In the production of machinery and equipment (which includes many of the industries traditionally classified among the high-tech industries), TFP fell by 4.4% per year in 2000-03 – a cumulated decline of about 14% in three years. This was mainly driven by the negative 6.4% per year in the production of electrical and optical equipment – the industry including, among other things, the production of personal computers and cellular phones (whose diffusion has, in contrast, proceeded at a very fast pace over this period).

In many such industries, capital-labor ratios increased faster than labor productivity, in parallel with sharp TFP declines. This is consistent with the aggregate evidence of rising value added shares of capital and rising capital-output ratios. The steadiness in the growth of capital-labor ratios in non-durable and durable manufacturing throughout 1995-2003 is particularly striking. In this period of time, in these industries the growth of labor productivity zeroed or became negative, but the capital-labor ratios continued to grow at about the same rates as in 1995-00 and 1980-95. This applies to textiles, leather and footwear and chemicals. All of these industries are examples of particularly abrupt declines in TFP growth and particularly sharp increases in the value added share of capital; in these industries, however, capital-labor ratios continued to grow by 3-4% per year, slightly - but only slightly - below the growth rates in 1980-95.

Now, to add some evidence to this picture, let’s see to what extent these industries outsourced their activities in the same period. Table 1-4 presents our evidence on the degree of domestic (Table 1 and 2) and international (Table 3 and 4) outsourcing for fourteen manufacturing industries and for an average manufacturing industry in the Italian economy.

Let’s consider Italy’s average manufacturing industry first. As of 2003, the latest year for which data are available, this archetypal industry would respectively buy domestically produced and imported intermediate inputs for 37.5% and 22.6% of its total non-energy inputs. For this archetypal industry, the domestic outsourcing of intermediates has been declining between 1995 and 2003, going down from 41.9% to 37.5% of total inputs. In 1999-2003, textiles and clothing (-5.2%), chemicals (-8.7%) and rubber and plastic (-3.9%) account for most of the slowdown of domestic outsourcing of intermediate inputs. But at the same time, these industries are responsible for the slightly growing intensity of international outsourcing that mildly gone up from 22% (in 1995) to 22.6% (in 2003) of total input purchases.

As to market services, Italy's average manufacturing industry kept buying more and more services outside the boundaries of the firm and the industry. Both domestic and international outsourcing intensities increased over the sample period with higher growth rates for domestic outsourcing at an average rate of 3.4%, compared to 0.4% for international outsourcing.

2.3 Comparing our measure with other measures of outsourcing

The FH measure

The measure of offshore outsourcing provided by Feenstra-Hanson (FH onwards) is the most commonly used in the literature (Olsen, 2006). Their measure is obtained as the share of imported intermediate inputs over total costs (Feenstra-Hanson, 1996 and 1999). Starting from this index they get a *narrow* measure of outsourcing by considering only those inputs that are purchased from the same industry as the good being produced. Then they calculate what they call *differential outsourcing* as the difference between their broad and narrow outsourcing measures. So far these outsourcing measures have been the most widely used by the empirical literature because import data by industry were not accessible. In this paper, we calculate, for the first time in Italy, direct measures of domestic and international outsourcing using imported and domestic symmetric I-O tables.

The broad outsourcing measures of FH and our outsourcing indexes for material and service inputs are highly correlated (0.6 on average). This means that they provide the same type of information. However FH shares are systematically lower than our measures. It may be the case that, indirect measures of outsourcing, obtained applying the same import share to all industries, provide an underestimated measures of the phenomenon.

Measures of international fragmentation of production

Our pieces of evidence can also be compared with the available evidence on the international fragmentation of production (IFP) provided by Helg and Tajoli (2005). They employ a finer industry breakdown. But the thrust of their results may anyway be compared to ours.

What do IFP data on Italy tell us?

There is a group of so-called traditional sectors (namely textiles, apparel, shoes and to a smaller extent furniture), where production phases have become increasingly diversified in terms of factor intensity, and for which unskilled labor is the main factor of production in at least one phase. These are the sectors most subject to international fragmentation. In Germany, the practice to process abroad a large share of apparel production (code 18) started more than a decade ago, and re-imports of apparel amounted to more than 25% of domestic production in 1996, i.e., more than a quarter of German apparel was processed abroad. In Italy, the apparel sector is also the most affected, even if to a much smaller extent. In both countries, over time it is possible to observe an increase in the use of outward processing trade (OPT) in a number of sectors, with the particularly evident case of the apparel industry (code 18). In Italy, upward trends in the relevance of OPT also characterize textiles (code 17) and footwear (code 19), while in Germany the latter has reduced OPT.

The second group for which OPT is relevant is composed of relatively advanced industries: office machinery, communication equipment, precision instruments, and transport equipment. The reasons for IFP in these industries are probably different than in the traditional sectors. Here too, some production phases – such as assembly – have become increasingly standardized and more intensive in unskilled labor. But in these advanced sectors, fragmentation could also be driven by technological differences among countries and by technological inter-linkages, rather than by factor-cost differentials. In both Italy and Germany, the communication equipment industry is the most involved in the use of IFP within this second group, showing an increasing trend in OPT until the mid-1990s, but a slowdown in the last year of the sample.

3. Domestic and international outsourcing and productivity growth in Italy

3.1 Empirical specification

To evaluate the productivity counterpart of outsourcing we estimate a panel regression that relates the growth rate of value added per full-time equivalent employed worker in industry i at time t ($GROWTHLP_{it}$; with i=1,..14; t=1995, ..,2003) to a set of industry and period fixed effects, the growth rates of the industry capital labor ratios ($GROWTHKL_{it}$) as well as our variables of interest, domestic and international outsourcing of intermediates and services as follows:

$$GROWTHLP_{it} = \gamma\left(GROWTHKL_{it}\right) + aI_i + bT_t + \beta_m^d \Delta\left(OSM^d\right)_{it} + \beta_s^d \Delta\left(OSS^d\right)_{it} + \beta_m^f \Delta\left(OSM^f\right)_{it} + \beta_s^f \Delta\left(OSS^f\right)_{it} + e_{it}$$

In the equation above, “OSS” is for outsourcing of services, “OSM” for outsourcing of intermediates, “d” for domestic, “f” for international (foreign).[5] We measure outsourcing as indicated in the descriptive section. For comparative purposes, we also provide estimates à la Feenstra-Hanson.

[5] This specification follows from decomposing the growth rate of value added per worker as the product of two terms: the marginal product of capital and the GDP share of investment. Under diminishing returns to capital, the marginal product of capital is a declining function of the initial level of labor productivity. If the scale parameter in the production function is a function of outsourcing, then the growth rate of labor productivity is also a function of the change in outsourcing. As long as R&D spending raises TFP, the marginal productivity of capital is a function of R&D investment shares.

The equation above is an attempt of estimating the determinants of productivity within the production function framework. As usual, labor productivity enhancements are the result of two factors. The first of them is capital accumulation: the contribution of capital accumulation to labor productivity growth is brought about by higher marginal productivity of capital and higher capital-labor ratios. The second contribution to labor productivity growth is due to improved methods of production (as captured by total factor productivity, TFP from here onwards). The TFP growth component is thus the right-hand side of the equation above, inclusive of the white noise error term.
TFP growth is higher the faster the pace of technological progress. The presence of the industry fixed effects (I_i) in a productivity growth regression is indeed motivated by the fact that technological improvements are sharply different across the manufacturing industries.
But year-to-year variation of productivity growth rates may not originate from production function shifts or shifts along the production function and instead be business cycles fluctuations hich often cause companies to engage in labor hoarding. This is why the equation above also includes a set of time-varying common factors (the period fixed effects T_t) that affect the various industries to the same extent.
In the specification above, TFP growth is also affected by outsourcing. Outsourcing may increase efficiency for both compositional and structural reasons. If a firm delegates to some other firm within or outside its industry of operation, inside or outside the country, this is usually done with the goal of relocating the inefficient parts of its production process. If this is the case, there are gains to be reaped in terms of the bigger output produced by the average worker left behind in the firm of origin. This is a compositional effect. Moreover, outsourcing may also enable more fundamental reorganization of production that may result in higher productivity if the external provision of intermediates or services takes place reducing costs of production through, say, the improved access to new or cheaper inputs for the company or better accounting and monitoring techniques enabled by the adoption of ICT.
On impact, however, it may well be that neither the compositional nor the structural gains from delegated production are enough to offset transitional adjustment costs (resulting in waste and X-inefficiency). If this is the case, then the estimated coefficients of outsourcing variables may turn out negative in a regression relating the growth rate of labor productivity to its determinants.
In addition to the ones discussed before, the regression above also involves another important interpretation issue that has to do with the likely endogeneity of outsourcing. Firms with a high growth of labor productivity may be more likely to be well endowed enough to engage in the coordination costs entailed by outsourcing. Hence a positive estimated coefficient between

outsourcing and productivity growth may not be telling us anything about the TFP growth effect of outsourcing, but rather that more dynamic firms are more likely to engage in outsourcing.

Yet the reverse causation may also be negative. Only firms in distress may find the necessary impetus to face the radical changes brought about by splitting production processes across firms and/or countries.

Given the likely endogeneity of outsourcing, we experiment with lagged values of the same variables so as to lessen this shortcoming. Wit the same goal, in some specifications, we will also be interacting outsourcing variables with the GDP share of R&D investment lagged twice. The underlying idea is that the potential scope for productivity improvement is more likely reaped if it is undertaken in parallel with a more general innovation effort, of which R&D investment is a measure.[6] We explore this possibility in our regression analysis.

Finally, in principle, one does not expect to see the estimated coefficients of outsourcing-related variables to be systematically different depending on whether outsourcing takes place within or outside the borders of a country. If it is the mere act of delocalizing that is supposed to have a productivity counterpart, this may materialize from delocalization towards anywhere. Yet we allow for the coefficients of the various outsourcing variables to differ so as to eventually test for their equality.

3.2 Results

Table 5 presents the main results obtained from estimating the equation above with both OLS and WLS methods of estimation.

The reason to try both methods is that OLS estimates give equal weight to all observations, thus granting a disproportionate weight to a very small and very volatile industry such as “Coke and refined petroleum products”. Using WLS, with industry value added as weights, is a way to check that our results are not unduly influenced by what happens to this small industry. In the end, we regard WLS estimates as our preferred estimates.

Our regression explains about 50% of the total variance, with both industry and period fixed effects always statistically significant. The capital-labor ratio coefficient is the most precisely estimated and varies between .3 and .45. We are aware that the growth of the capital-labor ratio should be instrumented. It is in fact well known that such a variable is affected by TFP changes, which makes one of the crucial assumptions of the classical linear regression model to break down. This will be carried out in a second draft of this paper. For the time being, we simply report our partial

[6] R&D is supposed to be associated with innovation and innovation, in turn, with TFP growth (see for instance the firm-level evidence in Griffith, Huergo, Mairesse and Peters (2005) on France, Germany, Spain and the UK).

correlations and note that the – biased - estimates of the value added share of capital is not too far from what commonsense (namely: growth accounting) would predict.

So much is for the (limited) set of control variables we allowed for in our baseline regression. Next we take a look at the results for outsourcing.

In the first two columns of Table 5, we report the estimated coefficients of our preferred measures of outsourcing, while the estimates from the same specification using the Feenstra-Hanson measures of outsourcing are reported in column 3 and 4. Results are quite different from each other, depending on the indicator adopted. In column 1 and 2, the international outsourcing of intermediates is negatively related to productivity growth, while the coefficient of domestic outsourcing of intermediates is not different from zero. As to the outsourcing of market services, domestic outsourcing of services is negatively related to productivity growth, while the coefficient of international outsourcing of services is statistically equal to zero. This holds for both WLS and OLS. When it comes to FH measures of offshoring of services and intermediates, the coefficients previously equal to zero in column 1 and 2 become statistically significant and positive.

Yet the pattern of contemporaneous correlation may somehow mix up, in addition to the possible efficiency-enhancing effect of outsourcing, the potential reverse causation previously discussed. The estimated negative coefficients may well imply that the least dynamic firms engage in more outsourcing, particularly domestically.

This is why we checked whether the pattern of partial correlation changes when moving to lagged variables. And it does: in column 5 and 6, all the outsourcing variables are now statistically insignificant with the notable exception of the international outsourcing of intermediates, whose estimated coefficient is about .10 both with WLS and OLS. Interestingly, though, when the FH measures of offshoring replace ours in the statistical analysis, this changes the pattern of correlation once again. The international outsourcing of intermediates becomes once again negative while the international outsourcing of services is now statistically positive.

Finally, we tested whether interacting R&D spending with outsourcing tends to reinforce (or weaken) the coefficients estimated in the previous regressions. In general, results are weakened. The only statistically significant coefficients are those relative to domestic outsourcing of intermediates. Yet this result holds with WLS but not with OLS.

4. Conclusions

In this paper, we have attempted to carry out two tasks. The first one is to quantify the extent of domestic and international outsourcing in the Italian manufacturing sector using recently released symmetric input-output tables. But we also made a first attempt to evaluate the productivity counterpart of our and previous outsourcing indicators. Although our results appear rather unstable across specifications, the empirical estimates we regard as most plausible tend to show a clear pattern that we aim to further substantiate in future work. Our empirical analysis indicates that outsourcing of intermediates is the only component of outsourcing to be positively related to productivity growth, while the other forms of outsourcing are not robustly related to productivity growth. Interestingly enough, it also turns out that the results obtained from our indicator of outsourcing are quite different from those arising from the commonly used Feenstra-Hanson measures of outsourcing.

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Table 1: Domestic outsourcing of intermediate products in Italy's manufacturing industries						
% points	1995	1999	2003	Δ(1995-99)	Δ(1999-03)	Δ(1995-03)
Food products and tobacco	26.8	26.1	25.6	-0.7	-0.5	-1.1
Textiles and clothing	53.1	49.0	43.8	-4.2	-5.2	-9.3
Leather and footwear	54.3	52.4	49.5	-1.9	-2.9	-4.8
Wood and wood products	52.9	52.8	50.6	-0.1	-2.2	-2.3
Paper, printing and publishing	37.5	36.3	33.9	-1.2	-2.4	-3.5
Coke and refined petroleum products	22.2	21.7	14.7	-0.5	-6.9	-7.5
Chemicals and chemical products	32.9	33.2	24.5	0.2	-8.7	-8.5
Rubber and plastic products	39.8	39.9	36.0	0.2	-3.9	-3.8
Other non-metallic mineral products	39.2	37.1	37.4	-2.1	0.3	-1.8
Basic metals and fabricated metal products	45.7	44.3	43.3	-1.4	-1.0	-2.4
Machinery and equipment n.e.c.	55.7	53.3	51.5	-2.4	-1.7	-4.2
Electrical and optical equipment	32.9	31.3	29.0	-1.6	-2.3	-3.9
Transport equipment	47.6	43.8	40.9	-3.8	-2.9	-6.7
Other mnfg. industries	45.5	47.2	44.7	1.7	-2.5	-0.8
Average manufacturing industry	**41.9**	**40.6**	**37.5**	**-1.3**	**-3.1**	**-4.3**
Source: own calculation from ISTAT – National Accounts						

Table 2: International outsourcing of intermediates in Italy's manufacturing industries						
	1995	1999	2003	Δ(1995-99)	Δ(1999-03)	Δ(1995-03)
Food products and tobacco	8.5	8.5	9.3	0.0	0.8	0.8
Textiles and clothing	17.3	17.7	20.9	0.4	3.2	3.6
Leather and footwear	16.2	16.2	20.4	0.0	4.1	4.1
Wood and wood products	15.0	13.9	14.7	-1.1	0.8	-0.3
Paper, printing and publishing	21.5	18.2	18.0	-3.4	-0.1	-3.5
Coke and refined petroleum products	29.5	16.1	32.5	-13.5	16.4	2.9
Chemicals and chemical products	40.9	38.3	44.5	-2.5	6.1	3.6
Rubber and plastic products	29.9	27.3	29.1	-2.7	1.8	-0.8
Other non-metallic mineral products	11.9	10.6	10.0	-1.3	-0.6	-1.9
Basic metals and fabricated metal products	23.6	21.2	20.9	-2.4	-0.3	-2.7
Machinery and equipment n.e.c.	14.1	14.4	15.0	0.3	0.6	0.9
Electrical and optical equipment	32.3	30.5	31.0	-1.8	0.5	-1.4
Transport equipment	24.5	26.9	29.3	2.4	2.4	4.8
Other mnfg. industries	22.2	18.5	21.1	-3.7	2.6	-1.1
Average manufacturing industry	**22.0**	**19.9**	**22.6**	**-2.1**	**+2.7**	**0.7**
Source: own calculation from ISTAT - National Accounts						

Table 3: Domestic outsourcing of market services in Italy's manufacturing industries						
	1995	1999	2003	Δ(1995-99)	Δ(1999-03)	Δ(1995-03)
Food products and tobacco	9.8	11.8	14.0	2.0	2.3	4.2
Textiles and clothing	11.2	13.4	15.4	2.2	2.0	4.2
Leather and footwear	12.4	13.6	13.2	1.1	-0.4	0.8
Wood and wood products	14.6	15.8	18.0	1.2	2.2	3.4
Paper, printing and publishing	17.8	20.1	21.9	2.3	1.9	4.1
Coke and refined petroleum products	18.4	30.1	26.3	11.7	-3.8	7.9
Chemicals and chemical products	10.9	12.4	14.3	1.5	1.9	3.4
Rubber and plastic products	13.9	15.9	18.2	2.0	2.3	4.3
Other non-metallic mineral products	20.4	21.8	23.0	1.3	1.2	2.6
Basic metals and fabricated metal products	14.7	18.0	19.0	3.4	0.9	4.3
Machinery and equipment n.e.c.	13.9	15.9	16.8	2.0	0.9	2.8
Electrical and optical equipment	12.5	14.3	14.7	1.8	0.4	2.2
Transport equipment	12.3	13.4	13.5	1.1	0.1	1.2
Other mnfg. industries	14.4	15.8	16.4	1.3	0.6	2.0
Average manufacturing industry	**14.1**	**16.6**	**17.5**	**+2.5**	**+0.9**	**+3.4**
Source: own calculation from ISTAT - National Accounts						

Table 4: International outsourcing of market services in Italy's manufacturing industries						
	1995	1999	2003	Δ(1995-99)	Δ(1999-03)	Δ(1995-03)
Food products and tobacco	0.6	0.7	0.8	0.1	0.1	0.2
Textiles and clothing	1.0	1.2	1.4	0.2	0.2	0.4
Leather and footwear	1.1	1.3	1.3	0.2	0.1	0.2
Wood and wood products	1.5	1.5	1.7	0.0	0.2	0.2
Paper, printing and publishing	1.5	1.5	1.6	0.0	0.1	0.1
Coke and refined petroleum products	3.4	5.8	5.6	2.4	-0.2	2.2
Chemicals and chemical products	1.8	1.8	2.0	0.0	0.2	0.3
Rubber and plastic products	1.1	1.1	1.2	0.0	0.1	0.1
Other non-metallic mineral products	0.7	0.7	0.7	0.0	0.0	-0.1
Basic metals and fabricated metal products	0.6	0.7	0.7	0.1	0.0	0.1
Machinery and equipment n.e.c.	1.2	1.2	1.4	0.0	0.1	0.2
Electrical and optical equipment	3.7	4.8	5.3	1.1	0.5	1.6
Transport equipment	1.5	1.8	1.6	0.3	-0.2	0.1
Other mnfg. industries	1.5	1.6	1.8	0.1	0.2	0.3
Average manufacturing industry	**1.5**	**1.8**	**1.9**	**+0.3**	**+0.1**	**+0.4**
Source: own calculation from ISTAT - National Accounts						

Table 5: Outsourcing and productivity growth in the Italian manufacturing industries

Dependent variable: yearly growth rate of value added per full-time equivalent employed (14 industries, 1995-03)

	WLS	OLS	WLS	OLS	WLS	OLS	WLS	OLS	WLS	OLS	WLS	WLS
	Our Osm, Oss	Our Osm, Oss	Feenstra-Hanson Osm	Feenstra-Hanson Osm	Lagged Osm, Oss	Lagged Osm, Oss	Lagged Feenstra-Hanson	Lagged Feenstra-Hanson	Our Osm, Oss	Our Osm, Oss	Feenstra-Hanson	Lagged Osm, Oss
Growth of capital - labor ratio	.39*** (.11)	.45*** (.13)	.36*** (.12)	.45*** (.15)	.31** (.13)	.44** (.17)	.36** (.17)	.38** (.17)	.43*** (.13)	.65*** (.16)	.41*** (.13)	.30** (.14)
Δ(OSM int'n'l)	-.18*** (.05)	-.27*** (.04)	-.25*** (.10)	-.40*** (.08)	.10** (.05)	.11** (.05)	-.19** (.10)	-.16 (.10)				
Δ(OSS int'n'l)	.03 (.03)	-.03 (.04)	.25** (.11)	.39*** (.11)	-.02 (.04)	-.02 (.05)	.11** (.04)	.09** (.04)				
Δ(OSM domestic)	.09 (.07)	.00 (.06)	.27*** (.07)	.23*** (.06)	-.08 (.09)	-.04 (.08)	-.12 (.09)	-.11 (.08)				
Δ(OSS domestic)	-.32*** (.10)	-.56*** (.11)	-.54*** (.18)	-.89*** (.18)	.06 (.13)	.02 (.14)	-.14 (.16)	-.15 (.18)				
Interaction terms												
R&D*OSM$^{int'n'l}$									.06 (.08)	.02 (.10)	.01 (.09)	.02 (.09)
R&D*OSS$^{int'n'l}$									.00 (.02)	-.00 (.02)	.02 (.11)	-.01 (.02)
R&D*OSM^{dom}									.20** (.10)	.20 (.14)	16** (.07)	-.08 (.11)
R&D*OSS^{dom}									-.00 (.09)	-.02 (.12)	-.04 (.12)	.09 (.10)
Adjusted R-Squared	.51	.58	.47	.51	.32	.27	.30	.29	.34	.50	.33	.26
RMSE	.027	.034	.028	.036	.032	.041	.041	.042	.031	.037	.031	.316
# observations	112	112	112	112	98	98	98	98	112	112	112	98

Notes: all regressions include industry and period fixed effects.