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Measuring Agricultural GDP Performance: A technical note

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At the national aggregate level there is a clear distinction between "real gross domestic product" (GDP at market prices in constant terms) and "real gross domestic income" (GDI). GDP at market prices in constant terms is essentially an output volume measure, calculated each year at the level of the whole economy with market prices kept constant at their value in the base year. The concept of GDI goes beyond and tries to measure total real income which residents derive from domestic production. GDI represents the total buying power generated in the economy in the process of production. To arrive to GDI, we have to add to GDP the external terms of trade effect.

When the external terms of trade of a country improves (its export prices increased relatively more than its import prices), it means that a given volume of its exports would buy a bigger bundle of its imports. "An improvement in the (external) terms of trade makes it possible for an increased volume of goods and services to be purchased by residents out of the income generated by a given level of domestic production"[1].

An example could illustrate the importance and relation between these two indicators. Take the cases of Costa Rica and Peru: both countries showed a similar annual average GDP growth (5.4%) during the period 2000-07, however during the same years average GDI growth in Peru (7.2%) was 1.8 percentage points higher than its GDP growth rate and, in the contrary, Costa Rica's GDI growth (4.0%) was 1.4 percentage points lower than its GDP growth rate. The difference was due to the extremely positive evolution of the external terms of trade in Peru, and its negative trend in Costa Rica.

(in million US dollar)

	2000	2001	2002	2003	2004	2005	2006	2007	Average Annual Growth 00-07
Costa Rica									
GDP, at constant prices 2000=100	15.947	16.118	16.586	17.648	18.400	19.485	21.202	22.756	5,4%
GDI (terms of trade adjusted GDP)	15.947	16.009	16.359	17.153	17.713	18.341	19.623	20.990	4,0%
GDP Annual Growth %		1,1%	2,9%	6,4%	4,3%	5,9%	8,8%	7,3%	
GDI Annual Growth %		0,4%	2,2%	4,9%	3,3%	3,5%	7,0%	7,0%	
External Terms of Trade (PX/PM)	100,0	98,2	96,7	94,1	92,2	88,6	85,7	85,0	-2,5%
Peru									
GDP, at constant prices 2000=100	53.336	53.450	56.133	58.397	61.382	65.522	70.473	76.732	5,4%
GDI (terms of trade adjusted GDP)	53.336	53.224	56.015	58.686	63.155	68.464	77.647	84.883	7,2%
GDP Growth %		0,2%	5,0%	4,0%	5,1%	6,7%	7,6%	8,9%	
GDI Growth %		-0,2%	5,2%	4,8%	7,6%	8,4%	13,4%	9,3%	
External Terms of Trade (PX/PM)	100,0	96,9	98,6	102,8	115,2	120,6	148,4	152,0	7,1%

[1] See WB Statistical Manual, National Accounts, Terms of Trade Adjustment, World Bank website.

The same rationale applied at the aggregate economy level should be applied at the sectoral level, especially in the case of agriculture which is the main source of income for the poorest quintiles of developing economies. In many cases "real" agricultural GDP (AGDP) is taken as if it were an indicator of the level of well-being of agricultural families as a whole, though it only represents the amount of net production (discounting all inputs) valued at prices of a certain base year. Therefore, the changes from year to year in the real AGDP, because it is calculated at "constant prices", only reflect changes in the "quantum" of the sectoral production, which does not take into account changes in relative agricultural prices that often are more important in its impact on the agricultural income. In agriculture, it is not strange that increases in production are linked to decreases in producer's income because agricultural prices also decline, caused by excess supply or by other factors. This is part of the own nature of the sector for which supply is inelastic, even more in the short term. Situations of "good" agricultural performance from the point of view of the internal supply of domestic products, can often coincide with "unhappy farmers" because of a reduction of their income due to lower prices. To look only at the AGDP gives a very partial image of what is happening in the sector. There is a need to adjust the real AGDP by the evolution of domestic agriculture relative prices (agriculture terms of trade - ATT), in order to have an indicator of the purchasing power of the quantum of agricultural production obtained during the period [2].

To adjust real GDP to take into account the effect of agriculture terms of trade, we have to estimate the following equation:

1) ATT adjusted AGDP = Real AGDP * ATT

But,

2) $\text{Real AGDP} = \frac{\text{Nominal AGDP}}{\text{AGDP deflator}}$

and,

3) $\text{ATT} = \frac{\text{AGDP deflator}}{\text{GDP deflator}}$

then, using equations (2) and (3):

4) $\text{ATT adjusted AGDP} = \frac{\text{Nominal AGDP}}{\text{GDP deflator}}$

From equation (4), it could be seen that to adjust "real" AGDP by the agriculture terms of trade index is equivalent to divide (deflate) the "nominal" or "current" AGDP by the GDP deflator. The "nominal" AGDP is equal to the agricultural gross value added, which is the

[2] ATT could be defined as the ratio of an agricultural price index with respect to a non-agricultural price index. In this case we are using the "implicit" price index from national accounts statistics and the agricultural GDP deflator is measured against the total GDP deflator, and not only with respect to prices of non-agricultural production.

amount of the agricultural production valued at basic prices minus the amount of its intermediate inputs valued at market prices, during the current period. This concept, commonly found in international data bases of national account statistics as "agricultural gross value added at basic prices" ($AGVA_{bp}$), includes the returns to factors of production engaged in agriculture during a given period, but also includes the consumption of fixed capital (depreciation) incurred during the production period and the net amount of *taxes on production* (taxes minus subsidies)[3]. In order to arrive to a true measure of agricultural "factor income", it will be necessary to subtract from $AGVA_{bp}$ the amounts corresponding to fixed capital consumption and net taxes on production to obtain the "agricultural net value added at factor cost" ($ANVA_{fc}$), as indicated below:

$$ANVA_{fc} = AGVA_{bp} - D - T + S$$

Where,
D = Consumption of fixed capital in agriculture (Depreciation)
T = Taxes on agricultural production
S = Subsidies on agricultural production

The concept of $ANVA_{fc}$ measures "the remuneration of all factors of production (land, capital and labor) and can be termed ***factor income***, as it represents all the value generated by a unit engaged in a production activity"[4]. This measure is referred to the income generated by agricultural activities over a given accounting period, even though the part of the corresponding revenues could be deferred until a later date. ***Factor Income*** is equal to the sum of "compensation of employees" (salaries and other labor cost) and "net operating surplus" (profits, land rents, net interest, self-employment income and other). This definition does not take into account the residence or location of the owners of the production factors. Also, it should not be confused with farmers' household income, in which definition are included other sources of income (non-agricultural activities, rents, income transfers) in addition to income from agricultural activities.

Although $ANVA_{fc}$ is not easily available in national account statistics of many developing economies[5], nominal AGDP (or $AGVA_{bp}$) could be used as a good "proxy", if capital consumption is relatively low with respect to production value and the amount of taxes and subsidies on production are also low, as there usually are in developing economies. Its rate of change could be a good estimator of the rate of change of that factor income[6].

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[3] The concept of "agricultural gross value added at basic prices" ($AGVA_{bp}$) already excludes net taxes minus subsidies *on products*, which refers to taxes or subsidies on goods and services (excluding value added tax, import and export taxes) that become payable as a result of the production, sale, transfer, leasing or delivery of those goods or services, or as a result of their use for own consumption or own capital formation. They have to be differentiated from taxes or subsidies *on production* which mainly consist of current taxes or subsidies on the labor or capital employed in the production. (Stat OECD Glossary)

[4] See Chapter IV Agricultural Income Indicators in EUROSTAT (1997).

[5] $ANVA_{fc}$ is a concept not included explicitly in the System of National Accounts of the United Nations.

[6] As an example, during 2000-07 in Peru the percentage of fixed capital depreciation over agricultural value added was constantly less than 2.5% and the percentage of taxes minus subsidies was nil. In Costa Rica the percentage of depreciation was kept within a close range (8.5%-10.0%) and taxes minus subsidies between 2.8%-3.0%. As a result, there was a very high correlation (0.99) between the growth rates of Agricultural GDP and $ANVA_{fc}$.

Using the changes of the nominal $AGVA_{bp}$ as a "proxy" for changes in agriculture "factor income", there is still another step that has to be made to convert the nominal data to "real" figures, taking into account the evolution of agricultural relative prices. As indicated in equation (3), the nominal agricultural GDP should be divided by the GDP deflator, which is a measure of the change in prices of all new, domestically produced, final goods and services in an economy, we then would get a better idea of agricultural real "factor income" growth.

As an example, the next chart shows three different cases of interaction between the evolution of agriculture production quantum ("real" Agricultural GDP), the evolution of domestic agriculture relative prices (intersectoral terms of trade), and its impact on agricultural factor income. These cases refer to Costa Rica, Peru and Jamaica during the period 2000 to 2007 (except for Costa Rica that has data for 2008). We have divided the time series into two sub-periods 2000-05 and 2005-07 (or 2008 in case of Costa Rica), to show the change in domestic price trends and their relation with international price changes. Notice that during 2000-05, growth of agricultural "real" GDP, in the average, was higher in Peru (3.0%) than in Costa Rica (2.1%), however the different evolution of agricultural relative prices (agricultural terms of trade) in their domestic markets reverse the result in terms of agricultural factor income: in Costa Rica it grew at 2.9% a year, while in Peru it grew only by 0.5% a year during the period 2000-05. In Jamaica, the negative trend of agriculture "real" GDP (-2.7%) was attenuated by a slight increase in agriculture terms of trade on its impact over factor income (-2.3%).

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average Annual Growth 00-05	Average Annual Growth 05-08
Costa Rica											
Agric GDP, at constant prices (2000=100)	423.053	428.949	414.948	445.574	448.806	467.894	526.188	563.668	561.502	2,1%	6,4%
Real Agric. Factor Income (adjusted Agric. GDP)	423.053	395.116	394.439	431.484	442.721	475.249	527.303	545.976	526.336	2,9%	3,5%
Agric. GDP Growth %		1,4%	-3,3%	7,4%	0,7%	4,3%	12,5%	7,1%	-0,4%		
Real Agric. Factor Income Growth %		-6,6%	-0,2%	9,4%	2,6%	7,3%	11,0%	3,5%	-3,6%		
Intersectoral Terms of Trade (PAgric/P global)	100,0	92,1	95,1	96,8	98,6	101,6	100,2	96,9	93,7	0,9%	-2,7%
Change in Intersectoral Terms of Trade		-7,9%	3,2%	1,9%	1,9%	3,0%	-1,3%	-3,3%	-3,2%		
PERU											
Agric GDP, at constant prices (2000=100)	12.775	12.855	13.639	14.045	14.076	14.746	15.830	16.340		3,0%	5,3%
Real Agric. Factor Income (adjusted Agric. GDP)	12.775	12.685	12.430	12.863	12.840	13.007	13.491	14.547		0,5%	5,8%
Agric. GDP Growth %		0,6%	6,1%	3,0%	0,2%	4,8%	7,4%	3,3%			
Real Agric. Factor Income Growth %		-0,7%	-2,0%	3,5%	-0,2%	1,3%	3,7%	4,4%			
Intersectoral Terms of Trade (PAgric/P global)	100,0	98,7	91,1	91,6	91,2	88,2	85,2	89,0		-2,4%	0,5%
Change in Intersectoral Terms of Trade		-1,3%	-7,6%	0,5%	-0,4%	-3,3%	-3,4%	1,1%			
JAMAICA											
Agric GDP, at constant prices (2000=100)	21.206	22.552	20.971	21.984	20.075	18.626	21.588	21.157		-2,7%	6,6%
Real Agric. Factor Income (adjusted Agric. GDP)	21.206	21.096	19.241	18.288	18.670	19.615	20.567	20.855		-2,3%	3,1%
Agric. GDP Growth %		6,3%	-7,0%	4,8%	-8,7%	-7,2%	15,9%	-2,0%			
Real Agric. Factor Income Growth %		-0,5%	-8,8%	-5,0%	2,1%	5,1%	4,9%	1,4%			
Intersectoral Terms of Trade (PAgric/P global)	100,0	93,5	91,7	83,2	93,0	105,3	95,3	98,6		0,4%	-3,3%
Change in Intersectoral Terms of Trade		-6,5%	-1,9%	-9,3%	11,8%	13,2%	-9,5%	3,5%			

During 2005-07, average growth in real agricultural GDP was strong in the three countries (more than 5.3% yearly), but their agricultural relative price trends became negative in Costa Rica (-2.7%) and Jamaica (-3.3%), and slightly positive in Peru (0.5%). These results dumped the income effect in the first two countries and increased the quantum effect in the Peruvian agricultural growth.

Conclusion

Agricultural GDP growth as it is normally published ("quantum" measure) is an important economic indicator to measure the progress or the rate of expansion of the agricultural sector's capacity to produce output and to supply goods needed for final consumption and intermediate use. However, just as important it is to look at the income generated by agricultural GDP growth ("income" measure) as a reflection of future consumption possibilities for the agricultural household, and as a source of improvements to their standard of living over time. We have to connect developments in the "real" agriculture and market prices with its consequences on income and poverty of those who have a high dependency on the agricultural sector.

There is an urgent need to incorporate more effectively the price analysis into our current agricultural policy analysis, based mainly in the appreciation of physical dimensions, like real GDP, production, yields, areas, and the like. The national account statistics is a good source of processed data for sectoral analysis, which primary information is usually provided by the sectoral ministries.

As shown in this technical note, it is possible (with very simple adjustments) to better utilized current agricultural national accounts with important implications for policy design. There is much to gain from a greater integration of the work of agriculture statistical offices and national accounts or social accounts institutions, and from the dissemination of their periodic results between policy decision makers, policy researchers and other stakeholders.

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