

IMF POLICY PAPER

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QUOTA FORMULA—DATA UPDATE AND FURTHER CONSIDERATIONS—ANNEXES

IMF staff regularly produces papers proposing new IMF policies, exploring options for reform, or reviewing existing IMF policies and operations. The following documents have been separately released:

- The **Staff Report** prepared by IMF staff and completed on July 2, 2014.
- **Staff Supplement** on *Quota Formula – Data Update and Further Considerations – Annexes*.
- **Staff Supplement** on *Quota Formula – Data Update and Further Considerations – Statistical Appendix*.

These documents were prepared by IMF staff and were presented to the Executive Board in an informal session on July 24, 2014. Such informal sessions are used to brief Executive Directors on policy issues, and to receive feedback from them. No decisions are taken at these informal sessions. The views expressed in this paper are those of the IMF staff and do not necessarily present the views of the IMF's Executive Board.

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QUOTA FORMULA—DATA UPDATE AND FURTHER CONSIDERATIONS—ANNEXES

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Annex I. Results of the 2011 International Comparisons Program (ICP)¹

The results of the 2011 International Comparison Program (ICP) were published on April 29, 2014. The 2011 ICP includes further significant improvements in methodology as well as an expansion in geographical scope since the last round in 2005, on which the previous quota data for PPP GDP were based. Overall, the 2011 ICP resulted in significant changes for some individual members' PPP GDP share and a substantial increase in the PPP GDP share for EMDCs. It is difficult to determine the exact factors that contributed to the significant differences between the results from the 2011 benchmark, which are based on a new price survey, and the results derived by extrapolating the 2005 data using national GDP price deflator growth rates. Improvements in methodology and increased country coverage were likely important factors in the changes of members' PPP GDP shares. Recent analysis conducted for the ICP Global Office also suggests that methodological improvements in linking regions of the world together introduced with the 2011 ICP have made the PPP results more reliable across the different world regions.

Background

The quota data for PPP GDP are obtained from the World Economic Outlook (WEO) database, which in turn draws on data prepared by the ICP.² The WEO uses PPP data to compute weights to produce aggregate ratios and growth rates for country groups. The WEO PPP price indices are based on the results of the ICP survey, and the ICP updates its surveys over time (the last survey prior to 2011 was in 2005).³ Purchasing power parities (PPPs) are deflators of bilateral ratios of GDP in national currency to compare the size and price levels of economies around the world. For example, the ratio of Brazilian GDP in reais to US GDP in dollars (USD), whose units are reais/USD, would be deflated by the Brazil-US PPP, whose units also are reais/USD, to obtain the relative volume of GDP between Brazil and the US expressed as a unitless index. If we wish to express this volume in USD units we then multiply the relative volume index by US GDP (the GDP of the numeraire country in national currency units).

Differences between GDP on a PPP basis and GDP on a market exchange rate basis reflect a variety of factors. GDP conversions into a common unit using market exchange rates are generally regarded as producing measures of countries' ability to pay in a common currency of conversion. For internationally traded goods and services, prices measured in given currency units tend toward broadly similar levels in different countries. On the other hand, items that are only domestically consumed ("non-tradables"), particularly services, may have persistently differing prices from country to country when measured in a given currency. Empirically, applying currency exchange

¹ Prepared by Kim Zieschang (STA); and Sheila Bassett, and Carlos Janada (all FIN).

² See the Statistical Appendix for further details.

³ Comprehensive information on the ICP can be found at the following website:
<http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/ICPEXT/0,,contentMDK:22377119~menuPK:6782247~pagePK:60002244~piPK:62002388~theSitePK:270065,00.html>.

rates to compare the size of economies in GDP volume tends to underestimate the purchasing power of money in EMDCs and, thereby, the purchasing power of their economies relative to the advanced economies. PPPs also are more stable than market exchange rates. A wide variety of temporary factors influence market exchange rates, including the stance of monetary policy, currency speculation, temporary changes in the current and capital accounts, and official exchange market interventions. PPPs on the other hand reflect more stable underlying valuations.

The PPP data are widely used. The data are used by researchers as well as a large number of international and regional organizations, including for poverty headcounts (World Bank), WEO (IMF), allocation of structural and cohesion funds (European Commission), Human Development Index (UNDP), health inequality assessment (WHO), and assessment of per capita expenditures in education (UNESCO).

Worldwide PPP-based comparisons of GDP require a comprehensive data collection effort beyond what national statistical offices do. The ICP began in 1968 as a modest research project jointly conducted by the United Nations Statistical Division and the International Comparisons Unit of the University of Pennsylvania. The first round of the ICP in 1970 included only 10 countries. Regionalization of the effort began after the 1975 comparison and the Eurostat-OECD PPP Program became part of the ICP in the early 1980s. The first time all regions of the world were covered was in 1993. The ICP is now the largest international statistical initiative, covering 179 economies and eight geographic regions, including Africa, Asia and the Pacific, the Caribbean, Commonwealth of Independent States (CIS), Latin America, OECD-Eurostat, the Pacific Islands, and Western Asia. The World Bank has been the global coordinator of the ICP since 1993. The IMF has participated on the Executive Board and Technical Advisory Group of the ICP, and has financially contributed to the ICP, since the 2005 round.

The 2005 ICP round was an unprecedented global statistical effort and represented a further major overhaul of methods used. Data collection was overseen by regional coordinating agencies, which compiled the results and produced regional estimates of PPPs. The strong partnership with Eurostat and the OECD and their parallel programs for their members made it possible to combine the results from those efforts with the worldwide effort, thereby producing coverage for 146 economies, far exceeding the number of participants in any previous ICP survey. Work was done in six “regions” of the world (Africa, Asia, CIS, OECD-Eurostat, South America, and Western Asia), overseen by the ICP Global Office in the World Bank. National agencies were responsible for conducting surveys and regional agencies worked on regional comparisons. The 2005 ICP incorporated certain restrictions on the estimation of the global system of PPPs, as some regions did not want the global ICP to make any adjustments to the bilateral PPPs that they had compiled for countries lying within their respective regional territories. This effectively imposed a principle termed (regional) “fixity” on the global comparison. To implement a uniform methodology, the 2005 ICP decided that “fixity” would apply to the PPP estimates within every one of the six ICP regions. This

effectively meant that adjusting the global system of bilateral parities to be transitive⁴ could not be done for all countries at one time, and there was a need to link groups of regional systems of transitive bilateral PPPs together into a global transitive system by calculating a transitive set of region-level parities.⁵ To compute the regional linking factors or parities, the 2005 survey introduced a “ring comparison” technique whereby the regional link factors were computed using price data on a list of products specifically determined for a “ring group” of countries, at least two of which represented each region.⁶ As discussed further below, important changes in the regional linking technique were introduced with the 2011 ICP that made the regional link estimates more reliable.

The 2011 ICP Round and PPP Data Quality

The 2011 round of the ICP has made further headway in strengthening the PPP data. This survey updated the underlying price surveys from 2005 to 2011. Country coverage was expanded and the quality of the price surveys was enhanced, building on the strong base provided by the 2005 ICP. Improvements were made in four major areas: (i) the survey frameworks were strengthened to ensure that data collection would provide the most reliable average prices possible; (ii) an ICP national accounts framework was developed to ensure that expenditure values were compiled in compliance with the System of National Accounts, while also ensuring consistency with prices collected; (iii) the “Ring Approach” used in 2005 to link the regions and the Eurostat-OECD PPPs to the global results was changed to a “global core list” approach in which all participating countries were asked to include a common set of items in the regional list of products they surveyed;⁷ (iv) finally, and more broadly, a research agenda was established and then implemented by the Technical Advisory Group and other experts to advise the Global Office on price survey, expenditure compilation, data validation and computation processes to be applied at the country, regional, and global levels.

Country coverage was increased significantly in the 2011 ICP round compared with the 2005 round. The 2011 round covers 179 economies (of which 164 are Fund member countries) compared to the previous round of 146 countries (143 members). In addition to the eight regions described earlier, there were 20 non-benchmark countries (10 members) for which the PPP factors were

⁴ A system of bilateral parities is *transitive* when for any set three (or more) bilateral comparisons PPP_{ik} , PPP_{ij} , and PPP_{jk} involving countries i , j , and k , $PPP_{ik} = PPP_{ij} \times PPP_{jk}$. This property is not in general satisfied by the initial, directly calculated system of PPPs and is obtained by a statistical adjustment algorithm.

⁵ Thus, for example, the parity of the US with South Africa would be the product of (1) the parity of the US with the OECD-Eurostat region, (2) the parity of the OECD-Eurostat region with the African region, and (3) the parity of the African region with South Africa, with the second parity in this sequence being the regional link factor.

⁶ The “ring” countries thus priced both their regional list of products as well as the “ring” list of products used to link the regions together.

⁷ The 2011 ICP’s regional “fixity” conditions and associated regional linking scheme are broadly similar to those implemented in 2005, except that the regional link factors are based on an international “core list” of products for which prices are collected in all countries rather than only for the selected “ring” group as in 2005. The 2011 “global core list” also contained a broader selection of items found across the world than the 2005 “ring list,” which was based on the items priced in the OECD-Eurostat comparison.

approximated using consumption expenditure. An additional 15 non-benchmark economies (14 Fund members) did not participate in the 2011 survey but their PPPs were estimated by the ICP using a linear regression.

Additional methodological improvements were introduced. A number of methodological changes contributed to often sizeable differences between the PPP GDP data based on the 2011 ICP and the data extrapolated to 2011 from the 2005 ICP data using national GDP volume statistics.

- First, though the methodologies of the 2011 and 2005 ICPs are in many respects similar for global linking and aggregation, the 2011 approach broadened the base of countries from which data were drawn for compiling the regional linking parities to reduce their sensitivity to pricing problems in particular countries. In particular, the 2005 ICP had used data on a specific list of goods and services for only 18 economies as a “ring” to link together the regions of which they were respectively members. By contrast, the 2011 ICP used data on a “core list” of goods and services collected in almost all participating economies to link regions together.⁸
- Second, while the 2011 and 2005 ICPs used a “country-product-dummy” (CPD) regression method to compute PPPs at the basic heading level, the 2011 ICP up-weighted individual products seen as having significant market share in their respective countries.
- Third, the methodology used to calculate dwelling rent differed across regions between 2005 and 2011, with use of an imputed rent method more prevalent in 2011.
- Fourth, the PPPs for government expenditure incorporated productivity adjustments more extensively in 2011 than in 2005.
- Finally, the cost-based methodology for the construction component of capital formation expenditure was simplified in 2011 to labor, materials, and equipment rental, in view of complications encountered with acquiring the greater amount of primary data needed for the basket of the construction components method used in 2005.

Overall, PPP data are as reliable as the national GDP and price statistics from which they are constructed, and are broadly comparable in quality to the other data used in the quota formula. All economic statistics, unless based on a perfectly measured, fully covered population of units, are estimators. The statistics produced by the ICP do not differ in this regard from other economic statistics and, indeed, their properties depend on the properties of the GDP and price estimators underlying them and the methodology employed to link the country estimators.

Nonetheless, as for any set of economic statistics, the implementation of PPPs confronts certain measurement challenges. The PPP data are estimators of the price component of the

⁸ See Deaton, A. and B. Aten, 2014, *Trying to Understand the PPPs in ICP 2011: Why Are the Results So Different?* http://www.princeton.edu/~deaton/downloads/Deaton_Aten_Trying_to_understand_ICP_2011_V3_1.pdf

price-volume decompositions of GDP ratios in national currencies. They are point measures that fall within a margin of error of the unknown true values. The most difficult expenditure components of GDP to measure at both current (national) prices and at purchasing power parity are (i) those resulting from nonmarket production, such as general government services (e.g., education, health, and public administration), (ii) the value of housing services yielded from rented and, especially, owner-occupied dwellings, and (iii) the value of work in progress, construction, and fixed capital formation in the form of structures. In (i), final expenditures are measured as a sum of costs of production, and it is necessary to establish how productively inputs are used to generate the nonmarket public service outputs on which final expenditures are made. The GDP volume arising from nonmarket goods and services is affected by productivity of inputs, and the productivity of inputs is notably affected by capital intensity. Thus, differing productivities between countries compared should be accounted for in factoring the price and volume components of a nominal GDP ratio. In (ii), housing characteristics vary around the world and should be adjusted for in comparing rentals and, for owner occupied dwellings, imputed rentals. The latter affects both imputed level and price of owner-occupied housing, as well as the price of rental housing. International variations in housing characteristics are part of the relative volume (PPP GDP) rather than price (PPP) component of the above factorization of a nominal GDP ratio between countries. Similar considerations apply to comparing fixed capital formation between countries in (iii). Although methods for addressing these issues are conceptually well understood, the data for implementing the methodologies are not always readily available. The 2005 ICP took these challenges into account within the limits of the available information, and the 2011 ICP survey further progressed in addressing the latter two challenges.

Comparing the 2005 and 2011 ICP results

This section compares PPP GDP for the period 2010-12 based on the new 2011 ICP data with estimates using the 2005 ICP data, while recognizing the limitations of such comparisons. The ICP cautions that estimates of PPP rates between benchmark years using changes in GDP deflators relative to the U.S. (as done in the WEO) can lead to large differences relative to the PPP benchmarks, which are based on detailed price surveys.⁹ As noted above, the methodological changes that were introduced and the expanded country coverage with the 2011 ICP survey are also likely to affect the results relative to data based on the 2005 ICP data.

⁹ Extrapolation of PPPs based on relative price deflators would best capture developments in relative PPP GDP if countries had similar economic structures and were evolving in a similar way, which is clearly not the case across the broad range of the Fund's membership. For instance, the share of non-tradables in a given economy might increase (or decrease) over time due to changes in its relative prices that are not captured by simply adjusting the PPP factors by the price differential between that of the domestic economy and the numéraire country, leading to potential distortion over time. In addition, the extrapolations can be affected by changes in terms of trade.

The comparisons reveal significant changes in PPP GDP data (Table AI.1), possibly linked to methodological improvements in linking different regions of the global economy.¹⁰ It is difficult to determine the exact reasons behind the large deviations between PPP GDP based on the 2011 ICP survey and the extrapolated data based on the 2005 ICP survey. However, recent work conducted for the ICP Global Office by Deaton and Aten indicates that the “ring” methodology used to link regional blocks in the 2005 survey may have overstated the relative price levels, and thus understated the GDP-PPP, of poorer regions, and that improved methods introduced in the 2011 ICP avoided this problem. Changes in the methodology for linking the regions, as discussed above, may explain a significant part of the differences between the results of the two ICP rounds. Specifically, the “ring approach” used in 2005 is thought to have significantly understated PPP GDP in many countries outside the OECD-Eurostat region in the 2005 ICP. The improved methodology of the 2011 ICP in linking regions based on price data from all countries in a region is likely to capture better the relative PPP GDP of different regions, and provide a more reliable picture in comparing different regions.

The PPP GDP of many EMDCs records a substantial increase. A total of 151 countries see an increase in their PPP GDP, and global PPP GDP increases by 15.6 percent relative to the estimates based on the 2005 benchmarks. Of the 151 countries whose PPP GDP increases, the majority are EMDCs (20 AEs and 131 EMDCs). In contrast, 36 members see a decline in PPP GDP (5 AEs and 31 EMDCs). The PPP GDP for the United States, which is the numéraire country, remains unchanged. Overall, EMDCs and LICs gain an additional 5.3 pp and 0.4 pp, respectively, in global PPP share with the 2011 ICP compared with data based on the 2005 ICP.

¹⁰ See Deaton and Aten, *op.cit.*

Table AI.1. PPP GDP: 2011 ICP Factors vs. 2005 ICP Factors

	PPP GDP 2010-2012 Average (SDR billions) 1/		PPP GDP Shares (percent)		Change in SDR (percent)	Change in Shares (pps)
	2011 ICP 2/	2005 ICP 2/	2011 ICP 2/	2005 ICP 2/		
Advanced economies	24,609	23,967	41.94	47.22	2.68	-5.28
Major advanced economies	20,264	19,906	34.53	39.22	1.80	-4.68
United States	10,083	10,083	17.18	19.86	--	-2.68
Japan	2,857	2,878	4.87	5.67	-0.71	-0.80
Germany	2,151	1,980	3.67	3.90	8.65	-0.23
France	1,523	1,413	2.59	2.78	7.74	-0.19
United Kingdom	1,420	1,463	2.42	2.88	-2.99	-0.46
Italy	1,316	1,170	2.24	2.30	12.54	-0.06
Canada	914	919	1.56	1.81	-0.54	-0.25
Other advanced economies	4,344	4,061	7.40	8.00	6.98	-0.60
Spain	954	892	1.63	1.76	6.97	-0.13
Netherlands	462	445	0.79	0.88	4.02	-0.09
Australia	621	592	1.06	1.17	4.92	-0.11
Belgium	283	263	0.48	0.52	7.66	-0.04
Switzerland	262	225	0.45	0.44	16.26	0.00
Sweden	254	241	0.43	0.47	5.25	-0.04
Austria	232	222	0.39	0.44	4.29	-0.04
Norway	199	170	0.34	0.34	17.22	0.00
Ireland	126	118	0.22	0.23	7.29	-0.02
Denmark	150	132	0.26	0.26	13.39	-0.01
Emerging Market and Developing Countries 3/	34,072	26,792	58.06	52.78	27.17	5.28
Africa	2,116	1,671	3.61	3.29	26.57	0.31
South Africa	394	356	0.67	0.70	10.68	-0.03
Nigeria	328	265	0.56	0.52	23.88	0.04
Asia	17,947	14,168	30.58	27.91	26.68	2.67
China 4/	8,941	7,451	15.24	14.68	19.99	0.56
India	3,809	2,879	6.49	5.67	32.31	0.82
Korea, Republic of	930	991	1.59	1.95	-6.07	-0.37
Indonesia	1,333	721	2.27	1.42	84.81	0.85
Singapore	240	200	0.41	0.39	19.61	0.01
Malaysia	393	299	0.67	0.59	31.69	0.08
Thailand	563	394	0.96	0.78	43.09	0.18
Middle East, Malta & Turkey	4,405	2,962	7.51	5.83	48.72	1.67
Saudi Arabia	876	530	1.49	1.04	65.43	0.45
Turkey	834	677	1.42	1.33	23.24	0.09
Iran, Islamic Republic of	767	630	1.31	1.24	21.66	0.07
Western Hemisphere	5,118	4,431	8.72	8.73	15.52	-0.01
Brazil	1,811	1,460	3.09	2.88	24.05	0.21
Mexico	1,215	1,103	2.07	2.17	10.15	-0.10
Venezuela, República Bolivariana de	326	241	0.55	0.47	35.14	0.08
Argentina	437	449	0.75	0.89	-2.62	-0.14
Transition economies	4,486	3,561	7.64	7.01	25.98	0.63
Russian Federation	2,077	1,526	3.54	3.01	36.13	0.53
Poland	538	491	0.92	0.97	9.61	-0.05
Total	58,680	50,759	100.00	100.00	15.60	
Memorandum Item:						
EU 28	10,859	10,134	18.51	19.96	7.16	-1.46
LICs 5/	2,067	1,605	3.52	3.16	28.82	0.36

Source: Finance Department.

1/ Based on IFS data through 2012.

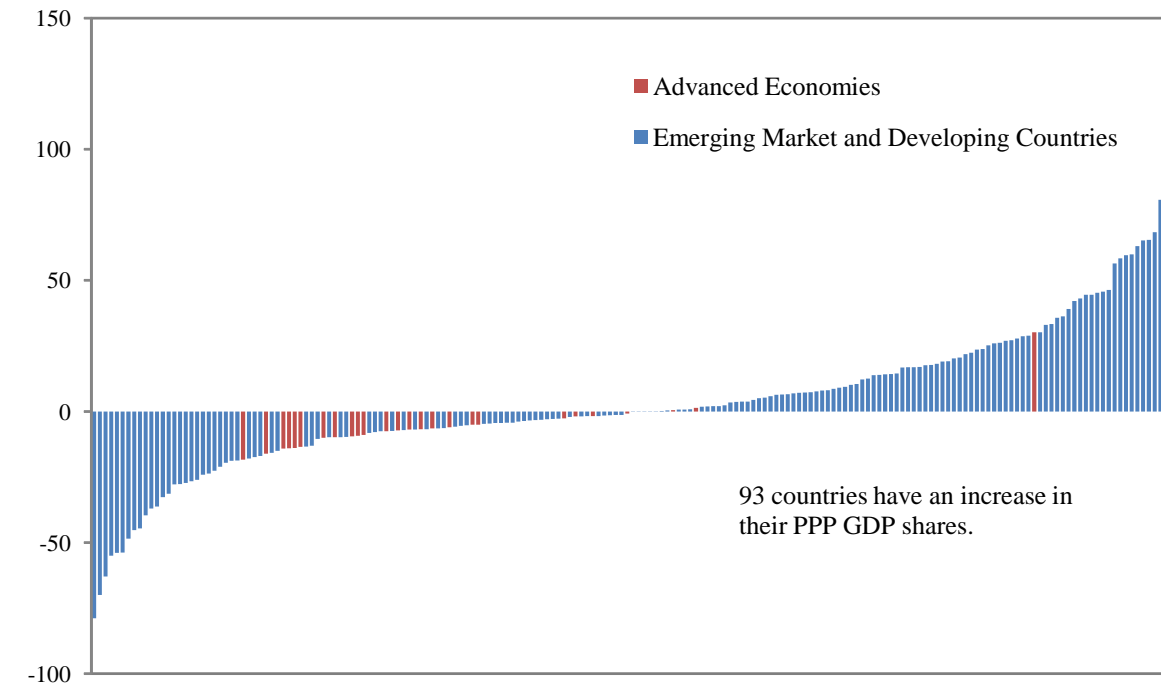
2/ The 2011 ICP column shows PPP GDP for the period 2010-12 based on the new 2011 factors published by the International Comparison Program (ICP) in April 2014; the 2005 column shows the PPP GDP series for the same period based on the 2005 ICP benchmark published in 2007. The two columns utilize the same nominal GDP data in local currency as well as deflators, both obtained from WEO.

3/ Including Czech Republic, Estonia, Korea, Latvia, Malta, Singapore, Slovak Republic, and Slovenia.

4/ Including China, P.R. and Hong Kong SAR. The PPP GDP only includes China, P.R., and Hong Kong SAR.

5/ PRGT-eligible countries

Figure AI.1. Distribution of Change in PPP GDP Shares 1/
(In percent)



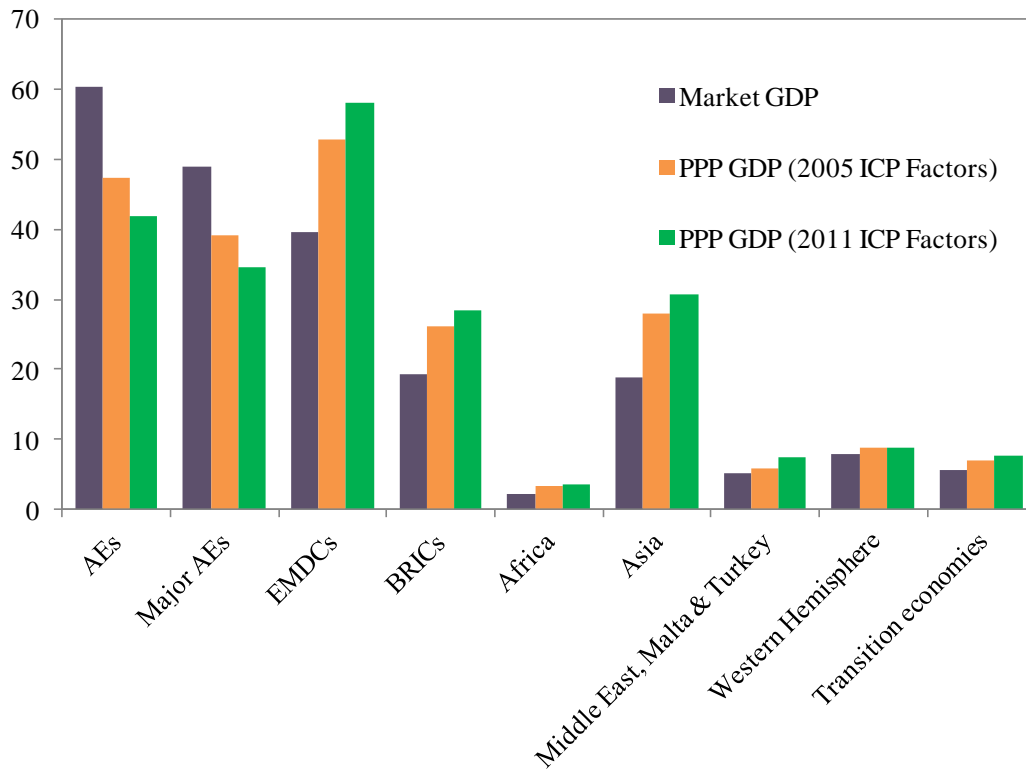
Source: IMF Finance Department.

1/ Percentage change of PPP GDP shares based on 2011 ICP factor relative to PPP GDP shares based on 2005 ICP factor.

In terms of PPP shares, 93 members (mainly EMDCs) gain with the 2011 ICP data compared with the 2005 ICP data (Figures AI.1 and AI.2). Three AEs gain PPP share (Norway, San Marino, and Switzerland) with a very small gain (0.01 pp); the remaining 23 AEs lose (collectively 5.3 pp). Ninety EMDCs gain PPP share (a total of 6.2 pp), but there are also 72 EMDCs losing PPP share (a total of about 1.0 pp). Thirty-eight LICs gain PPP share, resulting in a net gain in PPP GDP share, which increases to 3.5 percent from 3.2 percent. Based on data for 2010-12, EMDCs as a group have about two-fifths of market GDP, while they accounted for a little over half of PPP GDP based on the 2005 PPP factors, and nearly three-fifths after the update (Figures AI.3a and AI.3b).

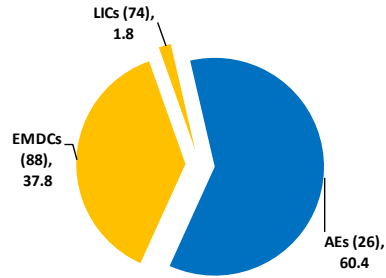
The top twenty gainers of PPP share are all EMDCs. Table AI.2a shows the members with the largest absolute gains and losses in PPP GDP shares. The EMDCs gaining the most include Indonesia (0.9 pp), India (0.8), China (0.6), Russia (0.5), and Saudi Arabia (0.4), which collectively account for nearly 60 percent of the group's increase. The largest reductions in PPP share are generally concentrated among AEs, including the US (-2.7 pp), Japan (-0.8), and the UK (-0.5). Korea, which for purposes of the quota data base is grouped among EMDCs, sees a decline of 0.4 pp. In relative terms (i.e., changes in percent), Zimbabwe's PPP global share gains the most while Kiribati's declines by the largest percentage value (Table AI.2b).

**Figure AI.2: Market and PPP GDP Shares 2010-12
(percent)**



Source: IMF Finance Department.

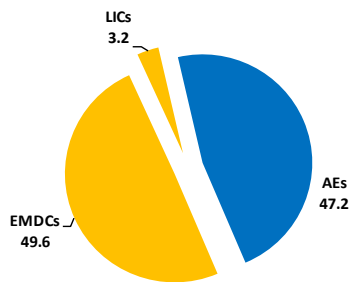
Figure AI.3a. Market GDP Shares (2010-12) *



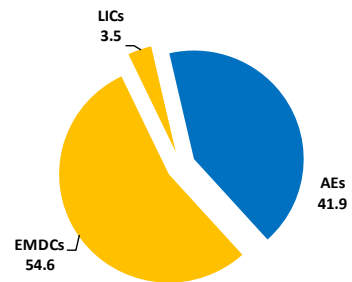
* Numbers in parenthesis represent number of countries; EMDCs excluding LICs

Figure AI.3b. PPP GDP Shares (2010-12)

2005 ICP Factors



2011 ICP Factors



Source: IMF Finance Department

Table AI.2a. Gainers and Losers of PPP Shares (pp) 1/

Top 20 Gainers PPP Shares (pps)			Top 20 Losers PPP Shares (pps)		
1	Indonesia	0.85	1	United States	-2.68
2	India	0.82	2	Japan	-0.80
3	China	0.56	3	United Kingdom	-0.46
4	Russia	0.53	4	Korea, Republic of	-0.37
5	Saudi Arabia	0.45	5	Canada	-0.25
6	Egypt	0.28	6	Germany	-0.23
7	United Arab Emirates	0.25	7	France	-0.19
8	Brazil	0.21	8	Argentina	-0.14
9	Algeria	0.19	9	Spain	-0.13
10	Thailand	0.18	10	Australia	-0.11
11	Iraq	0.18	11	Mexico	-0.10
12	Pakistan	0.17	12	Netherlands	-0.09
13	Philippines	0.11	13	Italy	-0.06
14	Kuwait	0.11	14	Israel	-0.06
15	Kazakhstan	0.11	15	Poland	-0.05
16	Turkey	0.09	16	Czech Republic	-0.05
17	Myanmar	0.08	17	Austria	-0.04
18	Malaysia	0.08	18	Sweden	-0.04
19	Venezuela, R.B. de	0.08	19	Belgium	-0.04
20	Iran, I.R. of	0.07	20	Greece	-0.03

1/ Difference between PPP GDP share based on 2011 ICP factors and PPP GDP share based on 2005 ICP factors.

Table AI.2b. Gainers and Losers of PPP Shares (percent) 1/

Top 20 Gainers PPP Shares (percent)			Top 20 Losers PPP Shares (percent)		
1	Zimbabwe	125.4	1	Kiribati	-78.8
2	United Arab Emirates	80.7	2	Marshall Islands	-69.9
3	Myanmar	68.4	3	Micronesia, FS of	-62.9
4	Iraq	65.4	4	Vanuatu	-54.9
5	Jordan	65.2	5	Timor-Leste	-53.9
6	Libya	63.0	6	Solomon Islands	-53.8
7	Indonesia	59.9	7	Tonga	-48.5
8	Kuwait	59.6	8	Barbados	-45.2
9	Algeria	58.4	9	Palau	-44.6
10	Zambia	56.4	10	Dominica	-39.6
11	Eritrea	46.4	11	Somalia	-37.0
12	Oman	45.7	12	Samoa	-36.3
13	Sudan	45.2	13	Bahamas, The	-32.6
14	Afghanistan	44.5	14	Guyana	-31.4
15	Yemen	44.5	15	Grenada	-27.7
16	Saudi Arabia	43.1	16	Gambia, The	-27.6
17	Egypt	42.1	17	Papua New Guinea	-27.3
18	Kazakhstan	39.1	18	Malawi	-26.6
19	Fiji	36.3	19	Tuvalu	-26.0
20	Mongolia	35.7	20	St. Lucia	-24.1

1/ Percentage difference between PPP GDP share based on 2011 ICP factors and PPP GDP share based on 2005 ICP factors.

Annex II. Variability—Summary of Staff Work

This annex summarizes staff's extensive work program on variability, dating back to the 2008 reform. Overall, staff has found no evidence of a link between the current measure of variability and actual or potential demand for Fund resources. The analysis has also highlighted that the current measure introduces significant instability into calculated quota shares under the quota formula. At the same time, staff has not been able to find a superior alternative measure, notwithstanding extensive work in this area (including outside the Fund). This in part reflects the difficulties in finding a single measure that fits all members, performs well under a wide range of circumstances, and is simple and transparent.

Variability in the quota formula is intended to capture members' potential need for Fund resources. The measure is based on a 13-year time-series (2000-12) of current receipts and net capital flows. Specifically, it is measured as the standard deviation of this series from a centered three-year trend.

Variability has been examined extensively, including in the context of the 2008 Reform and the comprehensive review of the quota formula (see Table AII.1 for a summary of alternative measures that have been examined by staff).¹ The work done to date has produced four main conclusions:

- There is no significant correlation between the current measure of variability and members' use of Fund resources.
- The current measure of variability in the quota formula is not a good proxy of members' balance of payments difficulties or underlying vulnerabilities, even for cases that do not involve members' use of Fund resources.
- The current measure of variability introduces significant instability into calculated quota shares, when the quota database is updated.
- Staff and outside work has not produced a measure that outperforms the current measure of variability in terms of vulnerabilities, transparency, and stability.

At the time of the 2008 Reform, staff undertook extensive work and analyzed a number of alternative formulations of variability measures. This included inter alia various scaling options, downside variability, extreme variability, as well as the volatility of GDP and consumption growth.² These approaches were updated at the onset of the 14th General Review, which reinforced the earlier

¹ Staff has also considered work on this topic outside the Fund, including by the G-24; see for example, A *Comprehensive Review of the IMF Quota Formula: What Should It Entail?* G-24 Secretariat, May 31, 2012.

² *Quota and Voice Reform—Stocktaking and Further Considerations* (7/11/07) <http://www.imf.org/external/np/pp/2007/eng/071107a.pdf>.

conclusion that it was difficult to identify a measure that was clearly superior to the current one in terms of providing an indicator of need for Fund resources, or stability.³

Further staff work was undertaken in the context of the comprehensive review of the quota formula. Empirical analysis suggested that the existing variability measure, even when adjusted for economic size, is virtually uncorrelated with use of IMF resources. Alternative definitions of variability were also examined but none consistently outperformed the current measure in terms of potential use of Fund resources or stability of CQS. Furthermore, staff noted conceptual issues that make it difficult to design a single measure of variability that would be appropriate for all members under all circumstances.⁴ In light of this work, there was considerable support for dropping variability from the formula.

Staff also explored whether the current measure of variability in the quota formula is a good proxy of members' balance of payments difficulties or underlying vulnerabilities. The June 2013 paper broadened the scope of the analysis to include measures of balance of payments difficulties, which might or might not result in the actual use of Fund resources. It found only very weak correlations between the current measure of variability (adjusted for economic size) and indices of exchange market pressure. Similarly, correlations between the current measure of variability and a range of external sector vulnerability indicators (reserves in percent of short-term debt at remaining maturity plus current account deficit; current account in percent of GDP; external debt in percent of GDP; and external debt in percent of exports) were found to be either not significantly different from zero or negative.⁵

The issue of instability in the current measure has also been examined in the context of data updates. This issue was brought to the fore in the 2011 update—the first update to include the global financial crisis (based on data through 2009). That update resulted in very large fluctuations in variability, mainly for advanced countries, which contributed to sharp movements in calculated quota shares.⁶ Subsequent updates continue to show sizable swings in the measure for many countries (see Figure AII.1).⁷ Staff also explored a number of alternative measures to address this issue. However, none of these measures demonstrated a substantial improvement in stability over the current measure.⁸

³ *Quotas—Updated Calculations and Quota Variables* (8/27/09) <http://www.imf.org/external/np/pp/eng/2009/082709.pdf>.

⁴ *Quota Formula Review—Data Update and Further Considerations* (6/28/12) <http://www.imf.org/external/np/pp/eng/2012/062812.pdf>.

⁵ *Quota Formula—Data Update and Further Considerations—Annexes* (6/6/13), Annex IV <http://www.imf.org/external/np/pp/eng/2013/060613.pdf>.

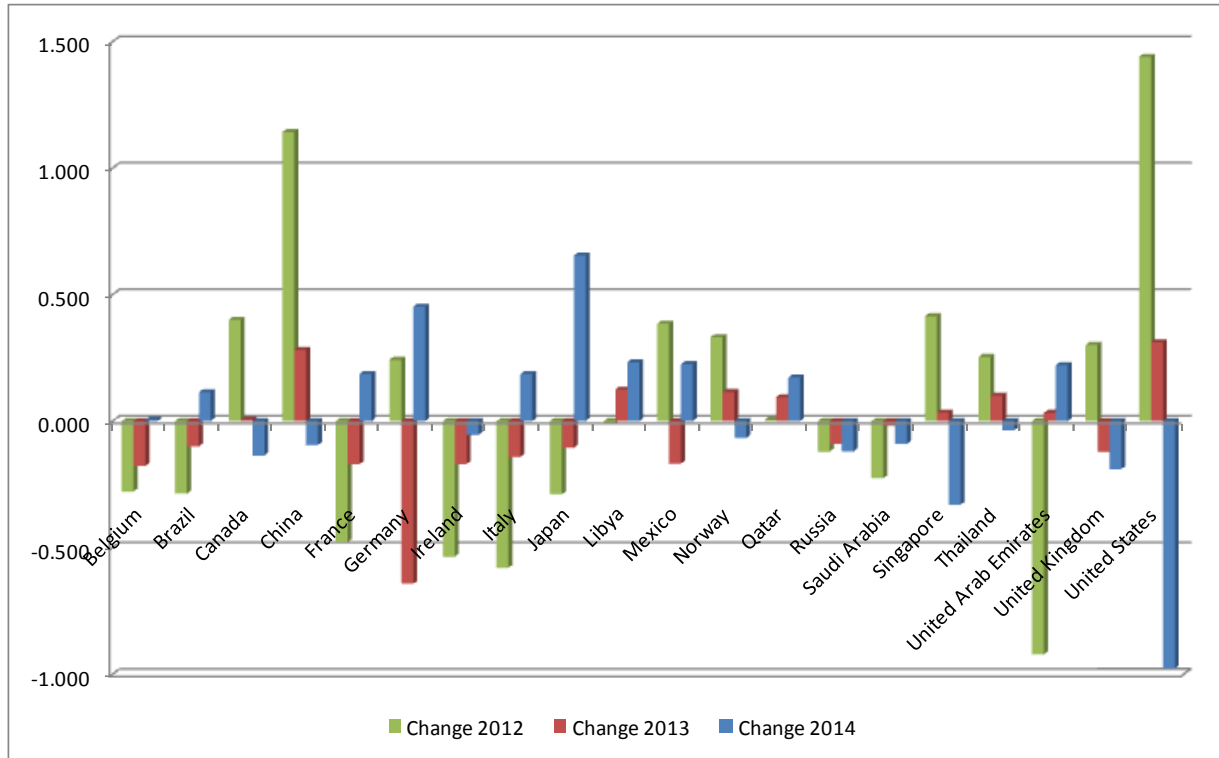
⁶ *Quota Formula Review—Data Update and Issues* (8/17/11) <http://www.imf.org/external/np/pp/eng/2011/081711.pdf>.

⁷ Figure AII.1 shows all the countries that are among the top 10 largest positive or top 10 largest negative changes in variability in at least two of the observations.

⁸ *Quota Formula Review—Data Update and Further Considerations* (6/28/12) <http://www.imf.org/external/np/pp/eng/2012/062812.pdf>.

In summary, staff’s empirical work suggests that the current measure does not capture its intended purpose in the formula and staff’s extensive work in this area has been unable to identify an alternative measure that is superior.

Figure AII.1. Changes in Variability Shares (last 3 updates)



Source: IMF Finance Department

Table AII.1. Alternative Measures of Variability Considered in Staff Papers 1/

Variable	Description
<i>1. Scaled Variability</i>	Variability of current receipts and net capital flows, divided by the country's GDP or the average of current receipts and net capital flows.
<i>2. Scaled Variability with a cap</i>	Scaled variability as defined above expressed as a share and capped at 500 percent of the country's actual quota share.
<i>3. Variability Scaled by GDP per capita</i>	Variability of current receipts and net capital flows divided by per capita GDP and expressed as a share.
<i>4. Variability with 5-year trend</i>	Variability of current receipts and net capital flows calculated as the root square deviation from a 5-year centered moving average over a recent 13-year period.
<i>5. Downside variability</i>	Square root of the sum of squared deviations from below-trend (measured as a 3-year moving average) current receipts and net capital flows.
<i>6. Extreme variability</i>	Similar to downside variability but takes into account only observations that are one standard deviation below the trend (3-year moving average). 2/
<i>7. Variability of current receipts plus variability of capital flows</i>	Sum of variability of current receipts and variability of net capital flows calculated separately.
<i>8. Volatility of GDP growth (un-scaled)</i>	Standard deviation of real GDP growth calculated over a recent 13-year period.
<i>9. Volatility of GDP growth scaled up by GDP</i>	Volatility of GDP growth as defined above multiplied by a recent 3-year average of nominal GDP.
<i>10. Volatility of consumption growth(un-scaled)</i>	Standard deviation of real consumption growth calculated over a recent 13-year period.
<i>11. Volatility of consumption growth scaled up by consumption</i>	Volatility of consumption growth as defined above multiplied by a recent 3-year average nominal consumption.
<i>12. Consumption risk sharing (un-scaled)</i>	Volatility of consumption growth relative to the volatility of income growth.
<i>13. Consumption risk sharing scaled up by consumption</i>	Consumption risk sharing as defined above scaled up using a recent 3-year average of nominal consumption.
<i>14. Variability based on 13-year average absolute deviation</i>	Average absolute deviation from a 3-year centered moving average of current receipts and net capital flows, calculated over a recent 13-year period.

15. <i>Variability based on 5-year standard deviation</i>	Standard deviation from the sample mean of current receipts and net capital flows, calculated over a recent 5-year period.
16. <i>Variability based on 5-year average absolute deviation</i>	Average absolute deviation from the sample mean of current receipts and net capital flows calculated over a recent 5-year period.
17. <i>Variability based on 5-year median absolute deviation</i>	Median absolute deviation from the sample median of current receipts and net capital flows, calculated over a recent 5-year period.
18. <i>Variability based on 5-year maximum deviation from the mean</i>	Maximum absolute deviation from the sample mean of current receipts and net capital flows, calculated over a recent 5-year period.
19. <i>Instability index</i>	Average absolute deviation of the change in current receipts and net capital flows relative to the slope of a linear regression of current receipts and net capital flows on a time variable, including a constant.
20. <i>Composite variability</i>	A composite vulnerability score is calculated as a linear combination of the current account to GDP ratio, reserve cover ratio, per capita GDP and real GDP growth with weights equal to the inverse of the cross-sectional standard deviation of the variables. The raw composite vulnerability score is transformed into a non-negative variable, which is then scaled up with the country's share in GDP and rebased.
21. <i>Per capita income</i>	GDP measured at market exchange rates divided by population.
<p>1/ Definitions and illustrative calculations for measures 1-13, except measure 2, can be found in <i>Quota and Voice Reform—Stocktaking and Further Considerations</i> (7/11/07) http://www.imf.org/external/np/pp/eng/071107a.pdf. Updated calculations are also available in <i>Quota—Updated Calculations and Quota Variables</i> (8/27/09) http://www.imf.org/external/np/pp/eng/2009/082709.pdf where measure 2 is also discussed. Measures 14-20 are considered in <i>Quota Formula Review—Data Update and Further Considerations</i> (6/28/12) http://www.imf.org/external/np/pp/eng/2012/062812.pdf. Measure 21 can be found in <i>Quota Formula Review—Further Considerations</i> (11/8/12) http://www.imf.org/external/np/pp/eng/2012/110812a.pdf.</p> <p>2/ A version based on a 5-year moving average was considered as well.</p>	