De La Salle University
AKI
Angelo King Institute
for Economic and Business Studies

EFFECTS OF RELATIVE PRICES ON CONTRIBUTIONS TO THE LEVEL AND GROWTH OF REAL GDP*

INTRODUCTION

Real GDP of industries as presently computed are limited in use to studying industries *individually* or in *isolation* because they differ in units of measure due to different deflators. For this reason, they need conversion to the same units — using relative prices as weights — for valid analysis in a *group* setting, to determine and compare industry contributions to the level and growth of the economy's real GDP. Unfortunately, relative prices are ignored in existing procedures for real GDP in chained or in constant prices and, consequently, the above industry contributions are subject to problems that this paper seeks to resolve so that these contributions become more meaningful and useful for policies to foster economic growth.

A GENERAL (GEN) FRAMEWORK FOR GDP

In Table 1, the economy's real GDP is obtained by dividing the economy's nominal GDP (i.e., GDP in current prices) by the aggregate GDP deflator. Each industry's real GDP is similarly obtained by dividing industry nominal GDP by the corresponding industry GDP deflator.

Written by
JESUS C. DUMAGAN
School of Economics
De La Salle University

Table 1. *Philippine GDP*						
	GDP in current prices		GDP in constant prices		GDP deflators	
	(million current pesos)		(million constant 2000 pesos)			
	2014	2015	2014	2015	2014	2015
Philippines	**12,642,735**	**13,285,239**	**7,164,016**	**7,579,941**	**1.765**	**1.753**
Agriculture and forestry	1,230,996	1,168,282	587,329	591,215	2.096	1.976
Fishing	197,134	195,653	130,495	128,109	1.511	1.527
Mining and quarrying	125,390	103,826	76,474	75,444	1.640	1.376
Manufacturing	2,603,644	2,669,622	1,666,514	1,762,103	1.562	1.515
Construction	828,161	913,761	422,150	459,586	1.962	1.988
Electricity gas and water supply	411,701	416,579	229,555	240,625	1.793	1.731
Transport communication and storage	783,492	854,259	536,562	579,054	1.460	1.475
Trade and repair of vehicles, personal, and household goods	2,243,271	2,401,777	1,184,994	1,266,656	1.893	1.896
Financial intermediation	988,894	1,060,471	515,484	545,076	1.918	1.946
Real estate renting and business activity	1,553,387	1,714,102	803,241	861,581	1.934	1.989
Public administration, defense, and social security	503,110	506,600	292,441	294,229	1.720	1.722
Other services	1,173,555	1,280,307	718,777	776,263	1.633	1.649

Source: Economic and Social Database (04-06-2016), Philippine Institute for Development Studies from the National Accounts, Gross Domestic Product by Industrial Origin (Revised/Rebased), National Statistical Coordination Board. The GDP deflators above were obtained *implicitly* by dividing GDP in current prices by GDP in constant prices.

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Source: Philippine Institute for Development Studies (2016) as summarized from the National Accounts, Gross Domestic Product by Industrial Origin (Revised/Rebased), National Statistical Coordination Board. The GDP deflators above were obtained *implicitly* by dividing GDP in current prices by GDP in constant prices.

For real GDP in constant prices, the level of the economy's real GDP equals the *simple* sum (i.e., no weights) of the real GDP of industries following the "traditional" (TRAD) aggregation procedure illustrated in Table 1 and re-shown in Table 2. In contrast, this paper proposes an alternative aggregation procedure using relative prices as weights of the real GDP of industries.

Relative price in Table 2 is the ratio of an industry's GDP deflator to the over all GDP deflator from Table 1.[1] By this definition, relative price is the real price per unit of an industry's real GDP measured in "baskets" of overall real GDP as *numeraire*. Therefore, a higher relative price means that a unit of an industry's real GDP is worth more "baskets" in exchange than a unit of another industry's real GDP with a lower relative price. Moreover, using relative price as a weight converts different real GDP of industries into the *same* unit of measure — that is, a "basket" of overall real GDP —

making them "purchasing power parity" (PPP) values in columns (5) and (6), Table 2.[2]

From above, the weighted sum of the real GDP of industries equals the economy's real GDP as shown in Table 2. This weighted sum is the "general"(GEN) aggregation procedure for the level of the economy's real GDP because it is true regardless of the price index formulas underlying the GDP deflators, implying that it is true for GDP in constant or in chained prices. Therefore, the GEN procedure in Table 2 for Philippine GDP in constant prices applies also to US GDP in chained prices and, in principle, to real GDP in any country (Dumagan, 2016).

Table 2. *Level of Philippine Real GDP*						
	TRAD		GEN			
	GDP in constant prices (million constant 2000 pesos)		Relative prices (weights)		GDP in PPP values (million constant 2000 pesos)	
	2014	2015	2014	2015	2014	2015
	(1)	(2)	(3)	(4)	(5) = (1) X (3)	(6) = (2) X (4)
Philippine GDP	**7,164,016**	**7,579,941**	**1.000**	**1.000**	**7,164,016**	**7,579,941**
Industry GDP weighted by relative prices [Columns (5) and (6)]						
Agriculture and forestry	587,329	591,215	1.188	1.127	697,545	666,568
Fishing	130,495	128,109	0.856	0.871	111,706	111,631
Mining and quarrying	76,474	75,444	0.929	0.785	71,052	59,238
Manufacturing	1,666,514	1,762,103	0.885	0.864	1,475,357	1,523,162
Construction	422,150	459,586	1.112	1.134	469,278	521,350
Electricity gas and water supply	229,555	240,625	1.016	0.988	233,291	237,681
Transport communication and storage	536,562	579,054	0.827	0.842	443,966	487,401
Trade and repair of vehicles, personal, and household goods	1,184,994	1,266,656	1.073	1.082	1,271,151	1,370,343
Financial intermediation	515,484	545,076	1.087	1.110	560,358	605,056
Real estate renting and business activity	803,241	861,581	1.096	1.135	880,228	977,987
Public administration, defense, and social security	292,441	294,229	0.975	0.982	285,088	289,042
Other services	718,777	776,263	0.925	0.941	664,996	730,484
Sum	**7,164,016**	**7,579,941**			**7,164,016**	**7,579,941**

Source: Author's calculations from Philippine GDP in Table 1.

By comparing TRAD to GEN in Table 2, TRAD appears problematic in ignoring relative prices because as a resultit understates(overstates) the level contributions to the economy's real GDP of industries with relative prices greater (less) than 1. Moreover, in Table 3, while TRAD recognizes "quantity" growth (i.e., growth in real GDP) as the only source of an industry's contribution, GEN posits two sources, consisting of PGE (pure growth effect) from quantity growth and PCE (price change effect) from "real price" growth (i.e., from a change in relative price). Therefore, an industry's positive quantity growth contribution will be diminished if accompanied by a negative real price growth that may even

[1] Note that the overall GDP deflator is the average of the industry GDP deflators. Therefore, relative price is greater (less) than 1 for industries with above (below) average GDP deflators. Relative prices based on this definition probably first appeared in Tang and Wang's (2004) decomposition of aggregate labor productivity (ALP) growth and their role has gained wider recognition in subsequent studies of ALP or simply of real GDP growth (Diewert, 2015; Dumagan, 2013; Dumagan, 2016; and Dumagan& Balk, 2016).

[2] See Dumagan (2016) for further discussion of the similarity of the above procedure to PPP conversion.

result in a negative net contribution to the economy's GDP growth. On the other hand, an industry's positive quantity growth contribution will be enhanced if accompanied by a positive real price growth.

Table 3. *Growth of Philippine Real GDP*				
	TRAD	GEN		Actual
	GDP growth (percent)	PGE (percent)	PCE (percent)	GDP growth (percent)
	2015	2015	2015	2015
	(1)	(2)	(3)	(2)+(3)
Industry contributions to GDP growth (percentage point)				
Agriculture and forestry	0.05	0.06	-0.50	-0.43
Fishing	-0.03	-0.03	0.03	0.00
Mining and quarrying	-0.01	-0.01	-0.15	-0.16
Manufacturing	1.33	1.18	-0.51	0.67
Construction	0.52	0.58	0.15	0.73
Electricity gas and water supply	0.15	0.16	-0.10	0.06
Transport communication and storage	0.59	0.49	0.12	0.61
Trade & repair of vehicles, personal, & household goods	1.14	1.22	0.16	1.38
Financial intermediation	0.41	0.45	0.17	0.62
Real estate renting and business activity	0.81	0.89	0.47	1.36
Public administration, defense, and social security	0.02	0.02	0.03	0.06
Other services	0.80	0.74	0.17	0.91
Sum = Philippine GDP percent growth	**5.81**	**5.76**	**0.04**	**5.81**

Source: Author's calculations of the TRAD, PGE, and PCE formulas in Dumagan (2016) using the data in Table 1 and Table 2. Discrepancies in the sum (PGE + PCE) in the last column from the individual PGE and PCE are due to rounding.

In Table 3, the sum of TRAD necessarily equals the sum of (PGE + PCE) for all industries and also equals the "actual" 5.81% GDP growth.[3] However, TRAD may differ from (PGE + PCE) for each industry. Consider that PCE captures growth effects of relative price changes that TRAD ignores. Hence, TRAD could yield a positive growth contribution when (PGE + PCE) is negative. This is shown by agriculture and forestry. This industry had a negative PCE due to falling relative prices from 1.188 in 2014 to 1.127 in 2015 (Table 2) that more than offset the positive PGE due to rising real GDP from 587,329 in 2014 to 591,215 in 2015 (Table 2) to end up with a negative (-0.43 percentage points) contribution but TRAD showed a positive result (0.05), that is, an over statement. Compared to (PGE + PCE) from GEN, TRAD overstates (understates) growth contributions of industries with falling (rising) relative prices. Thus, TRAD yields misleading results.

Another case in point in Table 3 is that TRAD identifies manufacturing as contributing the largest (1.33 percentage points) to GDP growth but GEN finds that its contribution is only half as much (0.67=1.18-0.51) after taking out from PGE (1.18) the negative PCE (-0.51) due to a fall in manufacturing relative prices from 0.885 in 2014 to 0.864 in 2015 (Table 2). It turns out according to GEN that the growth drivers are trade and real estate with each contributing about equally (almost 1.4 percentage points). It may be noted that the above GEN findings of a "sluggish" manufacturing and "booming" real estate are consistent with common observation.

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[3] Dumagan (2016) presented formulas and empirical illustrations of the TRAD and GEN—comprising PGE and PCE—procedures for an industry's contribution to the growth of the economy's real GDP.

CONCLUSION

Implications for Policy and Practice

Employing relative prices — ratios of industry GDP deflators to the economy's GDP deflator — as weights of real GDP of industries, this paper presented a GEN framework to determine the effects of differences and changes in relative prices on industry contributions to the level and growth of real GDP in chained or in constant prices. GEN is proposed as an alternative to the TRAD framework that ignores relative prices in determining industry contributions to the level and growth of real GDP.

If relative prices are ignored, level contributions of industries with above (below) average prices are understated (overstated); and, similarly, growth contributions of industries with rising (falling) prices are understated (overstated). These results were borne out by Philippine GDP in constant prices. Thus, by ignoring relative prices, TRAD is problematic by yielding understated or overstated industry contributions that are misleading — for example, the case of manufacturing highlighted above — for formulating programs or policy initiatives to foster economic growth by way of identifying growth drivers among industries. These misleading TRAD results could be mitigated, however, by implementing in GDP practice this paper's GEN framework.

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CONTACT INFORMATION

DLSU - Angelo King Institute for Economic and Business Studies (DSLU-AKI)
Room 223, St. La Salle Hall
2401 Taft Avenue
1004 Manila

Angelo King International Center
Corner of Arellano Avenue and Estrada Street
1004 Manila

+63-2-524-4611 loc. 287,
+63-2-524-5333, +63-2-5245347 (Fax)
http://aki.dlsu.edu.ph