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Does deflation method matter for productivity measures?

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Abstract

In this paper, we disagree on the opportunity to use the double deflation method to produce an equilibrating system of account at a constant price. In fact, by relaxing such a condition, by means of the single deflation method, we obtain a measure of purchasing power transfer that can be decomposed in productivity and market distortion. Results are presented for the evolution of the Italian economy for the periods 1995-2002.
Keywords: National Account, Prices Index, Total Factor Productivity, Input Output.
JEL Classification: C67, L16, O41.

1. Introduction

At the present, the national statistic institutes prefer to pursue the manageable double deflation approach producing as a result an equilibrating system of accounts at constant prices. The main intention of this paper is, instead, to provide a comprehensive framework to support the idea according to which a constant price system of account is in nature imbalance.

Whilst double deflation is consistent with the balancing rule, some objections arise if we consider that relative price change might reflect change in productivity. Indeed, when the purpose is an account system at constant prices the application of the usual methods might hide some important processes that the analysis of constant prices figures would al-

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low, as e.g. the effect of technical progress. In the main body of this paper, we attempt to justify our thesis using several contributions that implicitly or explicitly sustain this view. In doing so, we also pay attention to the complementarities between constant prices measures and productivity transfers among agents. As far as we know, the economic literature has often treated separately the technical change generation from the distribution of productivity gains among economic agents. We begin with the seminal Fontela's (1989) work that set up the distributional rule of productivity gains in the input output context, ending up with an extension that identify a measure of surplus called Purchasing Power Transfer (PPT) originally developed by Garau (1996). This measure is given by the productivity gains and the market surplus generated by extra-profit condition derived from rental position detained by agents. Such a decomposition is very useful from our point of view since it would provide information about the degree of non-competitiveness in different markets.

The rest of the paper is organized as follows. In the next section we deal with some basic concepts of constant price measures in the National Accounts and in section 3, we show the drawbacks of using the double deflation method. In section 4 we compute and understand Fontela's model of Total Factor Productivity Surplus (TFPS) with an application to the case of Italy, while in section 5, the theoretical explanation of the PPT comes with the explanation of the results we have obtained. Finally, some concluding remarks close the discussion.

2. Basic concepts of constant price measures in the National Account

The Handbook on Price and Volume Measures in National Account (European Commission, 2001) defines a constant price system of accounts as an economic situation for a particular year, expressed in the price of another year. A system of account, either in constant or current prices, should respect the accounting constraint, that is to say, total supply and total use should be equal for each product and for each industry. Such an accounting constraint is considered by the Handbook as an important advantage because it allows comparison and consistency among different estimates.

Three methods are available to produce a system of account at current prices: the *revaluation method*, the *quantity extrapolation method*, and the *deflation method*. Whilst the first two are based on quantity indexes, the deflation method is based instead on price indexes.

The *revaluation method* consists in collecting direct physical quantities and values using base year prices. This approach, albeit very powerful and meaningful, is very demanding because it requires direct observation of physical quantities. Actually, it is especially adopted for agricultural products and for goods produced for own final use. In the *quantity extrapolation method* a quantity indicator obtained by a quantity index is used to update the base year value. The *deflation approach* is recommended by the SNA93 and ESA95 to develop constant-price transactions for a homogenous good or service. It means to divide each period's current price values with appropriate price indexes. This approach, unlike the others, is very straightforward and furthermore it allows for an easier adjustment to account for quality changes. Indeed, the two methods based on quantity index might improperly allocate quality changes to changes in price and as it has been pointed out in ESA95 the changes in characteristics have to be recorded as changes in quantities and not as changes in prices.

The SNA requires the use of two separated approach to produce constant price measures for the value of final goods and services: the *expenditure approach* and the *output* or *double deflation* approach. According to the first one, for each component of the final demand, constant price measures are separately produced. The second one, instead, consists in determining constant price measures separately for gross output and intermediate inputs for each industry in the economy. So the GDP can be seen from the expenditure side as the aggregated constant price measures of the final demand, whilst from the output side it can be seen as the difference between gross output and intermediate inputs[1].

Although the SNA recommend deriving constant price estimates from both sides (output and expenditure) official statistics usually report only the result obtained from the production side. This is because the GDP calculated from the output side is often different from the one calculated from the expenditure side.

The SNA advise the use of alternative methods when the data required for constant price estimates of both output and intermediate consumption are not available. Such methods might be single deflation or single extrapolation.

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[1] In addition to the expenditure and output approach the GDP at constant prices can also be obtained from an income side approach. However, when we move into a constant prices context only output and expenditure measures can be used since the income measure of GDP would require a direct observation of its components, both labour income and operative surplus. While the former is, to some extent, directly observable, the latter is usually determined as a residual.

Single deflation means to deflate the value added at current prices using directly the producer price index which measures the price-changes of the output. The extrapolation method is based on indicators that reflect the movements in the volume changes of the industries inputs. Such inputs might be employment, labour-inputs, intermediate consumption or total inputs (weighted average of labour and intermediate inputs). Basically, the value added of the previous period is multiplied by an extrapolator indicator. This technique is mainly used to deflate value added in the financial sector and in the non-tradable sector.

An alternative method to the ones proposed by the SNA93 has been formalized in Durand (1994). Starting from the property that the real value-added of commodities delivered to final demand must be equal to the sum of the real values added by industries, he produces a value added matrix, industries x commodities, whose sum in row give the value added of the final demand while the sum in column gives the value added by industries. This allows for consistency between the value added seen from the side of expenditure (final demand) and the value added seen from the side of output (or production). Firstly, Durand obtains the value added matrix in current prices and then by deflating each column of the matrix by the corresponding commodity price he obtains the value added matrix at constant prices. So, each cell of the value-added matrix represents the contribution of a specific industry to the real value-added of a given commodity.

In recent literature, a quite interesting method to derive constant price measures has appeared. This method developed by Rampa (2008) begins with the assumption that the constant price estimates reported in the official statistics, such as the chained real value added time series and price and quantity indexes are not very accurate. Quantity and price indexes are not consistent with each other for certain periods or sectors and the real value added series is not as smooth as expected. Thus, Rampa (2008) proposes a subjective weighted least square estimation (SWLS) for the deflation of a yearly series of current price IO table for Italy.

3. Double deflation and productivity analysis

The double deflation method albeit widely used has been strongly criticized in the economic literature as it provides a measure of the net output of industries only under extremely restrictive assumptions. This method is in fact feasible only for constant price estimates which are ad-

ditive, such as those calculated using a fixed-base price index. Furthermore, the use of the double deflation could hide some important process behind economic growth such as technical progress.

Although the double deflation allows one to produce an equilibrating system of account even at constant prices, we argue that such a constraint might produce some important disadvantages. While the use of such a method can be accepted in current prices, some doubts arise as to whether a constant price measure has to be constructed. Essentially, we disagree on the requirement to produce an equilibrating system of account when we move into a constant prices framework since we believe that we might lose some important effects concerning economic growth such as efficiency, rent spillovers and all those elements that may concern disembodied technical change.

A single deflation procedure, instead, would allow one to determine a measure of productivity gains (Flexner, 1959, Fontela, 1989, Babeau, 1994 and Garau, 1996) and to understand the generating process of economic growth.

Furthermore, the use of a constant price method not only gives us the opportunity to obtain information about the internal generation process of productivity but also the external determinant of growth that are behind the effect of change in the terms of trade, if, of course, proper index prices are used to deflate imports and exports. This would yield quite interesting result since the literature on economic growth has now recognized the role of knowledge spillovers as the most important driving forces behind economic growth. As knowledge is incorporated in commodities, trade with high technological countries means high quality and sophisticated inputs (either intermediate or capital goods), that improve efficiency and in turn the competition among regions. Such a potential finding has been identified in Flexner's original paper (1959) and estimates of external rent spillovers may be found for the Swiss economy in Antille and Fontela, (2003).

Let us suppose to have for a given period *t*: $\mathbf{X}$ and, $\overline{\mathbf{X}}$, $\mathbf{l}$ and, $\overline{\mathbf{l}}$, $\mathbf{k}$ and, $\overline{\mathbf{k}}$, $\mathbf{m}$ and, $\overline{\mathbf{m}}$, $\mathbf{f}$ and, $\overline{\mathbf{f}}$, $\mathbf{e}$ and, $\overline{\mathbf{e}}$; the matrix of intermediates flows, a vector of labour income, the capital return, the import flows, the final demand and export demand respectively in current and constant prices. According to the accounting constraint both the following equations must hold:

$$\mathbf{X\iota} + \mathbf{l} + \mathbf{k} + \mathbf{m} = \mathbf{X} + \mathbf{f} + \mathbf{e} \qquad (1)$$

$$\bar{\mathbf{X}}\boldsymbol{\iota} + \bar{\mathbf{l}} + \bar{\mathbf{k}} + \bar{\mathbf{m}} = \bar{\mathbf{X}} + \bar{\mathbf{f}} + \bar{\mathbf{e}} \qquad (1a)$$

where $\boldsymbol{\iota}$ is a unit vector. Now, as we cannot observe $\bar{\mathbf{k}}$, the value added ($\bar{\mathbf{l}} + \bar{\mathbf{k}}$) must be of course obtained as a residual. However if we were able to deflate every single item of EQ. (1) including $\mathbf{k}$ or at least to find a proper deflator for the value added as a whole, it would be quite plausible that the equilibrating relationship represented in EQ. (1a) does not hold.

As pointed out by Flexner (1959) even though we were able to remove all the statistical discrepancies due to calculation and statistical approximations, EQ. (1a) would be inadequate to represent constant price relationship since whenever productivity change arises between base year values and current values, this must be reflected in a balancing item in EQ. (1a).

Accordingly, we may argue that a well defined system of account may provide a measure of productivity resulting from the difference between the amount of goods produced and the amount of inputs of production used. Such a measure will take positive value only if the quantity variation of the output is greater than the variation of all inputs. Therefore, the relationship in EQ. (1a) must not hold and the balancing term has a precise economic meaning, which is called by Fontela (1989), Total Factor Productivity Surplus (TFPS):

$$\left[\bar{\mathbf{X}} \cdot \boldsymbol{\iota} + \bar{\mathbf{l}} + \bar{\mathbf{k}} + \bar{\mathbf{m}}\right] + \mathbf{TFPS} = \bar{\mathbf{X}} + \bar{\mathbf{f}} + \bar{\mathbf{e}} \qquad (1a')$$

4. The transfer of productivity gains

Fontela (1989) calls the differences between output and inputs, both measured at constant prices, TFPS:

$$TFPS_{i,t} = \sum_j p_{i,j,0} \cdot q_{i,j,t} - \sum_j p_{j,i,0} \cdot q_{j,i,t} \qquad (2)$$

where $TFPS_{i,t}$ corresponds to the amount of real resource flows between time t and time 0, $q_{i,j,t}$ is the flow of output of sector i towards sector j and $p_{i,j,0}$ is the market price to its base year value.

Since $\sum_j p_{i,j,t} \cdot q_{i,j,t} = \sum_j p_{j,i,t} \cdot q_{j,i,t}$, the expression (2) can be re-written in terms of price variations as follows (Fontela, 1989):

$$TFPS_{i,t} = -\sum_j q_{i,j,t} \cdot (p_{i,j,t} - p_{i,j,0}) + \sum_j q_{j,i,t} \cdot (p_{j,i,t} - p_{j,i,0}) \qquad (2.1)$$

Whereas EQ. (2) measures the creation of TFPS using the index number approach, EQ. (2.1) can be interpreted as a distributional rule of TFPS. As it is self-evident such a distribution depends on the price variations of outputs (first element on the right hand-side) and inputs (second element on the right hand-side) and can be transposed into the traditional IO context if the entire accounting system in current and constant price is available. For a given period, *t*, the following definition of TFPS can be considered:

$$\mathbf{TFPS} = \left(\mathbf{S}'\boldsymbol{\iota} + \mathbf{s_k} + \mathbf{s_l} + \mathbf{s_m}\right) - \left(\mathbf{S}\boldsymbol{\iota} + \mathbf{s_f} + \mathbf{s_e}\right) \qquad (3)$$

where $\boldsymbol{\iota}$ is a unit vector, $\mathbf{S}[s_{i,j}] = \mathbf{X} - \bar{\mathbf{X}}$, $\mathbf{s_k}[sk_i] = \mathbf{k} - \bar{\mathbf{k}}$, $\mathbf{s_l}[sl_i] = \mathbf{l} - \bar{\mathbf{l}}$, $\mathbf{s_m}[sm_i] = \mathbf{m} - \bar{\mathbf{m}}$, $\mathbf{s_f}[sf_i] = \mathbf{f} - \bar{\mathbf{f}}$ and $\mathbf{s_e}[se_i] = \mathbf{e} - \bar{\mathbf{e}}$.

By considering a given year *t*:

- $s_{i,j} > 0$, it means that industry *j* is transferring surplus to the industry *i*,; and the reverse applies when $s_{i,j} < 0$, that is to say, industry *j* is paying relatively less for the inputs provided by industry *i*. Particularly interesting is the net industry contribution: $s_{n,i} = \sum_j s_{j,i} - \sum_j s_{i,j}$. When $s_{n,i} > 0$, industry *i* is transferring surplus to the rest of the economy more than it is gaining from all other sectors.
- Industry *i* is transferring surplus to its primary inputs when, sl_i and sk_i, are positive.
- When the price of commodity is falling, industries are transferring additional surplus to consumers making $sf_i < 0$
- From the trade side, we have an inflow of productivity gains from the Rest of the World when $se_i > 0$ and $sm_i < 0$. And, the reverse applies when $se_i < 0$ and $sm_i > 0$. Then we can compute, as in Fontela et al. (2003), the net outflow $sm_i - se_i > 0$ or net inflow in the opposite situation, $sm_i - se_i < 0$.

4.1 The distribution process of the TFP surpluses: the case of Italy for the period 1995-2002. The analysis of the TFPS is carried out for the period 1995-2002 for the Italian economy. The index prices are shown in Table 1. Index prices for consumption, production, imports and exports are supplied by ISTAT (2008a) whilst index price for labour, capital and investment are deflators obtained from the Italian System of National Accounts (ISTAT, 2008b). The symmetric Italian Input-Output, is obtained from the Make and Use Table for the year 2002, published by ISTAT (2008c).

The results are shown in Table 2. From the last column of this table, we see that the total amount of TFPS is negative, meaning that in the period 1995–2002, the Italian economy is not able to generate TFP gains and also to create an available surplus to be transferred through a reduction in sales prices to the consumers and investors.

The figures also show that the rate of return of one factors of production, paradoxically increases albeit inefficiency in production (negative innovation gains). Indeed, the rate of return to capital raises whilst the real wage rate fall, reflecting that production activities are transferring TFPS to capital and absorbing TFPS from labour. These results, we believe, are the consequences of the national labour market reform undertaken in 1993 (Income Policy Agreement) which has generated a high labour-capital conflict ending up giving advantage to capital and increase the labour market flexibility[2] and so leading to reduce the bargaining power of workers and the purchasing power of wages.

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[2] The work of Devicienti et al. (2007) shows that, after the national labour market reform, wages became more flexible since they are now more responsive to local unemployment. Before the reform wages were set within a centralized bargaining with automatic indexation of wages to the real inflation. The reform has, instead, introduced a new bargaining system. The centralized bargaining process still remains in order to set the industry wide national wage, but with indexation to the Government's target inflation (which is always lower than the real inflation). The additional wage distributed to the workers (or the top up component) is now set according to the firm and regional conditions.

TABLE 1
Price Index 2002 base 100=1995

	Production	Consumption	Export	Import	Investment	Capital	Labour
Agricolture, forestry and fishing	109.60	109.60	119.67	88.62	1.18	1.06	1.13
Mining and Quarrying	111.90	111.90	104.93	169.94	0.96	1.34	1.27
Manufacture of food products, beverages and tabacco	109.30	117.28	108.02	97.28	1.05	1.20	1.18
Manufacture of textiles and wearing appareal	109.60	120.80	115.80	113.00	0.96	1.07	1.25
Manufacture of leather and related products	116.40	126.80	141.34	118.43	1.43	1.09	1.29
Manufacture of wood and wood products	104.10	104.10	95.64	95.87	1.32	1.03	1.36
Manufacture of paper and paper products	95.30	95.30	93.48	75.99	1.26	1.38	1.22
Manufacture of printing and reproduction of recorded media	118.20	118.20	93.48	75.99	1.26	1.38	1.16
Manufacture of coke and refined petroelum products	117.00	117.00	198.75	166.24	1.13	1.30	1.27
Manufacture of chemicals and pharmaceutical	107.60	107.60	90.47	93.58	1.20	1.10	1.27
Manufacture of rubber and plastic products	105.60	105.60	96.51	95.44	1.17	1.18	1.25
Manufacture of other non-metallic mineral products	119.80	119.80	107.07	106.35	1.45	1.19	1.19
Manufacture of fabricated metal products, except machinery and equipment	103.40	103.40	92.14	88.47	1.42	1.13	1.22
Manufacture of machinery and equipment	113.30	113.30	116.14	120.07	0.99	1.13	1.25
Manufacture of eletrical equipment	103.30	103.30	106.98	106.54	1.14	1.28	1.21
Manufacture of transport equipment	113.00	113.00	111.69	117.61	0.84	1.09	1.20
Other manufacturing	115.30	115.30	113.45	111.48	1.16	1.10	1.32
Electricity, Gas and water supply	126.10	126.10	126.10	82.72	1.06	1.16	0.99
Construction	116.48	116.48	116.48	97.28	2.15	1.26	1.17
Wholesale and Retail trade; Repair of Motor vehicles and motorcycles	118.80	118.80	118.80	97.28	1.52	1.30	1.38
Accomodation and food sevice activities	126.80	126.80	126.80	97.28	1.64	1.35	1.38
Transporation and storage	113.30	113.30	113.30	97.28	1.29	1.33	1.16
Financial and Insurance activities	158.94	158.94	158.94	97.28	1.06	1.07	1.09
Real estate activity	118.80	118.80	118.80	97.28	1.12	1.14	0.90
Scientific research and development	118.80	118.80	118.80	97.28	1.12	1.14	1.41
Legal, accounting, managment and other professional activities	118.80	118.80	118.80	97.28	1.12	1.14	1.17
Public administration and defence; Compulsory social security	118.80	118.80	118.80	97.28	1.36	1.13	1.03
Education	119.50	119.50	119.50	97.28	1.42	1.28	1.00
Human healt services	121.30	121.30	121.30	97.28	1.66	1.22	1.10
Other service activities	115.34	115.34	115.34	97.28	1.91	1.33	1.20

As far as the net foreign flows are concerned, overall, during the period in analysis Italy experienced positive terms of trade effects. The net foreign inflow (14121) reflects the high capacity of the Italian economy to gains innovation spillovers from the Rest of the World (ROW). However, the capacity of the Italian economy to gain from terms of trade improvement is not able to offset the negative and domestic productivity performance. This gives us a picture of an economic system where consumers (Government and Households) and investors have to give up part (or all) of their TFPS to pay a high price for consumption and capital goods, respectively.

From a sectoral investigation we understand that *Mining and Quarrying* and *Manufacture of Transport Equipment* are those sectors able to generate the highest TFP gains. However, these sectors act a different distribution process of the TFPS.

Mining and Quarrying is able to distribute just a minimum part of its TFP gains since in this sector the rate of return to capital and the real wage rate increase, and its position with the rest of the world is weak. Indeed, we see that about 77% of the TFPS is absorbed by the rest of the world through an increase in the cost of imports (144, is the price index). Furthermore, the overall position with respect to the ROW is negative. Substantially, under the period in analysis, this sector has suffered of negative term of trade with the results of a net outflow of TFP surpluses (8084).

With regards to *Manufacture of Transport Equipment*, the total surplus available for distribution (10550) is greater than the innovation gains generated (10393). This is happening because *Manufacture of Transport Equipment*, is not only able to generate TFP surpluses but, at the same time, is also able to lower its cost through a reduction in the overall cost of primary inputs (22) and take advantage of positive spillovers from imports. On the other hand, the distribution process gives advantages to more investors (9415) and the ROW (1570) by a fall in the price of capital goods and exports, respectively.

The worst performance in term of innovation gains is coming from *Construction* and *Financial and Insurance Activities*. In the former sector, not only the TFPS is negative (49380) but also there is a net transfer of purchasing power toward primary inputs which is going to advantage only capital. Albeit the net benefit from the ROW is positive, this is not able to cover the rise in the price of value added and the negative TFPS, meaning that *Construction* is a sector that has a strong rental position in the market, absorbing as a consequence TFP surpluses from the final

TABLE 2. The distribution of TFP surpluses in Italy, 1995-2002; values in millions of Euros

	Agricolture, forestry and fishing	Mining and Quarrying	Manufacture of food products, beverages and tabacco	Manufacture of textiles and wearing appareal	Manufacture of leather and related products	Manufacture of wood and wood products	Manufacture of paper and paper products	Manufacture of printing and reproduction of recorded media	Manufacture of coke and refined petroleum products	Manufacture of chemicals and pharmaceutical	Manufacture of rubber and plastic products	Manufacture of other non-metallic mineral products	Manufacture of fabricated metal products, except machinery and equipment	Manufacture of machinery and equipment	Manufacture of eletrical equipment	Manufacture of transport equipment	Other manufacturing	Electricity, Gas and water supply	Construction	Wholesale and Retail trade; Repair of Motor vehicles and motorcycles	Accomodation and food sevice activities	Transporation and storage	Financial and Insurance activities	Real estate activity	Scientific research and development	Legal, accounting, managment and other professional activities	Public administration and defence; Compulsory social security	Education	Human healt services	Other service activities	Total
Total TFPS[a]	-2618	10512	-1703	-696	-3070	983	3020	-374	-168	3310	3355	-295	6620	5780	5482	10393	-673	-6382	-49380	4317	-3195	9183	-25502	-7011	1554	-4407	-9178	-8950	-5406	1987	-62513
Lowering(-)/increasingr(+) the cost of primary inputs {b= [b1+b2+b3]}	-2908	479	271	-494	-69	-79	667	758	237	83	309	132	172	498	1197	-22	109	-1428	2018	14232	5658	4805	-4757	-5703	2276	-1921	-8457	-8290	-2342	1364	-1205
Labour [b1]	-388	108	-9	724	331	357	91	-88	78	628	325	51	720	1015	374	174	640	-1187	-127	6614	2830	-611	-2473	-693	2656	-329	-7649	-8994	-3041	458	-7414
Capital [b2]	-2523	371	282	-1223	-402	-437	574	844	148	-553	-18	74	-556	-524	818	-198	-533	-263	2134	7590	2825	5384	-2313	-5019	-383	-1609	-844	696	671	894	5910
Net Taxes [b3]	3	1	-2	5	1	1	2	1	10	8	2	7	9	6	4	3	2	22	12	28	4	32	29	9	3	16	36	7	29	11	299
		-0.77																													
Positive/Negative spillovers from Import [c]	*3031*	*-8084*	*3989*	*624*	*-23*	*783*	*3194*	*493*	*-1554*	*9381*	*1324*	*329*	*8218*	*-364*	*3801*	*136*	*266*	*820*	*80*	*1451*	*861*	*2489*	*947*	*1228*	*573*	*1815*	*0*	*22*	*0*	*306*	36138
Total available for distribution {a+[-b]+c}	3321	1949	2016	422	-3024	1846	5547	-639	-1959	12608	4369	-98	14665	4919	8086	10550	-517	-4134	-51319	-8464	-7992	6867	-19798	-79	-149	-671	-721	-637	-3063	929	-25171
Distribution Process																															
Lowering (+) or increasing (-) prices for intermediate inputs [d]	2547	1798	540	497	-383	1470	3769	-1025	-844	2899	1919	-910	9832	-3005	3258	-1324	-1542	-3024	-1682	-2817	-3118	4276	-11909	287	-606	-777	-53	142	-677	461	0
Lowering(+) or increasing(-) prices for consumers [e]	834	0	331	-700	-603	131	688	-12	117	1769	304	-29	180	186	1367	889	270	-1093	85	-1044	-4873	2344	-6945	-691	-51	-52	-668	-778	-2386	812	-9620
Lowering (+) or increasing (-) prices for investors [f]	-1	90	-124	142	-2	-68	-1	-16	18	-3	5	-78	-1262	6904	1037	9415	131	0	-49726	-4454	0	-291	0	346	518	215	0	0	0	-364	-37568
Lowering (+) or increasing(-) the price of export [g]	-59	59	1269	483	-2036	313	1091	414	-1250	7943	2141	919	5914	835	2424	1570	624	-17	5	-149	-1	539	-944	-21	-11	-57	0	0	0	19	22017
Total distribution {d+e+f+g}	3321	1949	2016	422	-3024	1846	5547	-639	-1959	12608	4369	-98	14665	4919	8086	10550	-517	-4134	-51319	-8464	-7992	6867	-19798	-79	-149	-671	-721	-637	-3063	929	-25171
Net outflow(-)/inflow(+) {c-g}	3090	-8144	2720	141	2013	470	2103	79	-304	1438	-817	-590	2303	-1199	1378	-1434	-358	837	75	1599	862	1951	1890	1250	584	1872	0	22	1	287	14121

demand with important drawbacks especially for investors. In the latter sector, instead, the negative TFPS (25502) is partially offset by a reduction in the cost of primary inputs and positive external spillover from imports. Nevertheless, the total surplus available for distribution still remain negative (19798) with the consequences that consumers and investors have to pay a high price for consumption and capital goods, respectively.

If we just consider the net outflow or inflow of TFP surpluses, the best performance is experienced by *Agricultural, Forestry and Fishing*, for which we have a total net inflow of TFP gains (3090). Indeed, the related price index for imports is equal to 75.10 while the price index for export is 101.41 with an improvement of the terms of trade. On the contrary, the worst external performance is for *Mining and Quarrying* that experience a deterioration of the terms of trade (import price index is equal to 144.08 while the export price index is 88.92).

5. The purchasing power transfer (PPT)

In EQ. (2.1), the computation of the TFPS is obtained through market prices. We may decompose the market price $\mathrm{p_{i,j}}$, as follows:

$$p_{i,j,0} = p^{*}_{i,j,0} + p^{**}_{i,j,0}$$

where $p^{*}_{i,j,0}$, is the price we would have if the agents present in the market were not able to gain from rental positions. It means a situation where the prices of all sectors adjust to their productivity and the rate of productivity growth is the same in all sectors. That is to say, a situation in which extra profits are zero and there is not modification of relative prices. $p^{**}_{i,j,0}$, is instead an index of market bias, that identify the presence of extra-profits and those agents that are in the position to gains from market imperfection.

Substituting the definition of market price in EQ. (2.1), we have that:

$$TFPS_{i,t} = -\sum_{j} q_{i,j,t}\left(p_{i,j,t} - p^{*}_{i,j,0} - p^{**}_{i,j,0}\right) + \sum_{j} q_{j,i,t}\left(p_{j,i,t} - p^{*}_{j,i,0} - p^{**}_{j,i,0}\right) \quad (4)$$

Furthermore, with some simple adjustment, the EQ. (4) can be re-written ascribing to the TFPS and to the following decomposition the meaning of a measure of Purchasing Power Transfer (PPT):

$$PPT_{i,t} = \underbrace{-\sum_j q_{i,j,t}\left(p_{i,j,t} - p^{**}_{i,j,0}\right)}_{1} + \underbrace{\sum_j q_{i,j,t} p^{*}_{i,j,0}}_{2} + \underbrace{\sum_j q_{j,i,t}\left(p_{j,i,t} - p^{**}_{j,i,0}\right)}_{3} - \underbrace{\sum_j q_{j,i,t} p^{*}_{j,i,0}}_{4} \quad (5)$$

The market price indexes, $p_{i,j}$, allow us, through EQ. (2.1), to compute the overall purchasing power transfers (PPT). With the decomposition process, in EQ. (5), we can distinguish the technological performance of each sector (TFP), that is to say, the difference between the terms 4 and 2 on the right side of EQ. 5, and a measure of the alteration of the natural market mechanisms, given by difference between terms 3 and 1 on the right side of EQ. 5.

With regards to the TFP component, the difference between real outputs and real inputs should be computed using ideal price index or prices consistent with the neoclassical framework (Wolf, 1985 and 1989). This measure reflects the welfare gains of innovations that allow sector *i*, to increase its outputs faster than its inputs between time *0* and *t*, if $\left[\sum_j q_{i,j,t} p^{*}_{i,j,0} - \sum_j q_{j,i,t} p^{*}_{j,i,0}\right] > 0$.

The market component of the PPT decomposition is given by (1) and (3):

$$Market\ Surplus = \underbrace{-\sum_j q_{i,j,t}\left(p_{i,j,t} - p^{**}_{i,j,0}\right)}_{1} + \underbrace{\sum_j q_{j,i,t}\left(p_{j,i,t} - p^{**}_{j,i,0}\right)}_{3}$$

The difference between these two terms can be interpreted as redistribution among the different economic agents of the market power generated through changes of the prices of inputs and outputs. If $p_{i,j,t} < p^{**}_{i,j,0}$ then the industry is losing bargaining power and it is transferring part of its purchasing power to its customers (intermediate producers or final users) by supplying its products at a lower relative price. Accordingly, the relative price of output of an industry decrease and the term (1)

will become positive. If $p_{j,i,t} > p^{**}_{j,i,0}$, the industry is transferring part of its purchasing power to its suppliers since is paying relatively more for its intermediate and primary inputs. This means that the term (3) will become negative.

With regards to the computation of the measure of TFP in EQ. (5), we adopt Divisia price indexes or their discrete approximation given by Tornqvist (or Translog) chain index:

$$p^*_j = \prod_{i=1}^{n+2} \left(\frac{r^1_{i,j}}{r^0_{i,j}} \right)^{\frac{1}{2}\left(w^0_{i,j} + w^1_{i,j}\right)}$$

where r_i are the inputs prices, (*n* intermediate inputs and 2 primary inputs) and w^0_i (w^1_i) are input shares, at constant prices, per unit of output for the two periods (the first, 1 and the last, 0). If current price values are deflated by their Törnqvist price index, the relative transfers reflect the effects of technical change. Indeed, in the neoclassical perfect competition context, it is recommended for consistency to use Tornqvist-Divisia indexes for the measurement of TFP (Wolff, 1989 and Fontela, 1994).

In order to compute the total measure of PPT, we should also calculate the Market Surplus (MS) through the distortionary price $p^{**}_{j,i,0}$. However, we do not have such price index. Then, in order to compute the MS component of EQ. 5, we can use the definition of the market price seen above, $\left(p_{i,j,0} - p^*_{i,j,0} = p^{**}_{i,j,0}\right)$. This also means that MS can be easily obtained as residual.

According to EQ. 5, if $\mathrm{PPT_{i,t}} > 0$, the sector *i* is transferring purchasing power to the rest of the economy, through a reduction in the market power and an increase in TFP. While if $\mathrm{PPT_{i,t}} < 0$ the sector *i* is absorbing resources from the rest of the economy. We may distinguish different situations:

$$PPT_{i,t} > 0, \begin{cases} \left[-\sum_j q_{i,j,t}\left(p_{i,j,t} - p^{**}_{i,j,0}\right) + \sum_j q_{j,i,t}\left(p_{j,i,t} - p^{**}_{j,i,0}\right) \right] > 0 \,; \left[\sum_j q_{i,j,t} p^*_{i,j,0} - \sum_j q_{j,i,t} p^*_{j,i,0} \right] > 0 \ \langle 1 \rangle \\ \left[-\sum_j q_{i,j,t}\left(p_{i,j,t} - p^{**}_{i,j,0}\right) + \sum_j q_{j,i,t}\left(p_{j,i,t} - p^{**}_{j,i,0}\right) \right] > 0 \,; \left[\sum_j q_{i,j,t} p^*_{i,j,0} - \sum_j q_{j,i,t} p^*_{j,i,0} \right] < 0 \ \langle 2 \rangle \\ \left[-\sum_j q_{i,j,t}\left(p_{i,j,t} - p^{**}_{i,j,0}\right) + \sum_j q_{j,i,t}\left(p_{j,i,t} - p^{**}_{j,i,0}\right) \right] < 0 \,; \left[\sum_j q_{i,j,t} p^*_{i,j,0} - \sum_j q_{j,i,t} p^*_{j,i,0} \right] > 0 \ \langle 3 \rangle \end{cases}$$

In ⟨1⟩ sector *i* is distributing purchasing power through an increase in efficiency (TFP>0) and through a reduction in their market power, MS>0. Basically, the market is imposing to sell their goods to a lower relative price. For case ⟨2⟩, the PPT is positive although the generic sector *i* is experiencing loss of efficiency (TFP<0). Indeed, the negative productivity impact is totally offset by an increase in the transfer of purchasing power to the rest of the economy through a loss of market power. In ⟨3⟩, the capacity to transfer purchasing power of sector *i* is partially offset by negative market imperfections meaning that the market conditions allow this sector to absorb resources from the rest of the economy. However, the net transfer of purchasing power is positive.

For the case of PPT<0, we can have:

$$PPT_{i,t} < 0, \begin{cases} \left[-\sum_j q_{i,j,t}(p_{i,j,t} - p^*_{i,j,0}) + \sum_j q_{j,i,t}(p_{j,i,t} - p^*_{j,i,0})\right] < 0\,; \left[\sum_j q_{i,j,t}p^{**}_{i,j,0} - \sum_j q_{j,i,t}p^{**}_{j,i,0}\right] < 0 \ \langle 1' \rangle \\ \left[-\sum_j q_{i,j,t}(p_{i,j,t} - p^*_{i,j,0}) + \sum_j q_{j,i,t}(p_{j,i,t} - p^*_{j,i,0})\right] > 0\,; \left[\sum_j q_{i,j,t}p^{**}_{i,j,0} - \sum_j q_{j,i,t}p^{**}_{j,i,0}\right] < 0 \ \langle 2' \rangle \\ \left[-\sum_j q_{i,j,t}(p_{i,j,t} - p^*_{i,j,0}) + \sum_j q_{j,i,t}(p_{j,i,t} - p^*_{j,i,0})\right] < 0\,; \left[\sum_j q_{i,j,t}p^{**}_{i,j,0} - \sum_j q_{j,i,t}p^{**}_{j,i,0}\right] > 0 \ \langle 3' \rangle \end{cases}$$

Considering the situation ⟨1'⟩, the sector absorbs purchasing power from the rest of the economy because of negative productivity and favourable market distortion. For ⟨2'⟩, the reduction of the market power is not enough to cover the negative impact in term of productivity. In the last situation ⟨3'⟩, the sector *i*, overall, absorb resources from the other sectors. Here, essentially, the appropriations of purchasing power through the exploitation of their rental position overwhelm the capacity to generate TFP.

5.1. *TFP and Market surpluses in Italy, for the period 1995-2002*. The results of the operations are presented in Table 3. The first column is the difference between terms (2) and (4) of EQ. (5), whilst the second one is the difference between the terms (1) and (3) of the same equation. The last column is the total effect.

With regards to the manufacturing sectors, the best performance in terms of TFP is in the *Manufacture of Fabricated Metal Products* and in the *Manufacture of Chemicals and Pharmaceutical. Manufacture of Fabricated Metal Products*, is not only able to increase its productivity but also to increase the overall PPT, through a reduction of its market surplus (MS>0), meaning that it is giving up purchasing power to the rest of the system.

On the contrary, for *Manufacture of Chemicals and Pharmaceutical*, the capacity to generate productivity is partially offset by an increase of its market power.

What is interesting is the position of the *Manufacture of Machinery and Equipment,* and *Manufacture of Transport Equipment* that lose productivity but, at the same time, give up part of their market power allowing the system to regain PPT.

The manufacturing sectors that, more than other, experience an increase in its market power, is the *Manufacture of Coke and Refined Petroleum Products*. Its strong market position overwhelms the capacity to transfer purchasing power in terms of TFP.

From the side of services it is worth noting that some public services such as *Public Administration and Defense*, *Education* and *Human Health Services*, albeit the real outputs is greater than the real inputs, the distortionary market conditions prevent a redistribution through a favorable change in prices.

Also for *Electricity, Gas and Water supply*, we have the same kind of situation. By and large, it follows that an increase in TFP in a given sector of the economy is not necessarily leading to a decrease of its relative market prices, nor a decrease in its market power. Since our analysis takes in consideration the period 1995-2002, it is quite possible that we are not able to capture the effect of the liberalization of the electricity supply that started in Italy at the beginning of 2000. Two years (2000-02) may not be enough to produce positive effect. From a liberalization policy we would expect not only an increase in TFP, but also a transfer of purchasing power to the rest of the system, given that a more competitive market in energy supply should lead to a decrease in its relative price change.

Construction and *Financial activities* not only have negative performance in terms of productivity but they also increase their purchasing power by increasing their relative price.

In conclusion, we can say that the capacity to generate productivity does not automatically produce downward pressure on relative prices. There is not a mechanics process according to which positive innovation gains corresponds to an increase in the purchasing power of workers or capitalists, nor to a transfer of resources to consumers. Indeed, the total PPT available for distribution depends on the rule of distribution that in turn is the result of the structure of different markets. Prices in the market might be different from the ones we would expect in a perfect competitive market. So an industry may adjust its selling price increasing its purchasing power that is to say, enlarging the gap between the actual

market price and the ideal price. The same might occurs for instance in the market of labour or capital. Specifically, it is the combination of the degree of distortion in the market that determines the rule of distribution of the PPT.

Table 3 Total Factor Productivity and Market Surpluses in Italy, 1995-2002, in millions of Euros

	TFP	MS	PPT=TFPS
Agricolture, forestry and fishing	4182	-6800	-2618
Mining and Quarrying	-11495	22007	10512
Manufacture of food products, beverages and tabacco	547	-2249	-1703
Manufacture of textiles and wearing appareal	-153	-543	-696
Manufacture of leather and related products	-665	-2405	-3070
Manufacture of wood and wood products	717	266	983
Manufacture of paper and paper products	2239	781	3020
Manufacture of printing and reproduction of recorded media	-135	-239	-374
Manufacture of coke and refined petroelum products	2776	-2944	-168
Manufacture of chemicals and pharmaceutical	4727	-1417	3310
Manufacture of rubber and plastic products	432	2922	3355
Manufacture of other non-metallic mineral products	287	-582	-295
Manufacture of fabricated metal products, except machinery and equipmen	5933	687	6620
Manufacture of machinery and equipment	-2468	8249	5780
Manufacture of eletrical equipment	-507	5989	5482
Manufacture of transport equipment	-3827	14220	10393
Other manufacturing	22	-695	-673
Electricity, Gas and water supply	3699	-10081	-6382
Construction	-2425	-46955	-49380
Wholesale and Retail trade; Repair of Motor vehicles and motorcycles	-16472	20789	4317
Accomodation and food sevice activities	-6010	2815	-3195
Transporation and storage	-4399	13581	9183
Financial and Insurance activities	-1034	-24467	-25502
Real estate activity	2808	-9819	-7011
Scientific research and development	-2402	3955	1554
Legal, accounting, managment and other professional activities	658	-5066	-4407
Public administration and defence; Compulsory social security	7172	-16350	-9178
Education	6858	-15808	-8950
Human healt services	905	-6311	-5406
Other service activities	-1747	3734	1987
Total	-9779	-52734	-62513

6. Conclusion

In this paper we have highlighted the importance of adopting a single deflation method as the necessary approach to produce a system of economic account at constant price that is in equilibrium only if it accounts for productivity gains. Furthermore, with a well-defined system of account at constant price, we are able to produce a productivity model that

allows one to understand the distribution of purchasing power among agents.

Such a model could be very helpful for policy makers, since it gives a picture of the inter-industry diffusion and distribution of the welfare gains of innovations, that might be used to reorient economic priorities and managing the process of price adjustment when, for instance, the industrial policy take the form of selective subsidies. Indeed, public investment in a give sector might not produce the expected positive outcome if this industry does not transfer part of its purchasing power to the rest of the system. So, selective subsidies can be oriented to correcting distortions or imperfections in the market mechanism or addressed towards those progressive sectors that have a sufficiently high rate of innovation and operate, transferring massive welfare gains to the rest of the economy.

In our point of view, there is also scope for further development. Specifically, the analysis of the distributional rule of the TFPS can also be integrated in the Leontief multiplier in order to capture the impact of the policy in terms of distributions of innovation gains. Yet a cost-linkage function can be constructed in order to improve our understanding of the mechanism of price adjustment.

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