Sardar Patel Institute of
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Sectoral Shares in GDP: Estimation at Current and Constant Prices

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Madhusudan Datta*

Abstract: *In estimating real value added (RVA) the Central Statistical Organization focuses on some quantum index of activity in the relevant sector. This contradicts the fundamental national accounts identity between aggregate product and expenditure. The double deflation approach is also unacceptable as it violates the cost minimization hypothesis of firms. We have taken an abstract illustrative example to highlight the point that VA factors in influences other than the quantum of output and intermediate inputs. We conclude that the GDP deflator is the most appropriate for sectoral RVA which concept must be dissociated from any notion of quantity index of output.*

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Sectoral Shares in GDP: Estimation at Current and Constant Prices

Introduction

The growth of an economy is always associated with all sorts of changes – not only the change in the scale of activities but also changes in relative sizes of activities broadly defined, the underlying technology and market conditions governing the undertaking of the activities. These all-round changes cause changes in relative prices; real changes remain concealed in the observed values. To get an idea of the trend of the real economy, the standard practice is to deflate current values of goods and services by price indices, i.e., to compare values at constant prices.

When we want to go into greater detail than the summary statement of the performance of an economy contained in its GDP we consider the sectoral composition of GDP. But while GDP can be viewed as both the aggregate value added (VA) as well as the aggregate value of final goods and services in domestic production, GDP originating in a sector, say mining or distributive trade, is by no means the value of final product of the sector. A sector may produce only intermediate input and in that way make important contribution to the GDP. So, when we consider sectoral contribution to GDP our attention is on VA, not the final product.

Since prices conceal real movements the attention is normally focused on constant price estimates, current price estimates are treated as estimates with price-veils. Since price-veils must be lifted in order to understand the real movements we must determine what constitutes the price deflator for sectoral value-added. The question must be viewed in the light of the fact, as already pointed out, that sectoral GDP does not refer to final goods and services emerging from the sector, nor does that normally bear a one-to-one correspondence with the real product of the sector. For, it is not difficult to visualize a situation when the product of a sector rises along with decline in price leading to fall in VA. In fact, structural change in the economy has many dimensions that are factored into the value added structure. This point is often lost sight of when we compare relative sectoral VA

The present paper takes up the question of the appropriate price deflator for sectoral VA. To measure of real value added (RVA) the Central Statistical Organization (CSO) of India takes an ad-hoc approach depending on availability of data. Their focus seems to be to find a measure that reflects some quantum index of activity in the relevant sector. We have discussed below that finding a quantum index is a worthy task in itself but that must be dissociated from RVA as the approach contradicts a fundamental national accounts identity.

In section-II we present some basic facts relating to trends in sectoral GDP shares at current and constant prices as reflected in the CSO estimates of VA. Comparison of current and constant price estimates raises the question of interpretation of RVA. Section-III takes up the question of RVA in the light of the fundamental national accounts identity between domestic production and expenditure on GDP. The section also explores how the different methods of estimating RVA relate to the fundamental identity. Section-IV takes a simple but abstract illustrative example to highlight the point that technical progress may cause VA to move paradoxically against the progressive sector and this has important implications relevant for the measure of RVA. The section compares the different approaches to the measurement of RVA and concludes that the use of the GDP deflator is the most appropriate for RVA which concept must be dissociated from any notion of quantity index. Section-V summarises the arguments and draws the conclusion of the study.

Section-II

Basic Facts

Tables 1 and 2 present the relative shares of the three major sectors in GDP[1]. It is seen from the tables that the share of the tertiary sector increased by about 13 percentage points in the first four decades up to 1990-92 but it rose further by almost the same margin in only the next one and a half decades. The share of the secondary sector also rose by roughly 12 percentage points in the first four decades but in the subsequent period it showed some fluctuations with only a marginal increase in 2005-07 compared to 1990-92. Thus the tertiary sector captured almost the whole of the share lost by

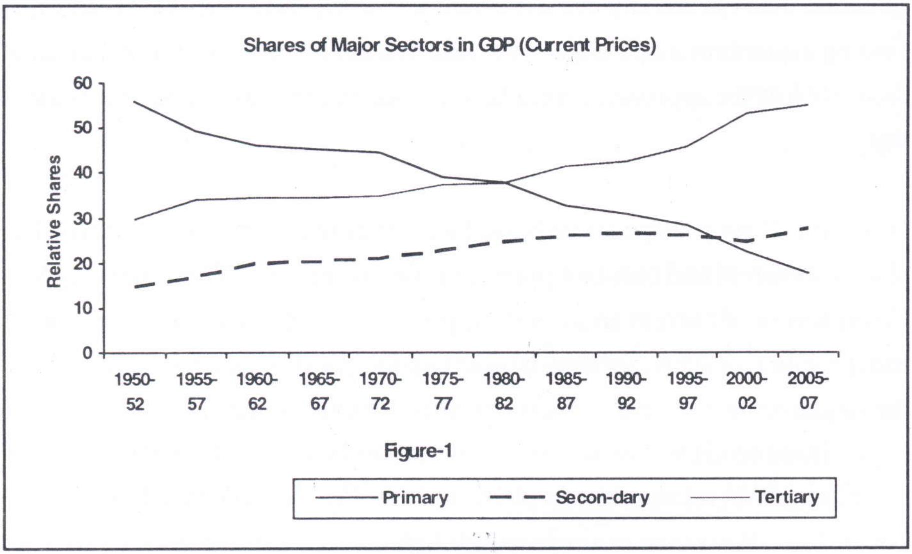


Figure-1

agriculture (primary sector) in the nineties and thereafter. The current and constant price estimates give remarkably similar results in this regard. By contrast to the behaviour of the major sectors, when we come to the sub-sectors of the tertiary sector we find the *relative shares (within the tertiary sector) as well as their trends to be substantially different between current and constant price estimates* (tables 1 and 2 and figures 1 to 4).

Table 1: Shares of Major Sectors in GDP* at *Current Prices*: Percentage Distribution of 2-yearly Averages.

Year	Primary	Secondary	Tertiary	*(Shares of Sub-sectors in Tertiary Sector GDP)*						
				THR	*TSC*	*only C*	*FIRB*	*only FI*	*only B*	*CSP*
1950-52	55.8	14.6	29.6	*21.2*	*11.6*		*34.8*	*3.0*		*32.4*
1955-57	49.3	17.0	33.8	*20.4*	*11.5*		*37.6*	*3.0*		*30.6*
1960-62	46.1	19.7	34.3	*22.2*	*12.2*		*35.3*	*3.5*		*30.4*
1965-67	45.2	20.3	34.4	*24.5*	*11.9*		*32.7*	*4.5*		*30.9*
1970-72	44.7	20.8	34.5	*25.2*	*12.4*	*1.7*	*30.8*	*5.5*	*0.5*	*31.7*
1975-77	39.2	22.8	37.3	*28.9*	*12.6*	*1.7*	*27.2*	*7.7*	*0.7*	*31.4*
1980-82	37.8	24.7	37.6	*32.1*	*12.4*	*1.7*	*24.8*	*8.5*	*0.9*	*30.7*
1985-87	32.7	26.2	41.1	*31.5*	*13.4*	*1.7*	*24.8*	*8.8*	*1.4*	*30.2*
1990-92	30.9	26.6	42.5	*29.8*	*14.4*	*2.4*	*26.0*	*11.2*	*1.4*	*29.8*
1995-97	28.3	26.2	45.6	*34.0*	*16.0*	*2.9*	*24.7*	*13.4*	*1.2*	*25.4*
2000-02	22.4	24.7	52.9	*29.0*	*15.2*	*3.0*	*26.7*	*11.2*	*4.8*	*29.2*
2005-07	17.6	27.5	55.0	*31.6*	*16.1*	*3.8*	*26.5*	*10.6*	*7.1*	*25.9*

* At factor cost.

Notes:

Calculations for tables 1 and 2 are based on various issues of *National Accounts Statistics*, CSO. Note: Business Services (B) incorporates freshly available data on computer services, renting of machinery and R&D from 1999-2000 onwards.
Abbreviations – THR: trade, hotels and restaurants; TSC: transport, storage and communications; C: Communication which is a part of TSC. FIRB: Finance, insurance, real estate and business services. FI and B are parts of FIRB. CSP: community, social and personal services.

Table 2: Shares of Major Sectors in GDP* at *1993-94 Prices*: Percentage Distribution of 2-yearly Averages

Year	Primary	Secondary	Tertiary	*(Shares of Sub-sectors in Tertiary Sector GDP)*						
				THR	*TSC*	*only C*	*FIRB*	*only FI*	*only B*	*CSP*
1950-52	57.2	14.9	27.8	*30.9*	*12.2*	*1.4*	*23.1*	*3.4*	*1.6*	*33.1*
1955-57	55.4	16.7	27.9	32.8	12.8	1.65	22.2	4.1	1.4	32.2
1960-62	52.1	18.7	29.2	*34.1*	*13.8*	*1.8*	*20.5*	*4.6*	*1.3*	*31.6*
1965-67	44.5	226	32.9	*34.1*	*14.5*	*2.07*	*18.8*	*4.6*	*1.2*	*32.7*
1970-72	45.6	21.8	32.5	*33.7*	*14.6*	*2.2*	*18.4*	*5.4*	*1.0*	*33.4*
1975-77	42.8	22.6	34.6	*33.4*	*16.4*	*2.39*	*18.1*	*3.8*	*0.9*	*32.1*
1980-82	39.6	23.9	36.5	*33.5*	*17.0*	*2.7*	*18.1*	*6.4*	*1.0*	*31.4*
1985-87	35.4	25.1	39.5	*32.3*	*16.1*	*2.6*	*21.0*	*8.2*	*1.1*	*30.6*
1990-92	31.8	27.0	41.3	*30.3*	*15.4*	*2.5*	*24.7*	*10.9*	*1.7*	*29.7*
1995-97	28.2	27.9	43.8	*31.9*	*15.8*	*3.4*	*26.0*	*12.3*	*3.0*	*26.3*
2000-02	24.0	26.9	49.1	*30.2*	*16.9*	*5.8*	*25.5*	*13.3*	*3.6*	*27.4*
2005-07	18.6	27.7	53.7	*29.0*	*22.8*	*11.6*	*24.7*	*13.4*	*4.8*	*23.5*

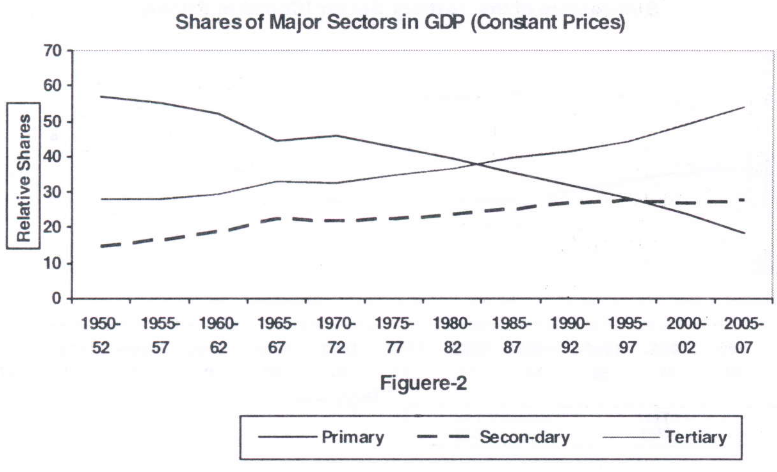
Note: Abbreviations explained in table-1.

Thus, we may highlight, when we study the trend of sectoral distribution of GDP since the initiation of planned Indian development the following facts emerge from the official statistics.

1) Three broad sectors – primary, secondary and tertiary: The trends of sectoral GDP-shares give the same picture for current and constant price estimates provided by the CSO.

2) Sub-sectors of the tertiary sector: The trends of relative shares within the tertiary sector are found to be quite different between current and constant price estimates provided by the CSO.

When two sets of estimates give different results the question naturally arises as to which estimate we should consider to be more relevant for our purpose. In order to decide on the issue we need to go into the concept of RVA and how it is being estimated in Indian official statistics.



Figuere-2

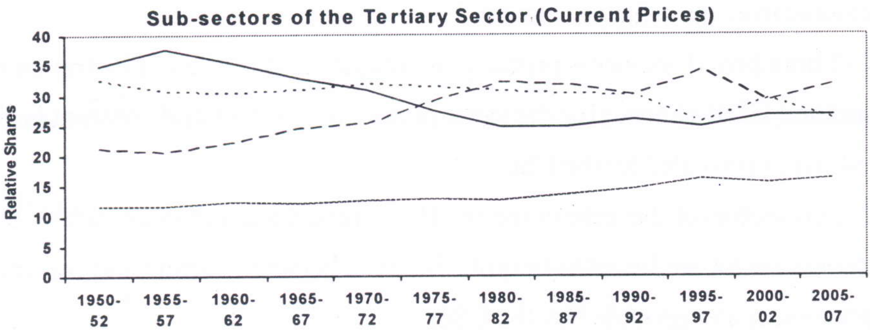


Figure-3

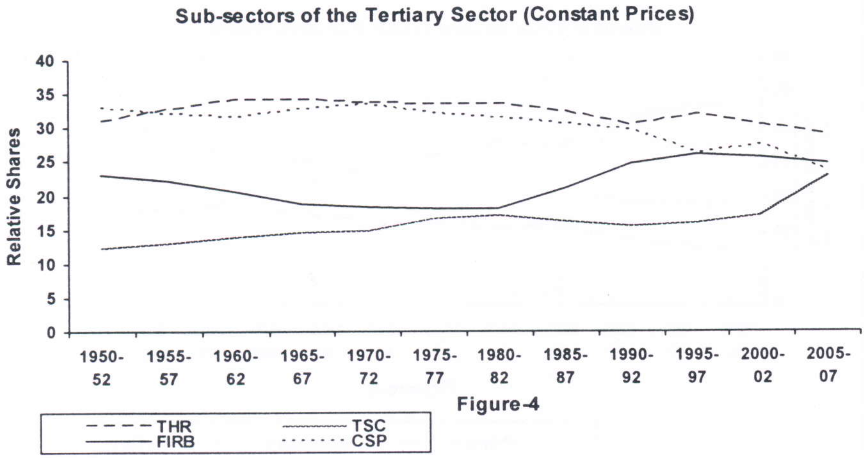


Figure-4

Section-III

RVA and Relevant Considerations

Value added is defined *at current prices* as the difference between the value of output and the value of intermediate inputs used in producing the output. Prices of both output and intermediate inputs are subject to the vagaries of the market and they do not change in tandem. All sorts of forces affecting the demand and supply sides of the two entities, including technical change and change in market structure, come into play in determining the VA. What is of special relevance here is that VA includes a residual element – profit, which may be viewed as the difference between net revenue and the full opportunity costs of the factors used in the production of output concerned, including the cost of using the owner's capital[2]. So, VA need not be proportional to either of the entities – output and intermediate input, or to the use of primary inputs like capital and labour.

VA is a purely monetary value bound by the national accounts identity that equates the aggregate VA in all activities with the aggregate value of all final goods and services produced in the economy. Thus the GDP has a real representation in the sense that the basket of final goods and services are quantifiable[3]. So, price of each final product is supposed to exist and the basket may be evaluated at constant prices[4]. That gives the real GDP and, hence, the GDP deflator.

Generally, when we use constant price estimates the idea is that we have discounted for price changes and, therefore, what we deal with indicates real changes. Following this idea it is often suggested that an estimate of RVA from a production process is obtained when both the output and inputs are evaluated at respective base year prices. This is the double-deflation (DD) procedure and it is recommended by the CSO to be the ideal whenever achievable. Following the input-output transactions framework, this procedure ensures that aggregate real VA is equal to the sum total of sectoral final demands at constant prices just as it is true (being a national accounts identity) for current price evaluation. *But the problem is that we are evaluating current year input quantities (chosen for current year prices) at base year prices. This violates the logic of cost minimization that requires input substitution when relative prices change.* When the current year is substantially far from the base year (say, a decade or two apart) changes in relative prices can be quite considerable (and there may be technical change leading to change in input structure) rendering the constant price VA unworthy of the interpretation as what the current year level of output would have generated had it been produced in the base year.

Even, it is possible for the estimate of RVA in a viable production process obtained by DD to be negative. A hypothetical illustration may put the point rather dramatically. Suppose, in some initial year gold is used as an intermediate input in the production of Y. After a technical change some cheaper raw material is used in production and the product also becomes cheaper as a consequence. Suppose, in the meanwhile, gold becomes costlier. To obtain RVA by DD for the base year with current year as base we must evaluate output at a lower price and input at a higher price possibly giving a negative VA. It is an absurd result as, indeed, past production added value then; there is no reason to regard past production as an exercise in wastage of resources. So, in a dynamic world the DD procedure is fraught with conceptual problems (Griliches, 1992).

In obtaining the constant price VA, or the RVA, the Central Statistical Organization of India (CSO) does not follow a uniform procedure for all the sectors. It follows the DD procedure for agriculture but for other sectors it takes ad-hoc procedures to somehow pick up some appropriate indicators depending on the availability of data (CSO, 2007); the focus of the estimates seems to be some sort of a quantity index. The CSO, indeed, factors the current price value added into price and quantity indices (statement 3, CSO, 2008).[5]

Such an approach inevitably makes drastic compromises particularly in the cases of services where the very concept of quantity is vague to a great extent (Hill, 1977); but the problem may not be much easier elsewhere because of joint production and continuous quality changes. However, these are problems associated with index numbers; one tries to achieve as much accuracy as practicable by availability of information. What is of more basic concern is that there is no way to ensure that the sum total of VA obtained by this approach, which is basically blowing up the base year estimates of VA by the relevant current year quantity indices, is equal to the sum of value of final goods and services at constant prices. Even if we had perfect quantity indices and we wanted to blow-up base year VA by these indices to get current year RVA, the fundamental identity between VA and final products cannot be maintained unless the technology (input-coefficients) matrix remains unchanged. But making that assumption is begging the question how that is possible in a progressive economy?[6] When the theory fails even the best estimates are of dubious quality. Such concerns are well grounded in economic literature[7].

The problem, it seems, arises because of an attempt to relate sectoral RVA directly to the real output of the sector. This, we have already noted above, is unwarranted. It is important to note that both output and intermediate inputs are entities that have real connotations but the sectoral VA, which is the difference between the values of the two entities, does not have a similar real connotation. We can define RVA only by applying the national accounts identity on constant price estimates and violation of this principle must be considered illegitimate.

Following the identity, aggregate RVA is equal to the aggregate final expenditure which, as mentioned above, can be deflated to get the real GDP. Now, it is natural to define sectoral RVA as the relevant sector's command over real GDP obtained by applying the GDP deflator on the sectoral VA. Clearly, an implication of this approach is that sectoral GDP shares at constant prices are the same as those at current prices. There is no case for the imposition of the concept of quantity index on RVA. The sectoral VA has the same dimension as that of GDP and, so, we can talk of sectoral GDP. While structural changes, in the broad sense, in the economy causes changes in sectoral shares, the latter factors-in influences other than changes in physical structure of production like changes in the market structure leading to changes in the degrees of monopoly in different lines of production. This means, for example, when the real output gets doubled the relevant sector's command over real GDP need not double up, and it is this quantity that should be viewed as the sectroal RVA. We illustrate the point below by taking an abstract example of the consequences of technical change.

Section-IV

Factor-augmenting Technical Progress and RVA

In a modern economy technological change in the broad sense affects not only the product but also the organization of production. It does not affect all lines of production in the same way. It leads to changes in the cost and quality of existing products as well as emergence of new products[8] affecting both the structure of intermediate demand represented by the input-output coefficients matrix (the technology matrix denoted by *A* below) and the structure of the final demand vector. The structure of the final demand vector, of course, changes also because of rise in per-capita income as income elasticity of demand vary greatly across sectors. Evolution in the sectoral distribution of GDP gets directly influenced by the above processes. When we are interested in changes over two points in time, say, a decade apart, the difference in the supply-side forces are directly represented in the different technology matrices but not confined to that only.

In the input-output framework, representing input-output coefficients matrix (i.e., the technology matrix) by *A* and the final demand and output vectors of the economy by *F* and *X* respectively, we may write the vector of sectoral value added as:

$$\chi = VX = V(I - A)^{-1}F \qquad \ldots \qquad (1)$$

where *V* is the diagonal matrix of value added per unit of output; all the variables being measured at current prices.

When we compare the production structure of two different periods the question of representation at constant prices arises. Here the idea is to compare real quantities as distinct from values. The solution is straightforward for all the variables on the right-hand side of (1) except *V*. Each variable must be represented at a base year price so that the constant price representations may be viewed as quantity indices. Comparison of two technology matrices is meaningful only when they are based on the same price set. In that case changes in the technology matrix reflect the technical and organizational[9] changes. The concept of constant price sectoral value-added, however, does not have a real (as distinct from value) representation in terms of the sectoral output as discussed in the previous section. This has bearing for the question of deflation of the *V* matrix.

At current prices the sectoral VA is, by definition, the difference between the value of output and the value of intermediate inputs used. Alternatively, VA is also viewed as the contribution of the primary factors in production and, so, it is distributed, conceivably, among primary factors. Payment to labour may possibly be thought as being determined largely by a market driven wage rate; but VA includes, apart from interest on capital, a residual element in the form of profit, which is difficult to be factored as a price and a quantity and is a rather volatile entity. This has important implications for comparison of sectoral distribution of GDP over two points removed from each other by a considerable time lag that makes for significant changes in market conditions. We will take a simple but abstract exercise involving a purely input augmenting technical progress. With this we will skirt around the above complications to highlight the differences in the measure of RVA by the three approaches discussed above.

Let there be only two commodities (sectors): M (for material goods or what is often referred to as commodity) and S (for services). Let us define physical unit of a commodity to be the quantity available for a unit of money in the *base* *year*; so, price of each commodity in unity in the base year. Then, we can take the technology matrix, A, the final demand and production vectors – F and X – all to be represented in real terms (physical units = value) in the base year. For the current year, deflation by relevant price indices is supposed to convert current money values to real values or physical units. But the matter is not so straightforward for RVA. In order to focus on RVA let us make an abstraction and assume A and F, and so, X to remain unchanged between the base year and the current year. Further, we assume the productivity of the only primary input (let us so assume), labour, to increase in the M-sector and remain unchanged in the S-sector with uniform wages across the two sectors (Baumol, 1967 and 1985). We assume price to be equal to unit cost and the whole VA to be distributed to labour.

Let us denote the base year and the current year by subscripts 0 and 1. We denote the sectors by superscripts. So, by assumption, $A_0 = A_1$, $F_0 = F_1$ and $X_0 = X_1$. This means that the real GDP (Y) is the same in the two years; or, $Y_0 = Y_1$. For labour input, to simplify matters further, let it be equal in the two sectors in the base year and let us define the unit of labour such that $l^M_0 = l^S_0 = 1$. Also, we have $l^S_1 = 1$, by assumption.

Due to improvement in productivity in the M-sector, let production of the same output in the M-sector take only half as much labour in the current year as in the base year. Or, $l^M_0 = 2\, l^M_1$. This means distribution of VA between the sectors, which was 1:1 in the base year, is now 1:2 in the current year and VA per unit of output has also changed in the same way; it is now double in the S-sector compared to that in the M-sector. This will be reflected in a rise in the relative price of the S-commodity[10].

Clearly[11], $Y_0 = F^m_0 + F^s_0 = w_0(l^m_0 + l^s_0) = 2w_0$ (as, $l^m_0 = l^s_0 = 1$)... (2)

[By the fundamental national accounts identity]

Further, measuring at constant prices, we have:

$Y_1 = F^m_1 + F^s_1 = w_1(l^m_1 + l^s_1) = w_1(0.5l^m_0 + l^s_0) = 1.5w_1 = 2w_0$ ... (3)
[Since $Y_0 = Y_1$]
We, therefore, have $w_1 = (4/3)w_0$; increased productivity is reflected in increased real wage. But, distribution of VA between the sectors, which was $w_0 : w_0$ (or, 1:1) in the base year, is now $0.5w_1 : w_1 = (2/3)w_0 : (4/3)w_0$; or, 1:2 in the current year in spite of unchanged quantities produced in the two sectors. This is the result one obtains by using the GDP deflator as we have taken the actual VA in the current period and applied the GDP deflator implicitly by equating aggregate VA of the two periods.

We may note here that the distribution of VA at current prices is also is 1:2 in the current year because of the assumption of a single homogeneous primary input. Our assumption only highlights the fact that factor augmenting technical progress may change the distribution of VA (rather paradoxically, against the progressive sector); this point will be missed if RVA is sought to be associated with some sort of quantity index as in the CSO approach. Though the physical quantities produced as well as the technology matrix in the current year remain the same as those in the base year in our illustration, change in RVA per unit of output (*V*-matrix) or a reallocation of value added, so to say, now emerges as a factor explaining the change in relative shares of the sectors. This suggests that real value added must be viewed as share in real GDP and, so, the GDP deflator will also be the value added deflator. Once this norm is accepted the current price sectoral shares will be no different from the constant price sectoral shares.

RVA by the DD procedure in the current year, however, would remain the same as in the base year as output and intermediate inputs remain unchanged by assumption. If this gives any comfort in the fact that RVA can be linked to output, the comfort melts down when we consider that this has been achieved by the assumption of unchanged technology matrix (A) in spite of changes in relative prices. That this will generally not be so was our argument against the procedure though here we have made the unrealistic assumption to highlight a different point taking a simple example of technical change. The DD approach is unable to take into account the change in the relative use of the primary factor of production in the two sectors.

Finally, coming to the CSO approach to RVA, in the above illustration the distribution in the current year will be the same as in the base year if, as is usually done by the CSO, the real sectoral output or some specific intermediate input quantity index is taken as the blow-up factor on base year VA. Like the DD approach, the CSO approach also ignores in most cases the change in the relative use of the primary factor of production in the two sectors. Thus, neither the DD approach nor the CSO approach is capable of taking into account the effects of structural changes, discussed here with the help of a simple example of factor augmenting technical change, on the RVA. The basic point we make here is that sectoral VA refer to value without any one-to-one correspondence with the volume of production. Sectoral shares factor-in influences other than real changes in the technology matrix A and the final demand vector F. So, the quantity index of output must be dissociated from the notion of RVA, otherwise it would be an illegitimate imposition.

Section-V

Summary and Conclusion

Sectoral shares in GDP both at current and at constant prices for the major sectors of the Indian economy have similar trends since early 1950s. However, when we look at the sub-sectors of the tertiary sector, the trends vary quite substantially between current and constant price estimates. While the current price sectoral shares have the unambiguous interpretation as the relevant sector's command over current GDP, one stumbles at what interpretation the constant price shares may have.

The general impression is that a change in constant price VA indicates real change in the relevant sector. Indeed, while the official estimates do not follow a uniform procedure for all the sectors, the thrust is at obtaining quantity indices. While the quantity index is important for its own sake, the method of blowing-up a base year sectoral VA by relevant sector's quantity index lands us into a contradiction with the fundamental national accounts identity. The point here is not of making adjustments to ensure equality of aggregate expenditure and aggregate VA at constant prices however they may be arrived at, but one of adopting estimation methods consistent with the identity at the conceptual level.

While GDP has a real connotation in the form of a basket of final goods and services, quantification problems notwithstanding, sectoral VA does not have a similar real connotation. It is a value not amenable to factorization into price and quantity. Sectoral RVA has the only interpretation as a share in the real GDP and it should be arrived at after deflation of sectoral VA at current prices by the GDP deflator. This has the implication that constant price sectoral shares will be the same as current price sectoral shares.

This, of course, does not undermine the importance of finding quantity indices for sectoral output; only RVA has to be dissociated from the quantity index. Sectoral VA does not have any one to one correspondence with sectoral output or intermediate inputs. It factors in a lot of other influences like factor augmenting technical progress and changes in market structure; these influences affect command of a sector over the real GDP. The double-deflation approach as well as the present official estimation method misses these dimensions entirely.

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Notes:

[1] The primary sector consists of agriculture and allied activities while the secondary sector is taken to include mining, manufacturing, construction and electricity, gas and water supply. The rest belong to the Tertiary sector, its components are shown in tables 1 and 2.

[2] It is a bit different from the accountant's measure of profit.

[3] This, of course, abstracts from the difficulties of measurement, particularly of services (Griliches, 1992). But these difficulties relate basically to problems of estimation, not the concept of RVA.

[4] Unless we allow for this possibility the concept of real GDP itself becomes elusive.

[5] CSO follows the single deflation procedure for the registered manufacturing sector. For other sectors the focus is to find some sort of quantity indices. Difficulty arises particularly in the cases of service activities where in many cases even the concept of the quantity of service is not clear. Relevant issues and the recommendations of the UNSNA has been discussed in Kulshrestha and Kolli (1999) and also in EPWRF (2004).

[6] As discussed in the next section, the identity can be written as $\chi = VX = V(I-A)^{-1}F$, the symbols are obvious, defined in section IV. For any A there exists some V such that the column sum of χ and F are the same. But this equality is not maintained when A varies but V is held fixed, as is implied by blowing up of the base year VA by the current year quantity index.

[7] In a related discussion Burndt and Hulten (2007) refers to Koopman's (1947) concerns regarding measurements without theory.

[8] Emergence of new technologies in the communications sector provides a striking example in the form of mobile phones and other products.

[9] One example is splintering of activity and consequent outsourcing (Bhagwati, 1984).

[10] VA per unit of output may change, in a more general set-up, due to several other factors, including an uneven change in the degree of monopoly in the two sectors.

[11] Internal consistency of the assumptions can be easily verified by writing the price equations and imposing the assumption that labour input in the two sectors are the same and that is, by definition, unity. Then applying the condition $X = (I - A)^{-1}F$ one obtains after some manipulation $F^m_0 + F^s_0 = 2w_0$.

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