Alternative Methods for Interpolating PPPs

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Abstract

The paper draws on a previous paper by Diewert and Fox which addressed two problems: (i) how to measure aggregate real output and inflation for a group of countries and (ii) how to construct measures of real GDP for a group of countries where the country measures of real GDP are comparable across time and space. In order to address both problems, it is necessary that the group of countries construct Purchasing Power Parities (PPPs). The present paper looks at the related problem of interpolating PPPs between benchmark years when PPPs have been constructed. The paper shows that the method of interpolation that was suggested by Diewert and Fox is equivalent to a variant of the method used by the Penn World Tables to interpolate PPPs between benchmarks. The interpolation methods are compared to actual OECD PPPs for the years 2001-2017.

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Purchasing Power Parities, PPPs, ICP, OECD country statistics, inflation, price and volume indexes, Fisher indexes, Pseudo Fisher indexes, country competiveness.

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1. Introduction

For many purposes, researchers want estimates of real GDP by country that are comparable across the countries in a group of countries. For each member country in the group of countries under consideration, national statistical agencies provide national price and quantity (or volume) indexes for the GDP of each member country. However, these indexes are not comparable across countries. International organizations like the OECD and the World Bank provide either *annual comparisons* of real GDP across their member countries (this is the case for the OECD) or *occasional benchmark comparisons* of GDP for a "world" group of countries (this is the case for the World Bank). Given this background, a number of questions arise:

- How indexes of "world" real GDP and inflation be calculated?
- How should the cross sectional comparisons of real GDP be combined with the time series comparisons of real GDP to construct "harmonized" indexes of real GDP that can be compared over time and space?
- Given that cross sectional comparisons of GDP for a group of countries are made only on an occasional basis, how can the cross sectional comparisons be interpolated between benchmarks in order to obtain a complete time series of cross sectional comparisons?

The OECD and the Penn World Tables have addressed the first two problems; see OECD (2001), (2014), Eurostat (2012) and Feenstra, Inklaar and Timmer (2015) for various approaches to addressing these problems. The interpolation problem has been addressed by Feenstra, Inklaar and Timmer (2015) and Diewert and Fox (2017) who offer competing methods for solving the problem. In this paper, we will review the Diewert and Fox suggested methods for addressing the above three problems. The main new result in this paper is to show that the method of interpolation suggested by Diewert and Fox is equivalent to the *blended method of interpolation* which is very close to the interpolation method suggested by Feenstra, Inklaar and Timmer.

2. Basic Definitions and Pseudo Laspeyres, Paasche and Fisher Volume Indexes

We assume that there are K countries in a comparison of international prices and quantities for some group of commodities over T time periods.[2] The *value aggregate* for country k in time period t is denoted by V_k^t for k = 1,...,K and t = 1,...,T. These value aggregates are measured in units of domestic currencies. We further assume that *country price indexes* P_k^t (or the corresponding *quantity or volume indexes* Q_k^t) are available for the K countries over the T time periods under consideration. These three sets of variables satisfy the following consistency restrictions:

(1) $V_k^t = P_k^t Q_k^t$; k = 1,...,K and t = 1,...,T.

[2] Typically, the length of the time period will be a year and so below, we will sometimes refer to annual estimates. But the length of the period may be a quarter or a month or any other suitable measure of time.

In addition to the above three sets of variables, we initially assume that a time series of *Purchasing Power Parities* (PPPs) is available for each country and each time period; i.e., we assume the availability of the series PPP_k^t for k = 1,...,K and t = 1,...,T.[3] PPP_k^t is denominated in units of the currency of country k and it represents the price in domestic currency of a comparable bundle of the products in the aggregate under consideration.[4] Thus V_k^t, P_k^t, Q_k^t and PPP_k^t are the *four fundamental series* that will be used in the subsequent definitions.

Real relative volumes (or quantities) for each country can be obtained for each year by dividing the national currency aggregate values V_k^t by the corresponding PPP_k^t for that year. Denote the resulting *relative volumes* by r_k^t. Thus we have:

(2) $r_k^t \equiv V_k^t/PPP_k^t$; k = 1,...,K and t = 1,...,T.

The r_k^t can be normalized into *period t country shares* σ_k^t of a "world" aggregate by using the following definitions:

(3) $r^t \equiv \Sigma_{k=1}^K r_k^t$; t = 1,...,T;
(4) $\sigma_k^t \equiv r_k^t/r^t$; k = 1,...,K and t = 1,...,T.

Estimates of "world" real expenditures on the aggregate in question can be defined by the following fixed base *Pseudo Laspeyres, Paasche and Fisher world volume indexes*:

(5) $Q_L^t \equiv \Sigma_{k=1}^K \sigma_k^1(Q_k^t/Q_k^1)$; t = 1,...,T;
(6) $Q_P^t \equiv [\Sigma_{k=1}^N \sigma_k^t(Q_k^t/Q_k^1)^{-1}]^{-1}$; t = 1,...,T;
(7) $Q_F^t \equiv [Q_L^t Q_P^t]^{1/2}$; t = 1,...,T.

Note that the OECD uses the Laspeyres definition (5) to define OECD real GDP. However, since the Paasche counterpart (6) to the Laspeyres definition (5) is simply the Laspeyres definition run backwards, it seems more appropriate to take an average of the two estimates of "world" volume given by (5) and (6) in order to obtain a final estimate.

The second thing to note is that it is not necessary to use the Pseudo Fisher index (7) in order to construct estimates of "world" volume: one could convert the country aggregate values into a common currency and then use these common currency country values V_k^t/e_k^t (where e_k^t is the exchange rate for country k in period t relative to a numeraire country) along with the country volumes Q_k^t and then use normal index number theory to calculate a true world Fisher index. We did this in Diewert and Fox (2017) and compared the resulting world growth rates with their pseudo Fisher counterparts and found some

[3] In subsequent sections, we will assume that the PPPs are only available for periods 1 and t; i.e., only PPP_k^1 and PPP_k^T are available for k = 1,...,K.
[4] If there were only one commodity in the aggregate, then PPP_k^t would simply be the price of one unit of the product or service in domestic currency, measured in units of measurement that are comparable across countries. For more materials on the construction of PPPs, see the OECD (2001) and Eurostat (2012).

small differences.[5] The exchange rate method Fisher growth rates were less smooth than the pseudo Fisher estimates which do not use exchange rates (but do use PPP's).

The r_k^t defined by (2) enable us to compare real volumes across the member countries in the group of countries at a single time period but they do not allow us to make comparisons across time periods. It is possible to link the cross sectional comparisons of real output or consumption to growth rates over time by multiplying the cross sectional comparisons at time period t, the r_k^t for k = 1,...,K, by the national volume growth rate of for a numeraire country, say country n, in order to obtain the volumes $r_k^t(Q_n^t/Q_n^1)$ for k = 1,...,K and t = 1,...,T. These volume estimates would respect the relative volumes defined by the r_k^t for each time period t and would also respect the intertemporal relative volumes for country n. The problem is that different choices for the numeraire country would lead to different choices for the resulting intertemporal comparisons. Thus some averaging of these numeraire based intertemporal volumes is necessary in order to obtain numeraire independent estimates of volume that are consistent over time and space. The OECD uses the weighted average of the country growth weights defined by (5) above to achieve numeraire independent estimates of relative country volumes while Diewert and Fox (2017) used the weighted average growth weights defined by (7) above. In the following section, we will define (in more detail) the DF method for achieving obtaining estimates of real output that can be compared across time and space.

3. The Diewert and Fox Consistent over Time and Space Volume and Price Indexes

We use the above definitions to construct the Diewert and Fox volume indexes for each country that are consistent with the cross sectional indexes defined by the r_k^t and are consistent with the intertemporal aggregate pseudo Fisher indexes Q_F^t defined by (7) above. Define the *Diewert and Fox volume index for country n in period t*, q_k^t, as follows:[6]

$$
\begin{aligned}
(8)\ q_k^t &\equiv \sigma_k^t r^1 Q_F^t ; && k = 1,...,K;\ t = 1,...,T;\\
&= (V_k^t/PPP_k^t)(r^1/r^t)Q_F^t && \text{using definitions (2)-(4)}\\
&= (P_k^t Q_k^t)(1/PPP_k^t)(r^1/r^t)Q_F^t && \text{using the identities (1).}
\end{aligned}
$$

Note that $q_k^1 = V_k^t/PPP_k^t$ (since $Q_{FP}^1 = 1$) and $q_k^T = (V_k^T/PPP_k^T)(r^1/r^T)Q_F^T$ for k = 1,...,K. The above real country volumes for periods 1 and T can be calculated just using national accounts information on the countries for periods 1 and T along with a knowledge of the PPP_k^t for periods t = 1 and t = T. The sum of the q_k^t over k for t = 1 and for a general t can be calculated as follows using definitions (8):

$$
\begin{aligned}
(9)\ \Sigma_{k=1}^K q_k^1 &\equiv \Sigma_{k=1}^K \sigma_k^1 r^1 Q_F^1\\
&= \Sigma_{k=1}^K (r_k^1/r^1) r^1 1 && \text{using definitions (4)-(7) for t = 1}\\
&= \Sigma_{k=1}^K r_k^1;
\end{aligned}
$$

[5] In the Appendix to this paper, we will extend the Diewert and Fox comparisons using more recent OECD data.

[6] Diewert and Fox (2017) omitted the normalizing factor r^1 in their definition of relative volumes that were consistent over time and space.

$$(10)\ \Sigma_{k=1}^{K} q_k^t \equiv \Sigma_{k=1}^{K} \sigma_k^t r^1 Q_F^t ; \qquad t = 2,3,...,T$$
$$= \Sigma_{k=1}^{K} (r_k^t/r^t) r^1 Q_F^t \qquad \text{using (4)}$$
$$= r^1 Q_F^t \qquad \text{using (3)}$$
$$= \Sigma_{k=1}^{K} q_k^1 Q_F^t \qquad \text{using (3) and (9).}$$

Equations (9) and (10) imply that the following relationships hold:

$$(11)\ (\Sigma_{k=1}^{K} q_k^t)/(\Sigma_{k=1}^{K} q_k^1) = Q_F^t ; \qquad t = 1,...,T.$$

Thus the sum of the volumes over countries in period t divided by the base period sum of the volumes is equal to the period t Pseudo Fisher volume index defined by (7) above.

We interpret the q_k^t as the consistent over time and space volumes[7] for the value aggregates, V_k^t, or "true" volumes or quantities. The corresponding *consistent over time and space price indexes* for the value aggregates ρ_k^t are defined by deflating the values V_k^t by the "true" volume or quantity indexes q_k^t; i.e., define the *"true" price index* for country k in time period t as follows:

$$(12)\ \rho_k^t \equiv V_k^t/q_k^t ; \qquad k = 1,...,K; t = 1,...,T.$$

4. The Diewert and Fox Interpolated Price and Volume Indexes

In this section, we consider using the fixed base country rates of volume growth, Q_k^t/Q_k^1, to extrapolate forward the base period real volumes, the q_k^1, for k = 1,...,K; i.e., define the *forward extrapolated real country volume for country k in period t*, q_{fk}^t, as follows:

$$(13)\ q_{fk}^t \equiv q_k^1(Q_k^t/Q_k^1) ; \qquad k = 1,...,K; t = 1,...,T;$$
$$= (P_k^1 Q_k^1)/(1/PPP_k^1)(Q_k^t/Q_k^1) \qquad \text{using definitions (8)}$$
$$= (P_k^1/PPP_k^1)Q_k^t.$$

The corresponding *forward extrapolated price index for country k in period t*, p_{fk}^t, is defined as the observed V_k^t divided by the forward extrapolated real country volume q_{fk}^t.[8]

$$(14)\ p_{fk}^t \equiv V_k^t/q_{fk}^t ; \qquad k = 1,...,K; t = 1,...,T;$$
$$= P_k^t Q_k^t/[(P_k^1/PPP_k^1)Q_k^t] \qquad \text{using (1) and (13)}$$
$$= PPP_k^1(P_k^t/P_k^1).$$

[7] The consistency of the q_k^t with each cross sectional comparison of volumes generated by using the PPPs is clear. The q_k^t are not fully consistent with the time sequence of the individual country national volumes Q_k^t; the q_k^t have only the aggregate time consistency property defined by equations (10).

[8] The p_{fk}^t defined by (14) are not normalized to equal unity for a base country for each period t; i.e., the p_{fk}^t are predictors for the "true" intertemporally consistent price indexes ρ_k^t defined by (12). The ρ_k^t have only one normalization; i.e., one of the ρ_k^t is set equal to unity for a single country, say k = 1 or k = K, and for a single time period, say t = 1.

Note the symmetry of the last equation in (14) with the first equation in (13). Note also that we do not require a knowledge of the "true" PPP's for the periods between 1 and T in order to calculate the q_{fk}^t and p_{fk}^t for all t = 1,...,T.

Now use the (fixed base) country rates of volume growth, Q_k^t/Q_k^T, to extrapolate backward the final period real volumes, the q_k^T, for k = 1,...,K; i.e., define the *backward extrapolated real country volume for country k in period t*, q_{bk}^t, as follows:

$$\begin{aligned}(15)\ q_{bk}^t &\equiv q_k^T(Q_k^t/Q_k^T)\ ; && k = 1,...,K;\ t = 1,...,T;\\ &= (V_k^T/PPP_k^T)(r^1/r^T)Q_F^T(Q_k^t/Q_k^T) && \text{using definition (8)}\\ &= (P_k^TQ_k^T/PPP_k^T)(r^1/r^T)Q_F^T(Q_k^t/Q_k^T) && \text{using (1)}\\ &= (r^1/r^T)Q_F^T(1/PPP_k^T)Q_k^t.\end{aligned}$$

The corresponding *backward extrapolated price index for country k in period t*, p_{bk}^t, is defined as the observed V_k^t divided by the backward extrapolated real country volume q_{bk}^t:

$$\begin{aligned}(16)\ p_{bk}^t &\equiv V_k^t/q_{bk}^t\ ; && k = 1,...,k;\ t = 1,...,T;\\ &= (r^T/r^1)(1/Q_F^T)PPP_k^T(P_k^t/P_k^T) && \text{using (115).}\end{aligned}$$

We consider two methods for harmonizing the long run consistent over time and space indexes of aggregate volume growth, q_k^T/q_k^1, with the national indexes of aggregate volume growth, Q_k^T/Q_k^1, for k = 1,...,K. The first method (suggested by Diewert and Fox (2017)) works by adjusting the forward extrapolated volumes $q_{fk}^t \equiv q_k^1(Q_k^t/Q_k^1)$ defined by (13) by growth factors that will ensure that the adjusted volumes for period T equal the "true" consistent volumes for period T, the q_n^T, defined by definitions (13) for t = T.

Define for each country k the national growth rates of the real aggregate under consideration by G_k and the corresponding harmonized (consistent over time and space) growth rates over the sample period by g_k as follows:

$$(17)\ G_k \equiv Q_k^T/Q_k^1\ ; \qquad k = 1,...,K;$$
$$(18)\ g_k \equiv q_k^T/q_k^1\ ; \qquad k = 1,...,K.$$

It would be ideal if $G_n = g_n$ for each n but this will not happen in real life. Thus we define the *error factors*, α_k, for each country k as follows:

$$(19)\ \alpha_k \equiv [g_k/G_k]^{1/(T-1)} = [g_k/G_k]^{1/1(T-1)}\ ; \quad k = 1,...,K.$$

Now define the Diewert and Fox adjusted *forward extrapolated volume for country k in period t*, q_{DFn}^t, as follows:

$$(20)\ q_{DFk}^t \equiv q_k^1(Q_k^t/Q_k^1)(\alpha_k)^{t-1}; \qquad k = 1,...,K;\ t = 1,...,T$$

The above definitions imply the following equalities using definitions (20) for t = T:

$$(21)\ q_{DFk}^{T} = q_k^{1}(Q_k^{T}/Q_k^{1})(\alpha_k)^{T-1}; \qquad \text{for } k = 1,...,K$$
$$= q_k^{1}(Q_k^{T}/Q_k^{1})([q_k^{T}/q_k^{1}]/[Q_k^{T}/Q_k^{1}])^{(T-1)/(T-1)} \qquad \text{using definitions (17)-(19)}$$
$$= q_k^{T}.$$

Thus Diewert and Fox used the national growth rates Q_n^t/Q_n^{t-1} adjusted by the error factors α_n to form estimates for the "true" volumes q_n^t defined by (8). These estimates q_{DFn}^t will only be approximations for t = 2,3,...,T−1 but they will equal the "true" q_n^t for t = 1 and t = T.

5. The Blended Method for Volume Interpolations

The second interpolation method is easier to understand. Recall that the period t forward and backward extrapolated estimates for the "true" q_k^t were defined by (13) and (15) as $q_{fk}^t \equiv q_k^1(Q_k^t/Q_k^1)$ and $q_{bk}^t \equiv q_k^T(Q_k^t/Q_k^T)$. The *blended method of interpolation* forms estimates for q_k^t by taking geometric averages of the q_{fk}^t and the q_{bk}^t with weights that vary as t varies. Thus the blended estimates q_{Bk}^t, are defined as follows:

$$(22)\ q_{Bk}^t \equiv [q_{fk}^t]^{(T-t)/(T-1)}[q_{bk}^t]^{(t-1)/(T-1)}; \qquad k = 1,...,K;\ t = 1,...,T.$$

Thus the weight on the forward estimate starts at 1 in period 1 and declines linearly with time until the weight becomes 0 in period T. The weights on the backward estimates move in the opposite direction. The above method for blending two alternative series for the same underlying variable is a variant of the geometric mean splicing method discussed by Hill and Fox (1997).[9]

Fortunately, we do not have to make a choice between the DF and blended methods for interpolation: *both methods generate the same interpolated series*. To show this, start off with the definition of the period t blended volume series q_{Bk}^t given by (22):

$$(23)\ q_{Bk}^t \equiv [q_{fk}^t]^{(T-t)/(T-1)}[q_{bk}^t]^{(t-1)/(T-1)}; \qquad k = 1,...,K;\ t = 1,...,T$$
$$= [q_k^1(Q_k^t/Q_k^1)]^{(T-t)/(T-1)}[q_k^T(Q_k^t/Q_k^T)]^{(t-1)/(T-1)} \qquad \text{using (13) and (15)}$$
$$= [q_k^1(Q_k^t/Q_k^1)]^{(T-t)/(T-1)}[q_k^1(Q_k^T/Q_k^1)(\alpha_k)^{T-1}(Q_k^t/Q_k^T)]^{(t-1)/(T-1)} \qquad \text{using (21) for } q_k^T$$
$$= q_k^1(Q_k^t/Q_k^1)(\alpha_k)^{t-1}$$
$$= q_{DFk}^t \qquad \text{using (20).}$$

Thus the blended interpolated volume series, q_{Bk}^t, coincide with the Diewert and Fox interpolated volume series, q_{DFk}^t.

6. Interpolating the Diewert and Fox Consistent over Time and Space Price Indexes

The blended method of interpolation used definitions (13) and (15) for q_{fn}^t and q_{bn}^t. Instead of applying the blended method to volumes, we can apply the blended method to

[9] Hill and Fox blended together two series which provided independent estimates for the same economic variable by taking a geometric mean of the two series with equal weights on the two series. Here we take geometric means with linearly declining and increasing weights for the two series.

interpolate price indexes using definitions (14) and (16) for the forward and backward extrapolated price indexes, $p_{fk}^t \equiv PPP_k^1(P_k^t/P_k^1)$ and $p_{bk}^t \equiv (r^T/r^1)(1/Q_F^T)PPP_k^T(P_k^t/P_k^T)$. However, these price indexes are estimates for the underlying "true" price indexes, ρ_k^t, which are *proportional* to PPPs when t is held constant. It is usual for PPPs to be normalized, where say the Kth PPP is set equal to unity. Thus we use definitions (14) and (16) in order to define the following *normalized forward and backward extrapolated PPP's*:

$$(24)\ PPP_{fk}^t \equiv p_{fk}^t/p_{fK}^t ; \qquad k = 1,...,K;\ t = 1,...,T$$
$$= PPP_k^1(P_k^t/P^1)/[PPP_K^1(P_K^t/P_K^1)] \qquad \text{using (14);}$$
$$(25)\ PPP_{bk}^t \equiv p_{bk}^t/p_{bK}^t ; \qquad k = 1,...,K;\ t = 1,...,T$$
$$= (r^T/r^1)(1/Q_F^T)PPP_k^T(P_k^t/P_k^T)/[(r^T/r^1)(1/Q_F^T)PPP_K^T(P_K^t/P_K^T)] \qquad \text{using (16)}$$
$$= PPP_k^T(P_k^t/P_k^T)/PPP_K^T(P_K^t/P_K^T)].$$

Note that the forward and backward normalized PPP's defined by (24) and (25) can be defined using just the PPP's for periods 1 and T and the national price indexes P_n^t. Quantity or volume information is not required in order to calculate the above extrapolated PPPs.

Now apply the blended method of interpolation to the normalized PPP series defined by (24) and (25). Thus the *blended PPP estimates* for period t, PPP_{Bk}^t, are formed as follows:

$$(26)\ PPP_{Bk}^t \equiv [PPP_{fk}^t]^{(T-t)/(T-1)}[PPP_{bk}^t]^{(t-1)/(T-1)} ; \qquad k = 1,...,K;\ t = 1,...,T.$$

The above blended method for interpolating PPPs between benchmarks is equivalent to the Diewert and Fox method for forming interpolated PPPs and is very similar to the interpolation method used in the Penn World Tables to interpolate between benchmark years, except that the blended method defined by (26) uses geometric averaging of the forward and backward extrapolated PPPs whereas the Penn World Tables uses arithmetic averaging of the extrapolated PPPs.[10]

In the Appendix, we illustrate how close the blended PPPs come to the annual series of country PPPs that are published by the OECD for the years 2001-2017. The Appendix also calculates the DF comparable across countries and time price and volume indexes for 36 OECD countries for these years.

7. Conclusion

The DF method for forming "world" real GDP can be applied at any level of aggregation provided that national price and volume indexes exist for the aggregate in question and provided that either annual or occasional benchmark PPPs are available for the aggregate.

[10] See Feenstra, Inklaar and Timmer (2015).

In the case of occasional benchmark PPPs, the blended method for forming PPPs for the missing years should provide reasonable estimates for the missing PPPs.

Appendix: Price and Volume Indexes Using OECD Data, 2001-2017

As was mentioned in the text, the basic series that were needed to evaluate the various indexes defined in the main text were V_k^t, P_k^t, Q_k^t and PPP_k^t. For our comparison of the various indexes, we used national GDP data for 36 OED countries over the period 2001-2017. The series were downloaded from OECD.STAT. The GDP value data for V_k^t were taken from the national accounts section of the tables in OECD.STAT, namely Table B1: Gross Domestic Product (expenditure approach), national currency, current prices in millions, annual data. The volume data for Q_k^t were taken from Table B1: Gross Domestic Product (expenditure approach), national currency, constant prices in millions of 2010 currency units, OECD base year, annual data. The national GDP price indexes P_k^t were formed residually as $P_k^t \equiv V_k^t/Q_k^t$ for k = 1,...,36; t = 2001,...,2017. The national price indexes P_k^t were divided by P_k^{2001} and the quantity indexes Q_k^t were multiplied by P_k^{2001} for all k and t. Thus the national price indexes were normalized to equal one in the base period and an offsetting normalization was made to preserve the values V_k^t in each period. In what follows, the resulting normalized prices and quantities will still be labelled as P_k^t and Q_k^t.

The Purchasing Power Parity series for OECD countries, PPP_k^t, was taken from the OECD.STAT series on Purchasing Power Parities for GDP; national currency per US Dollar so that the PPP for the US was set equal to unity for all years.

The listing of the 36 OECD countries in our sample is as follows:

- 1= Australia
- 2= Austria
- 3= Belgium
- 4= Canada
- 5= Chile
- 6= Czech Republic
- 7= Denmark
- 8= Estonia
- 9= Finland
- 10= France
- 11= Germany
- 12= Greece
- 13= Hungary
- 14= Iceland
- 15= Ireland
- 16= Israel
- 17= Italy
- 18= Japan
- 19= Korea
- 20= Latvia
- 21=Lithuania
- 22= Luxembourg

- 23= Mexico
- 24= Netherlands
- 25= New Zealand
- 26= Norway
- 27= Poland
- 28= Portugal
- 29= Slovak Republic
- 30= Slovenia
- 31= Spain
- 32= Sweden
- 33= Switzerland
- 34= Turkey
- 35= United Kingdom
- 36= United States.

Using the above OECD.STAT tables for the above 36 countries, the Pseudo Laspeyres, Paasche and Fisher aggregate OECD volume indexes, Q_L^t, Q_P^t and Q_F^t defined by (5)-(7) in the main text can be calculated. The resulting indexes are listed in Table A1 below. Note that Q_L^t is the official aggregate volume index for the 36 countries. It turns out that there is very little difference between the Pseudo Laspeyres index Q_L^t and our preferred Pseudo Fisher index Q_F^t.

As was mentioned in the main text, instead of computing Pseudo Laspeyres, Paasche and Fisher indexes, one could convert all prices and values into a numeraire currency and compute regular Laspeyres, Paasche and Fisher indexes of OECD GDP. In order to do these alternative calculations, we require annual exchange rate series, which are also available from OECD.STAT. Thus denote e_k^t as the US dollar exchange rate for country k in year t in terms of US dollars. This series is in OECD.STAT national accounts Dataset 4: PPPs and exchange rates; period averages, national currency per US dollar. The national prices and values, P_k^t and V_k^t, are converted into US dollar values and prices, P_k^{t*} and V_k^{t*}, using the following definitions:

(A1) $P_k^{t*} \equiv P_k^t/e_k^t$; k = 1,...,36; t = 2001,...,2017.
(A2) $V_k^{t*} \equiv V_k^t/e_k^t$; k = 1,...,36; t = 2001,...,2017.

The US dollar values V_k^{t*} defined by definitions (A2) can be used to define the following US dollar measures of nominal OECD GDP, V^{t*}, and the US dollar country k GDP shares, s_k^{t*}, as follows:

(A3) $V^{t*} \equiv \Sigma_{k=1}^{36} V_k^{t*}$; t = 2001,...,2017;
(A4) $s_k^{t*} \equiv V_k^{t*}/V^{t*}$; k = 1,...,36; t = 2001,...,2017.

The year t fixed base *Laspeyres, Paasche and Fisher volume indexes* of OECD GDP measured in US dollars, Q_L^{t*}, Q_P^{t*} and Q_F^{t*}, are defined as follows using the above definitions:

(A5) $Q_L^{t*} \equiv \Sigma_{k=1}^{36} s_k^{2001*}(Q_k^t/Q_k^{2001})$; t = 2001,...,2017;
(A6) $Q_P^{t*} \equiv [\Sigma_{k=1}^{36} s_k^{t*}(Q_k^t/Q_k^{2001})^{-1}]^{-1}$; t = 2001,...,2017;

(A7) $Q_F^{t*} \equiv [Q_L^{t*} Q_P^{t*}]^{1/2}$; t = 2001,...,2017.

The Fisher US dollar volume indexes, Q_F^{t*}, are listed in Table 1 below. The companion US dollar denominated OECD aggregate year t fixed base *Laspeyres, Paasche and Fisher price indexes*, P_L^{t*}, P_P^{t*} and P_F^{t*}, are defined as follows:

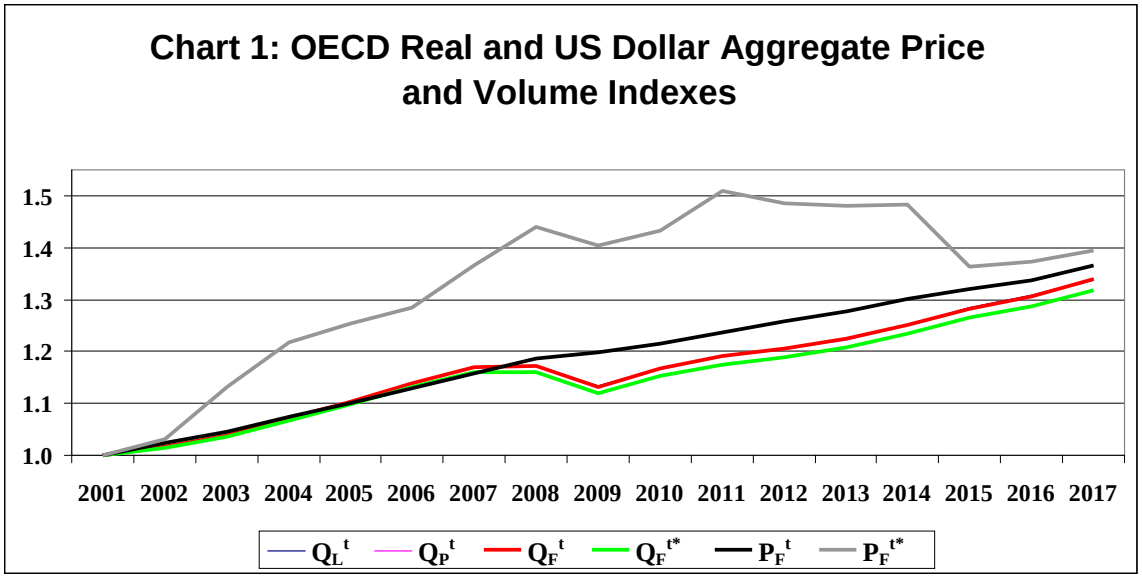
(A8) $P_L^{t*} \equiv \Sigma_{k=1}^{36} s_k^{2001*} (P_k^{t*}/P_k^{2001*})$; t = 2001,...,2017;
(A9) $P_P^{t*} \equiv [\Sigma_{k=1}^{36} s_k^{t*} (P_k^{t*}/P_k^{2001*})^{-1}]^{-1}$; t = 2001,...,2017;
(A10) $P_F^{t*} \equiv [P_L^{t*} P_P^{t*}]^{1/2}$; t = 2001,...,2017.

The US dollar Fisher OECD aggregate GDP price index, P_F^{t*}, is listed below in Table 1 and can be compared with its Pseudo Fisher counterpart index, P_F^t.

Table 1: OECD GDP Volume Indexes Using Real Shares, Q_L^t, Q_P^t and Q_F^t, Fisher US Dollar OECD GDP Volume and Price Indexes, Q_F^{t*} and P_F^{t*}, and Real Share OECD Fisher Price Indexes P_F^t

Year t	Q_L^t	Q_P^t	Q_F^t	Q_F^{t*}	P_F^t	P_F^{t*}
2001	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2002	1.01665	1.01657	1.01661	1.01488	1.02380	1.03203
2003	1.03820	1.03800	1.03810	1.03560	1.04637	1.13252
2004	1.07263	1.07232	1.07247	1.06815	1.07320	1.21776
2005	1.10362	1.10318	1.10340	1.09810	1.09970	1.25440
2006	1.13877	1.13844	1.13860	1.13139	1.12831	1.28491
2007	1.16894	1.16865	1.16879	1.15998	1.15720	1.36560
2008	1.17246	1.17234	1.17240	1.16128	1.18557	1.44008
2009	1.13275	1.13205	1.13240	1.11954	1.19855	1.40470
2010	1.16675	1.16650	1.16662	1.15332	1.21474	1.43359
2011	1.19021	1.19018	1.19020	1.17352	1.23744	1.50921
2012	1.20612	1.20555	1.20584	1.18961	1.25753	1.48644
2013	1.22512	1.22358	1.22435	1.20874	1.27632	1.48119
2014	1.25175	1.25058	1.25116	1.23375	1.30042	1.48289
2015	1.28406	1.28243	1.28324	1.26603	1.31927	1.36364
2016	1.30774	1.30519	1.30647	1.28691	1.33823	1.37358
2017	1.34026	1.33768	1.33897	1.31718	1.36619	1.39559

The above series are plotted in Chart 1 below.



The Pseudo Laspeyres, Paasche and Fisher volume indexes, Q_L^t, Q_P^t and Q_F^t, cannot be distinguished in the above Chart. The Pseudo Fisher volume indexes, Q_F^t, do differ from their US dollar counterparts, Q_F^{t*}, but the differences are small. However, the Pseudo Fisher price indexes, P_F^t, are substantially different from their US dollar counterparts, the P_F^{t*}. P_F^t grows very steadily throughout the sample period while P_F^{t*} has substantial fluctuations. As was noted in Diewert and Fox (2017), not only do price indexes based on converting all national currency prices and values into a common numeraire currency fluctuate violently, the resulting price indexes are not independent of the choice of the numeraire currency and so the use of this type of price index is not recommended.[11]

The Diewert and Fox consistent over time and space price indexes for country k and time period t, ρ_k^t, were defined by equations (12) in the main text as $\rho_k^t \equiv V_k^t/q_k^t$ where V_k^t is the nominal GDP of country k in year t in units of domestic currency and q_k^t is the Diewert and Fox consistent over time and space real GDP for country k in period t. We list the ρ_k^t in Table 2 below. To save space, the year variable has been replaced by t which runs from 1 to 17, which corresponds to the years 2001-2017. Using Table 2 and the official OECD.STAT table for the V_k^t, the reader can recover the q_k^t as V_k^t/ρ_k^t.

Table 2: Consistent Over Time and Space GDP Deflators for OECD Countries

t	ρ_1^t	ρ_2^t	ρ_3^t	ρ_4^t	ρ_5^t	ρ_6^t	ρ_7^t	ρ_8^t	ρ_9^t
1	1.32747	0.92202	0.89151	1.22011	291.96743	14.30840	8.68354	0.48740	1.00168
2	1.36545	0.91930	0.89223	1.25598	303.75049	14.77167	8.74716	0.49678	1.01976
3	1.40489	0.92132	0.90882	1.27054	315.85026	14.70524	8.97070	0.50391	1.03941
4	1.45174	0.93444	0.94534	1.31097	340.32002	15.35203	9.00280	0.52533	1.03567
5	1.51510	0.96245	0.97320	1.32444	364.15287	15.89192	9.35175	0.54928	1.06884
6	1.59294	0.97741	0.99360	1.36861	362.04256	16.38205	9.41825	0.59188	1.08292

[11] Diewert and Fox (2017) showed that volume indexes that are based on the use of common currency prices and values are invariant to the choice of the numeraire currency so the use of this type of volume index is not subject to the lack of invariance problem that common currency price indexes have.

7	**1.66684**	**1.01529**	**1.02792**	**1.41700**	**378.54458**	**16.67498**	**9.54560**	**0.64458**	**1.09322**
8	**1.77948**	**1.02796**	**1.04302**	**1.48510**	**409.44767**	**16.74325**	**9.55761**	**0.65576**	**1.09738**
9	**1.75957**	**1.02969**	**1.03747**	**1.46637**	**432.10716**	**16.64433**	**9.43507**	**0.63109**	**1.09409**
10	**1.85928**	**1.04206**	**1.03511**	**1.51229**	**444.91064**	**16.91668**	**9.39231**	**0.63363**	**1.11418**
11	**1.91684**	**1.05464**	**1.05532**	**1.57288**	**441.47603**	**16.92916**	**9.47160**	**0.64899**	**1.13924**
12	**1.99130**	**1.05201**	**1.06299**	**1.60922**	**448.95128**	**17.19334**	**9.78010**	**0.67371**	**1.17464**
13	**1.91985**	**1.05746**	**1.06951**	**1.62384**	**463.90989**	**16.96181**	**9.75744**	**0.69308**	**1.20111**
14	**1.95320**	**1.07417**	**1.07607**	**1.65450**	**493.80310**	**17.08237**	**9.85508**	**0.70852**	**1.21995**
15	**1.98915**	**1.08066**	**1.08373**	**1.68641**	**533.31988**	**17.60930**	**9.90991**	**0.72921**	**1.22965**
16	**2.03602**	**1.09703**	**1.10142**	**1.71642**	**551.75336**	**17.81748**	**10.08249**	**0.73888**	**1.24061**
17	**2.04824**	**1.11444**	**1.11821**	**1.74108**	**562.42229**	**18.23763**	**10.07195**	**0.76652**	**1.25783**

t	ρ_{10}^t	ρ_{11}^t	ρ_{12}^t	ρ_{13}^t	ρ_{14}^t	ρ_{15}^t	ρ_{16}^t	ρ_{17}^t	ρ_{18}^t
1	**0.91081**	**0.92880**	**0.66781**	**114.297**	**88.21061**	**0.96842**	**3.42412**	**0.81550**	**149.599**
2	**0.92020**	**0.93305**	**0.67734**	**120.702**	**93.07988**	**1.00328**	**3.53772**	**0.84134**	**146.890**
3	**0.96461**	**0.92938**	**0.71066**	**126.567**	**96.06549**	**1.04142**	**3.75997**	**0.86458**	**144.570**
4	**0.99515**	**0.93123**	**0.73909**	**136.622**	**99.27410**	**1.05477**	**3.75875**	**0.90654**	**142.843**
5	**1.00012**	**0.95239**	**0.77370**	**142.883**	**104.59005**	**1.10407**	**4.05626**	**0.93321**	**141.379**
6	**1.01681**	**0.96326**	**0.78697**	**149.438**	**115.50503**	**1.11175**	**4.30111**	**0.93515**	**141.370**
7	**1.03938**	**0.97919**	**0.84004**	**156.785**	**125.55350**	**1.12009**	**4.34377**	**0.94653**	**140.632**
8	**1.06099**	**0.98703**	**0.85174**	**157.613**	**137.78785**	**1.13627**	**4.65265**	**0.94287**	**140.578**
9	**1.05316**	**0.98987**	**0.85969**	**155.833**	**148.85932**	**1.09993**	**4.83584**	**0.94132**	**140.558**
10	**1.05746**	**0.99609**	**0.89332**	**156.411**	**164.41654**	**1.05111**	**4.92196**	**0.95661**	**138.239**
11	**1.06731**	**1.00055**	**0.90468**	**157.645**	**171.44679**	**1.05481**	**5.00412**	**0.96243**	**136.311**
12	**1.09164**	**1.01787**	**0.88524**	**162.426**	**177.09321**	**1.06420**	**5.11411**	**0.96678**	**134.822**
13	**1.07678**	**1.02788**	**0.83751**	**165.806**	**181.78349**	**1.07623**	**5.09383**	**0.97815**	**134.395**
14	**1.08596**	**1.03401**	**0.82181**	**174.028**	**186.30930**	**1.10139**	**5.29875**	**0.99462**	**138.577**
15	**1.10065**	**1.05397**	**0.82540**	**180.365**	**192.35961**	**1.09906**	**5.22765**	**1.00443**	**138.978**
16	**1.10460**	**1.06916**	**0.82780**	**185.261**	**197.50664**	**1.11255**	**5.25285**	**0.99010**	**137.440**
17	**1.10875**	**1.08436**	**0.83268**	**193.254**	**195.95164**	**1.13167**	**5.27160**	**1.00071**	**138.582**

t	ρ_{19}^t	ρ_{20}^t	ρ_{21}^t	ρ_{22}^t	ρ_{23}^t	ρ_{24}^t	ρ_{25}^t	ρ_{26}^t	ρ_{27}^t
1	**0.91081**	**0.92880**	**0.66781**	**114.297**	**88.211**	**0.96842**	**3.42412**	**0.81550**	**149.599**
2	**0.92020**	**0.93305**	**0.67734**	**120.702**	**93.080**	**1.00328**	**3.53772**	**0.84134**	**146.890**
3	**0.96461**	**0.92938**	**0.71066**	**126.567**	**96.065**	**1.04142**	**3.75997**	**0.86458**	**144.570**
4	**0.99515**	**0.93123**	**0.73909**	**136.622**	**99.274**	**1.05477**	**3.75875**	**0.90654**	**142.843**
5	**1.00012**	**0.95239**	**0.77370**	**142.883**	**104.590**	**1.10407**	**4.05626**	**0.93321**	**141.379**
6	**1.01681**	**0.96326**	**0.78697**	**149.438**	**115.505**	**1.11175**	**4.30111**	**0.93515**	**141.370**
7	**1.03938**	**0.97919**	**0.84004**	**156.785**	**125.554**	**1.12009**	**4.34377**	**0.94653**	**140.632**
8	**1.06099**	**0.98703**	**0.85174**	**157.613**	**137.788**	**1.13627**	**4.65265**	**0.94287**	**140.578**
9	**1.05316**	**0.98987**	**0.85969**	**155.833**	**148.859**	**1.09993**	**4.83584**	**0.94132**	**140.558**
10	**1.05746**	**0.99609**	**0.89332**	**156.411**	**164.417**	**1.05111**	**4.92196**	**0.95661**	**138.239**
11	**1.06731**	**1.00055**	**0.90468**	**157.645**	**171.447**	**1.05481**	**5.00412**	**0.96243**	**136.311**
12	**1.09164**	**1.01787**	**0.88524**	**162.426**	**177.093**	**1.06420**	**5.11411**	**0.96678**	**134.822**
13	**1.07678**	**1.02788**	**0.83751**	**165.806**	**181.783**	**1.07623**	**5.09383**	**0.97815**	**134.395**
14	**1.08596**	**1.03401**	**0.82181**	**174.028**	**186.309**	**1.10139**	**5.29875**	**0.99462**	**138.577**
15	**1.10065**	**1.05397**	**0.82540**	**180.365**	**192.360**	**1.09906**	**5.22765**	**1.00443**	**138.978**
16	**1.10460**	**1.06916**	**0.82780**	**185.261**	**197.507**	**1.11255**	**5.25285**	**0.99010**	**137.440**
17	**1.10875**	**1.08436**	**0.83268**	**193.254**	**195.952**	**1.13167**	**5.27160**	**1.00071**	**138.582**

t	ρ_{28}^t	ρ_{29}^t	ρ_{30}^t	ρ_{31}^t	ρ_{32}^t	ρ_{33}^t	ρ_{34}^t	ρ_{35}^t	ρ_{36}^t
1	**0.67022**	**0.51518**	**0.55956**	**0.74681**	**9.39247**	**1.76693**	**0.41455**	**0.69381**	**1.00000**
2	**0.68665**	**0.53282**	**0.59593**	**0.75840**	**9.61767**	**1.74681**	**0.60406**	**0.70483**	**1.02167**
3	**0.69480**	**0.56467**	**0.63059**	**0.78761**	**9.84012**	**1.77928**	**0.76404**	**0.72186**	**1.03611**
4	**0.71954**	**0.60072**	**0.64684**	**0.81505**	**9.89083**	**1.80039**	**0.84302**	**0.73199**	**1.06359**

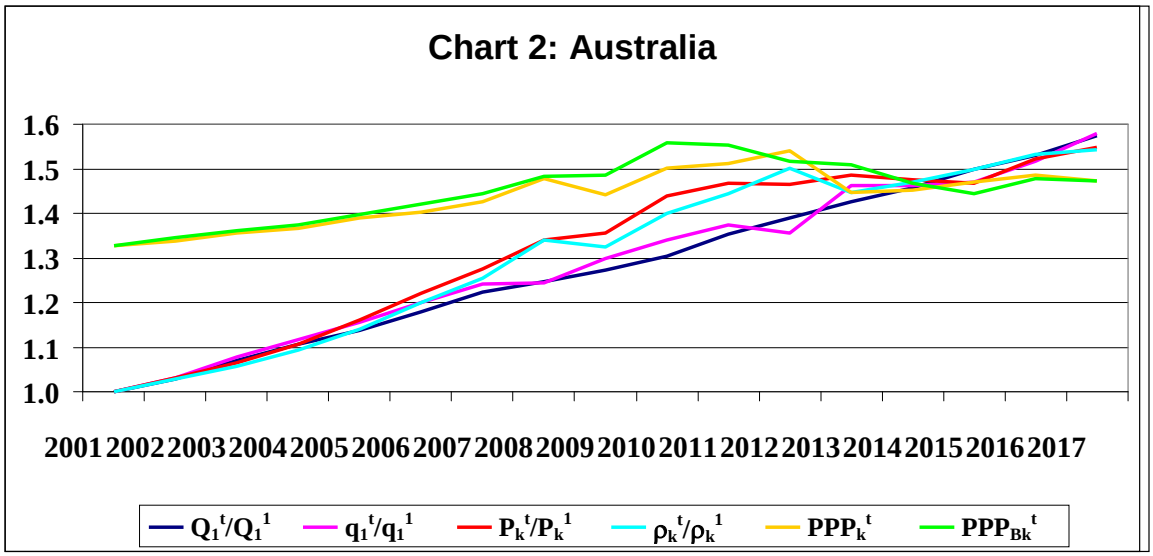
5	**0.72490**	**0.61627**	**0.66583**	**0.83976**	**10.34455**	**1.84051**	**0.91078**	**0.77222**	**1.09129**
6	**0.72753**	**0.63030**	**0.69290**	**0.83646**	**10.35512**	**1.81708**	**0.95671**	**0.79155**	**1.13546**
7	**0.75642**	**0.64760**	**0.73718**	**0.85652**	**10.37645**	**1.79176**	**0.99557**	**0.82942**	**1.16812**
8	**0.76535**	**0.64658**	**0.76251**	**0.87329**	**10.56203**	**1.79629**	**1.05868**	**0.84421**	**1.20310**
9	**0.76559**	**0.62919**	**0.78774**	**0.87708**	**10.88686**	**1.79406**	**1.10401**	**0.86657**	**1.22043**
10	**0.77100**	**0.62124**	**0.78929**	**0.89944**	**11.16637**	**1.81399**	**1.13872**	**0.86890**	**1.23843**
11	**0.79041**	**0.64240**	**0.79154**	**0.90591**	**11.21909**	**1.77279**	**1.22564**	**0.89566**	**1.26855**
12	**0.78275**	**0.65235**	**0.78456**	**0.89857**	**11.19024**	**1.75076**	**1.31863**	**0.90718**	**1.29296**
13	**0.77425**	**0.65156**	**0.78327**	**0.89524**	**11.40627**	**1.74122**	**1.41992**	**0.92236**	**1.32667**
14	**0.77842**	**0.65275**	**0.79505**	**0.89069**	**11.73562**	**1.72362**	**1.48526**	**0.93922**	**1.34473**
15	**0.79496**	**0.66638**	**0.80885**	**0.90322**	**12.10320**	**1.67715**	**1.62643**	**0.94325**	**1.35242**
16	**0.80310**	**0.67238**	**0.81978**	**0.90839**	**12.44035**	**1.68849**	**1.78094**	**0.96169**	**1.37057**
17	**0.82401**	**0.68756**	**0.83565**	**0.91499**	**12.66164**	**1.69788**	**2.01873**	**0.99251**	**1.39147**

Note that the price index for country 36 (the US) in period 1 (2001) is equal to 1. Thus ρ_k^t can be interpreted as the number of domestic currency units for country k that are required to buy one unit of US 2001 GDP in year t.

In the following 36 Tables and Charts, we will compare the (normalized) national volume indexes for each country k, Q_k^t/Q_k^1, with the corresponding (normalized) consistent over time and space volume indexes, q_k^t/q_k^1, where the q_k^t are defined by (8). The national volume indexes are likely to be more accurate than the harmonized volume indexes but the latter indexes are useful in situations where it is necessary to make intercountry comparisons of real GDP. The differences between the Q_k^t/Q_k^1 and the q_k^t/q_k^1 will illustrate the costs of the attempt to construct measures of real GDP that are comparable across space and time. Similarly, we will compare (normalized) national GDP deflators, P_k^t/P_k^1, with their harmonized (normalized) counterparts, ρ_k^t/ρ_k, where the ρ_k^t are defined by (12). Finally, we will compare the official OECD Purchasing Power Parities, PPP_k^t, with the Diewert and Fox blended PPPs, PPP_{Bk}^t, defined by (26). Recall that these blended PPPs can be defined using national price indexes (the P_k^t) and PPPs at the beginning and end of a sample period (the PPP_k^{2002} and the PPP_k^{2017}).

Table 3: PPP, Price and Volume Indexes for Australia

Year t	Q_1^t/Q_1^1	q_1^t/q_1^1	P_1^t/P_1^1	ρ_1^t/ρ_1^1	PPP_1^t	PPP_{B1}^t
2001	**1.00000**	**1.00000**	**1.00000**	**1.00000**	**1.32747**	**1.32747**
2002	**1.02986**	**1.03238**	**1.03113**	**1.02862**	**1.33649**	**1.34480**
2003	**1.07106**	**1.07808**	**1.06525**	**1.05832**	**1.35593**	**1.36126**
2004	**1.10523**	**1.11743**	**1.10569**	**1.09362**	**1.36494**	**1.37315**
2005	**1.13656**	**1.15713**	**1.16200**	**1.14135**	**1.38836**	**1.39671**
2006	**1.17949**	**1.19943**	**1.22027**	**1.19998**	**1.40290**	**1.42083**
2007	**1.22263**	**1.24194**	**1.27549**	**1.25566**	**1.42694**	**1.44339**
2008	**1.24614**	**1.24503**	**1.33930**	**1.34050**	**1.47907**	**1.48374**
2009	**1.27172**	**1.29991**	**1.35489**	**1.32551**	**1.44176**	**1.48668**
2010	**1.30289**	**1.33924**	**1.43969**	**1.40062**	**1.50132**	**1.55843**
2011	**1.35360**	**1.37488**	**1.46668**	**1.44398**	**1.51105**	**1.55206**
2012	**1.38933**	**1.35625**	**1.46436**	**1.50007**	**1.54011**	**1.51743**
2013	**1.42487**	**1.46349**	**1.48545**	**1.44625**	**1.44712**	**1.50972**
2014	**1.45838**	**1.46160**	**1.47463**	**1.47137**	**1.45249**	**1.46797**
2015	**1.49961**	**1.46900**	**1.46787**	**1.49846**	**1.47081**	**1.44291**
2016	**1.52896**	**1.51745**	**1.52220**	**1.53376**	**1.48552**	**1.47719**
2017	**1.57403**	**1.57996**	**1.54878**	**1.54297**	**1.47200**	**1.47200**



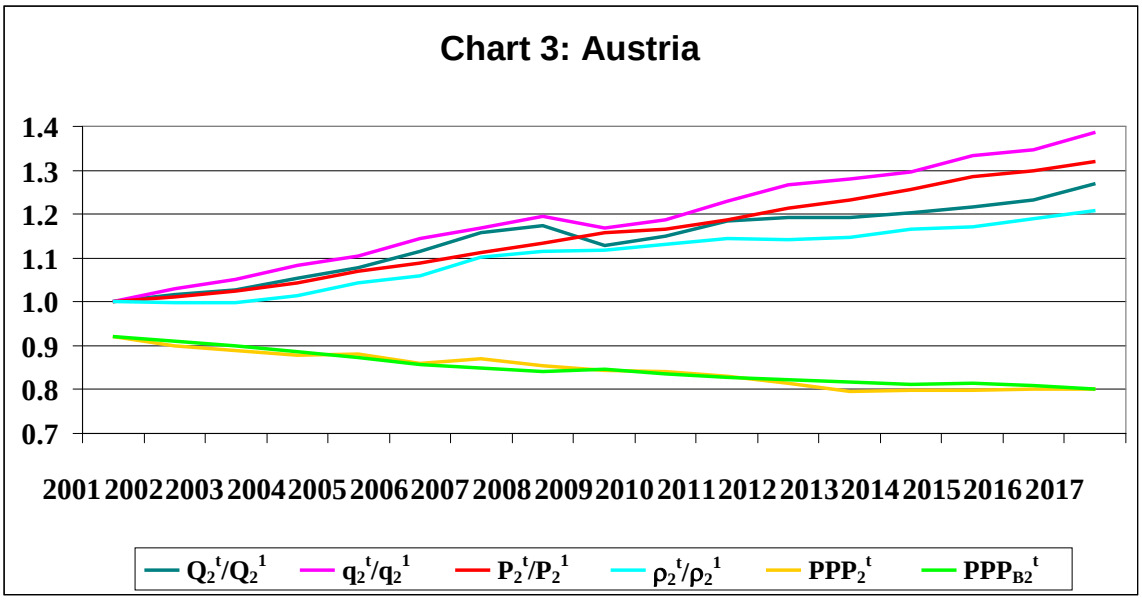
Ideally, we would like Q_k^t/Q_k^1 to coincide with q_k^t/q_k^1, P_k^t/P_k^1 to coincide with ρ_k^t/ρ_k^1 and for the true PPP_k^t to coincide with its blended approximation PPP_{Bk}^t.[12] We see for the case of Australia, these three sets of binary comparisons are reasonably close.[13] There is a tendency for the harmonized volume series, q_k^t/q_k^1, to be more volatile that its national volume series counterpart series, Q_k^t/Q_k^1, and for the harmonized price series, ρ_k^t/ρ_k^1, to be more volatile that its national price series counterpart series, P_k^t/P_k^1. On the other hand, there is a tendency for the blended PPP series, PPP_{Bk}^t, to be less volatile than the true PPP series, PPP_k^t.

Table 4: PPP, Price and Volume Indexes for Austria

Year t	Q_2^t/Q_2^1	q_2^t/q_2^1	P_2^t/P_2^1	ρ_2^t/ρ_2^1	PPP_2^t	PPP_{B2}^t
2001	1.00000	1.00000	1.00000	1.00000	0.92202	0.92202
2002	1.01652	1.03120	1.01146	0.99705	0.89980	0.91142
2003	1.02609	1.05220	1.02468	0.99925	0.88921	0.89994
2004	1.05415	1.08435	1.04251	1.01347	0.87856	0.88515
2005	1.07781	1.10373	1.06896	1.04386	0.88194	0.87383
2006	1.11503	1.14565	1.08919	1.06008	0.86081	0.85796
2007	1.15660	1.16943	1.11338	1.10117	0.86917	0.84790
2008	1.17349	1.19481	1.13517	1.11491	0.85442	0.84186
2009	1.12931	1.16959	1.15661	1.11678	0.84371	0.84512
2010	1.15006	1.18721	1.16671	1.13020	0.84144	0.83658
2011	1.18367	1.22947	1.18810	1.14384	0.83137	0.82845
2012	1.19173	1.26642	1.21251	1.14099	0.81365	0.82356
2013	1.19203	1.28068	1.23220	1.14690	0.79708	0.81656
2014	1.20191	1.29639	1.25660	1.16502	0.79880	0.81135
2015	1.21503	1.33282	1.28569	1.17207	0.79906	0.81541
2016	1.23266	1.34648	1.29969	1.18982	0.80042	0.80948
2017	1.27007	1.38694	1.31991	1.20870	0.80091	0.80091

[12] PPP_k^t will coincide with PPP_{Bk}^t for t = 2001 and t = 2017 for each country k by construction.

[13] If Q_k^t/Q_k^1 is close to q_k^t/q_k^1, then P_k^t/P_k^1 will be close to ρ_k^t/ρ_k^1 since $P_k^tQ_k^t = \rho_k^tq_k^t = V_k^t$ for all k and t.



The differences between the official national and DF harmonized rates of growth for prices and volumes for Austria are much greater than was the case for Australia. However, the blended PPP_{B2}^t for Austria are quite close to the actual OECD PPP_2^t for Austria.

Table 5: PPP, Price and Volume Indexes for Belgium

Year t	Q_3^t/Q_3^1	q_3^t/q_3^1	P_3^t/P_3^1	ρ_3^t/ρ_3^1	PPP_3^t	PPP_{B3}^t
2001	1.00000	1.00000	1.00000	1.00000	0.89151	0.89151
2002	1.01781	1.03408	1.01680	1.00080	0.87330	0.88868
2003	1.02569	1.04314	1.03676	1.01941	0.87714	0.88593
2004	1.06297	1.05987	1.05729	1.06038	0.88882	0.87615
2005	1.08523	1.07355	1.07987	1.09163	0.89179	0.86424
2006	1.11243	1.10275	1.10482	1.11451	0.87506	0.85468
2007	1.15080	1.12484	1.12700	1.15300	0.87997	0.84551
2008	1.15981	1.13863	1.14858	1.16994	0.86694	0.84177
2009	1.13368	1.12763	1.15752	1.16372	0.85009	0.83842
2010	1.16479	1.18309	1.17932	1.16107	0.83582	0.84087
2011	1.18573	1.20495	1.20292	1.18374	0.83191	0.83668
2012	1.18852	1.22275	1.22668	1.19234	0.82214	0.83368
2013	1.19090	1.23046	1.23951	1.19966	0.80617	0.82445
2014	1.20630	1.24702	1.24776	1.20701	0.80021	0.81116
2015	1.22352	1.26988	1.26167	1.21560	0.80132	0.80816
2016	1.24080	1.28721	1.28166	1.23544	0.80362	0.80873
2017	1.26226	1.31145	1.30317	1.25429	0.80362	0.80362

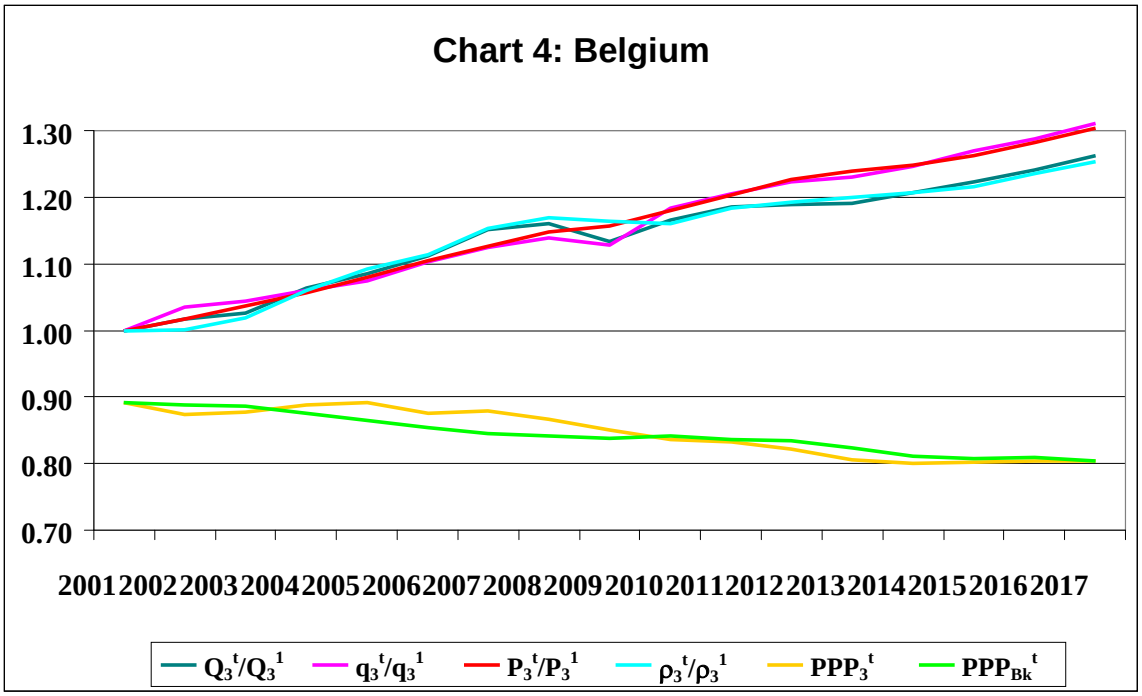


Table 6: PPP, Price and Volume Indexes for Canada

Year t	Q_4^t/Q_4^1	q_4^t/q_4^1	P_4^t/P_4^1	ρ_4^t/ρ_4^1	PPP_4^t	PPP_{B4}^t
2001	1.00000	1.00000	1.00000	1.00000	1.22011	1.22011
2002	1.03010	1.01314	1.01244	1.02939	1.22933	1.21733
2003	1.04867	1.05277	1.04541	1.04133	1.22626	1.23533
2004	1.08103	1.08629	1.07970	1.07447	1.23259	1.24370
2005	1.11563	1.14459	1.11368	1.08551	1.21364	1.24538
2006	1.14490	1.16641	1.14278	1.12171	1.20534	1.24169
2007	1.16852	1.18798	1.18071	1.16137	1.21305	1.25064
2008	1.18021	1.19069	1.22800	1.21718	1.23439	1.27724
2009	1.14540	1.14348	1.19982	1.20183	1.20152	1.23978
2010	1.18072	1.17580	1.23431	1.23947	1.22113	1.26204
2011	1.21780	1.20382	1.27432	1.28913	1.23990	1.27762
2012	1.23906	1.21179	1.28989	1.31891	1.24461	1.27021
2013	1.26973	1.25011	1.31033	1.33090	1.22400	1.26942
2014	1.30599	1.28685	1.33615	1.35602	1.23036	1.27172
2015	1.31906	1.26550	1.32606	1.38217	1.24695	1.25006
2016	1.33771	1.26867	1.33417	1.40678	1.25234	1.24540
2017	1.37848	1.31812	1.36450	1.42699	1.25126	1.25126

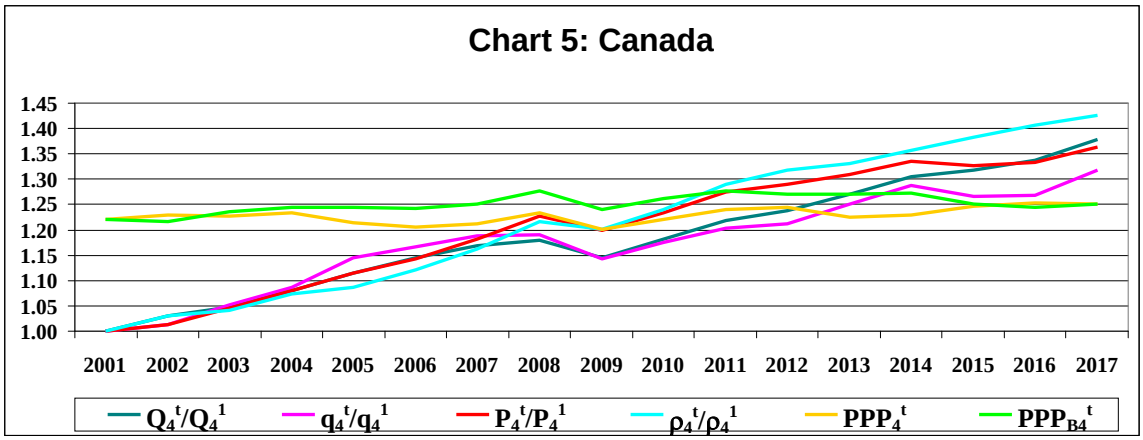
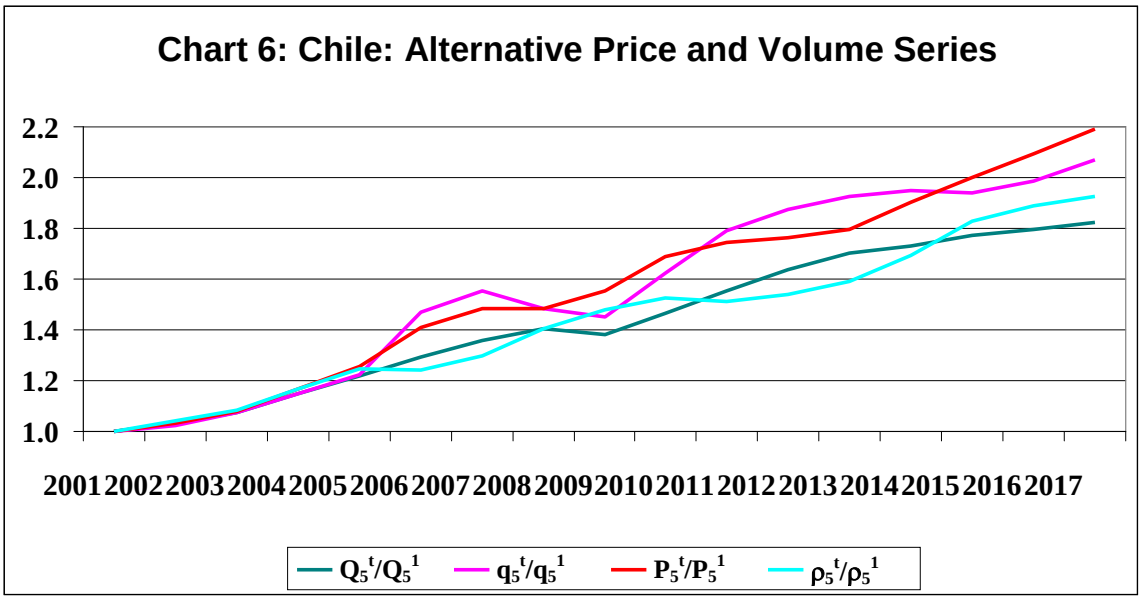


Table 7: PPP, Price and Volume Indexes for Chile

Year t	Q_5^t/Q_5^1	q_5^t/q_5^1	P_5^t/P_5^1	ρ_5^t/ρ_5^1	PPP_5^t	PPP_{B5}^t
2001	1.00000	1.00000	1.00000	1.00000	291.967	291.967
2002	1.03107	1.02469	1.03392	1.04036	297.307	294.277
2003	1.07325	1.07272	1.08126	1.08180	304.842	299.198
2004	1.15063	1.15115	1.16614	1.16561	319.972	311.164
2005	1.21671	1.22453	1.25526	1.24724	333.690	321.665
2006	1.29357	1.46874	1.40793	1.24001	318.850	346.779
2007	1.35702	1.55228	1.48309	1.29653	324.063	352.270
2008	1.40492	1.48498	1.48229	1.40237	340.326	342.001
2009	1.38294	1.44957	1.55129	1.47998	354.061	351.754
2010	1.46376	1.62369	1.69032	1.52384	359.254	375.175
2011	1.55321	1.79036	1.74294	1.51207	348.017	375.248
2012	1.63582	1.87514	1.76264	1.53768	347.229	368.722
2013	1.70199	1.92540	1.79748	1.58891	349.681	365.927
2014	1.73206	1.94985	1.90395	1.69130	367.214	376.702
2015	1.77199	1.93878	1.99857	1.82664	394.345	387.429
2016	1.79442	1.98740	2.09301	1.88978	402.571	397.440
2017	1.82116	2.07079	2.19037	1.92632	404.194	404.194



The national growth rates for prices and volumes for Chile are not close to their harmonized counterparts for the later years in our sample. Because the Chilean currency scale is so different from most other currencies, it is necessary to plot the PPPs for Chile in a separate chart.

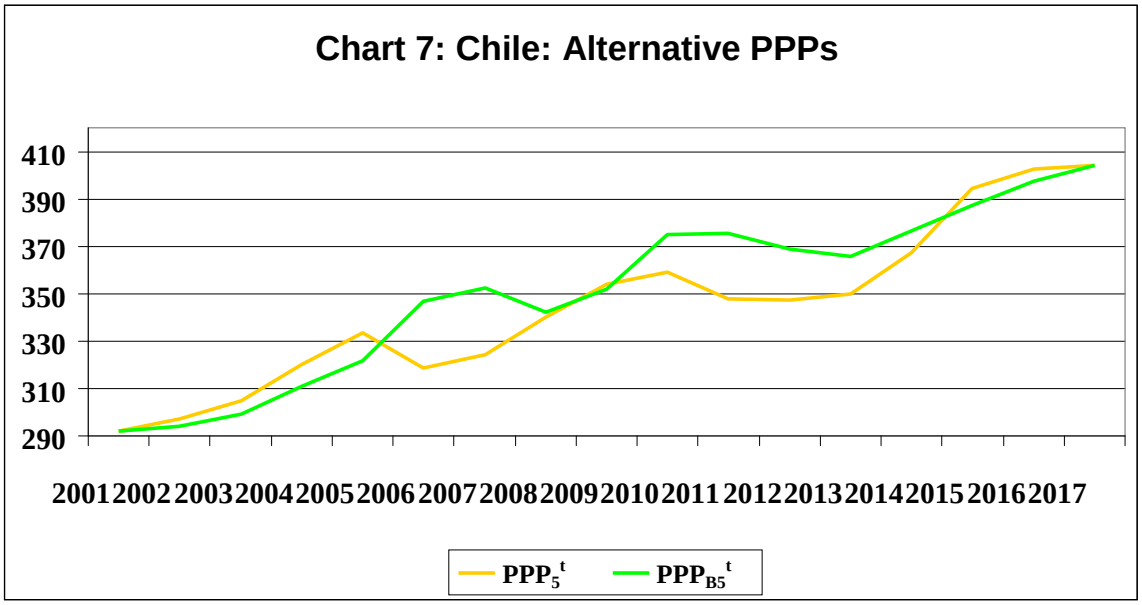
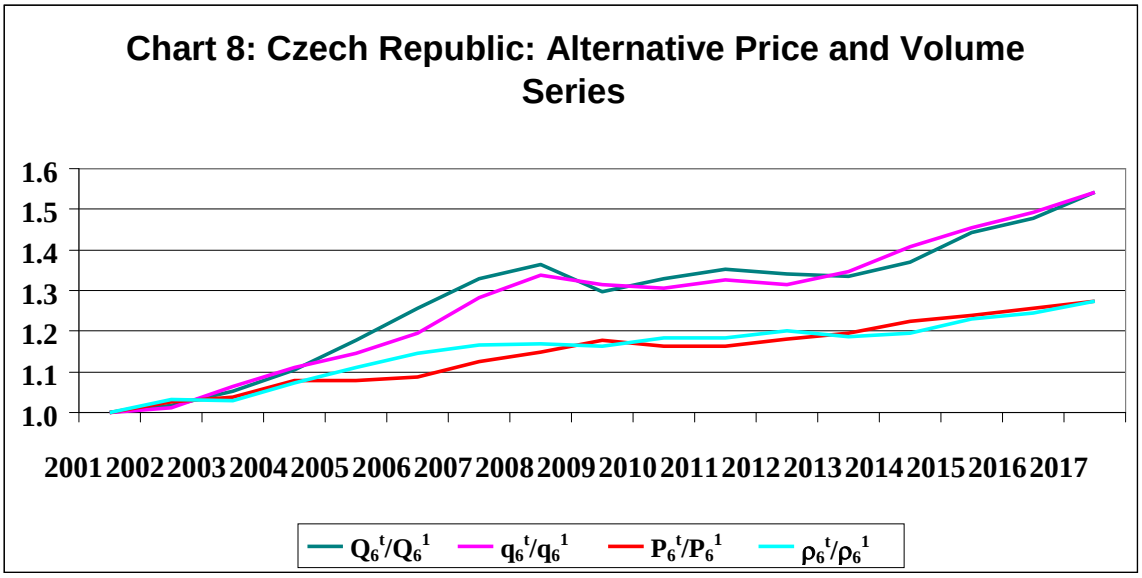


Table 8: PPP, Price and Volume Indexes for the Czech Republic

Year t	Q_6^t/Q_6^1	q_6^t/q_6^1	P_6^t/P_6^1	ρ_6^t/ρ_6^1	PPP_6^t	PPP_{B6}^t
2001	1.00000	1.00000	1.00000	1.00000	14.30840	14.30840
2002	1.01652	1.01138	1.02715	1.03238	14.45832	14.44305

2003	1.05315	1.06472	1.03903	1.02773	14.19271	14.31883
2004	1.10482	1.11134	1.07926	1.07294	14.43411	14.45833
2005	1.17701	1.14457	1.08006	1.11067	14.56249	14.00762
2006	1.25767	1.19462	1.08752	1.14493	14.42765	13.66642
2007	1.32814	1.28299	1.12578	1.16540	14.27504	13.75329
2008	1.36376	1.33898	1.14891	1.17017	13.91671	13.74417
2009	1.29827	1.31557	1.17876	1.16326	13.63809	13.97044
2010	1.32778	1.30495	1.16196	1.18229	13.65978	13.58912
2011	1.35139	1.32745	1.16221	1.18316	13.34530	13.29082
2012	1.34058	1.31553	1.17917	1.20163	13.29770	13.20822
2013	1.33409	1.34604	1.19606	1.18544	12.78527	13.14350
2014	1.37032	1.40687	1.22572	1.19387	12.70321	13.19649
2015	1.44307	1.45399	1.24001	1.23070	13.02057	13.18624
2016	1.47843	1.49085	1.25570	1.24525	13.00002	13.18582
2017	1.54179	1.54118	1.27410	1.27461	13.10675	13.10675



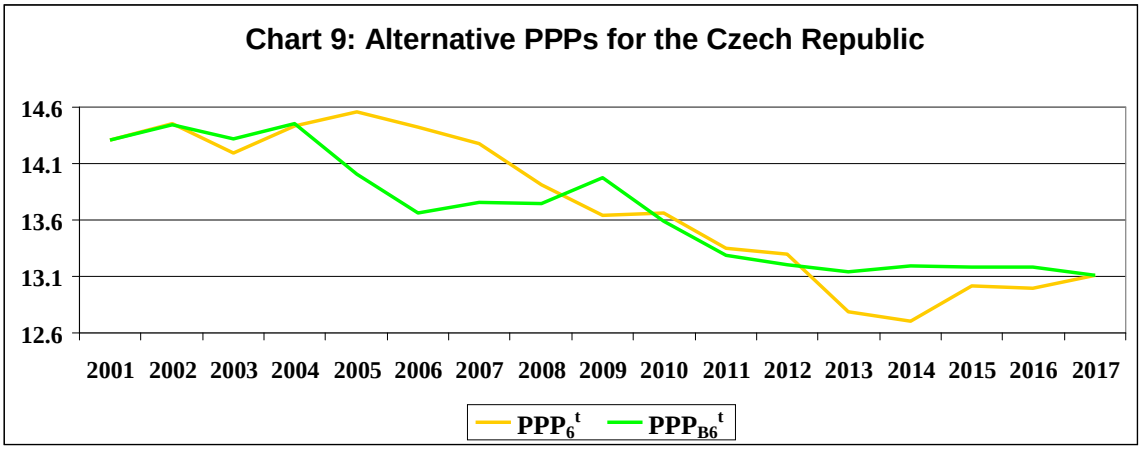
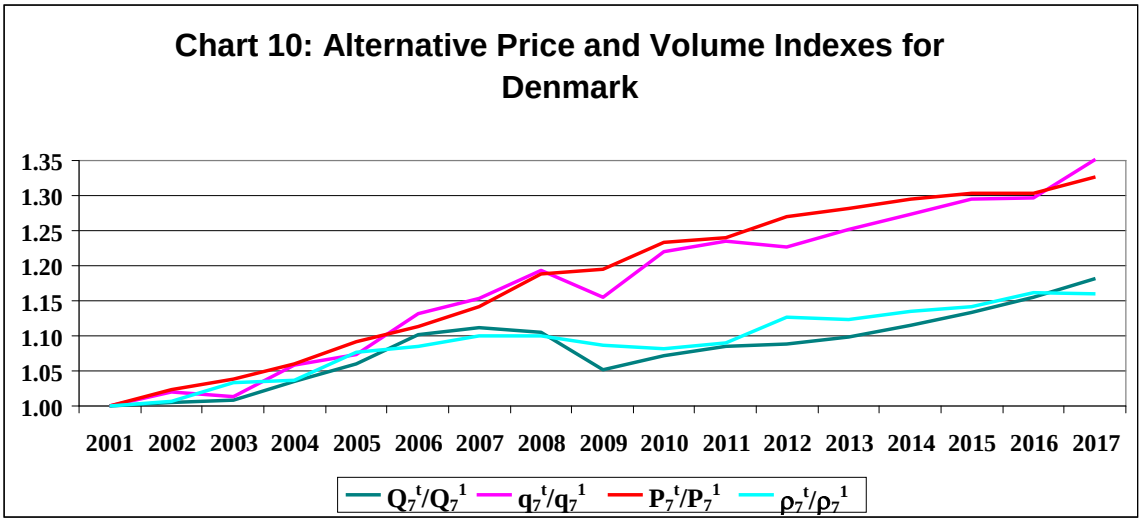


Table 9: PPP, Price and Volume Indexes for Denmark

Year t	Q_7^t/Q_7^1	q_7^t/q_7^1	P_7^t/P_7^1	ρ_7^t/ρ_7^1	PPP_7^t	PPP_{B7}^t
2001	1.00000	1.00000	1.00000	1.00000	8.68354	8.68354
2002	1.00466	1.02077	1.02348	1.00733	8.56161	8.66096
2003	1.00858	1.01402	1.03864	1.03307	8.65804	8.54220
2004	1.03549	1.05911	1.06041	1.03677	8.46451	8.40712
2005	1.05969	1.07374	1.09123	1.07695	8.56944	8.30568
2006	1.10115	1.13088	1.11389	1.08461	8.29464	8.14627
2007	1.11117	1.15332	1.14098	1.09928	8.17175	8.04433
2008	1.10548	1.19336	1.18815	1.10066	7.94413	8.13441
2009	1.05124	1.15562	1.19444	1.08655	7.73094	8.03390
2010	1.07091	1.22073	1.23295	1.08162	7.58405	8.11490
2011	1.08522	1.23453	1.24082	1.09075	7.46649	7.91911
2012	1.08768	1.22676	1.27030	1.12628	7.56414	7.87458
2013	1.09783	1.25211	1.28158	1.12367	7.35485	7.72893
2014	1.11561	1.27278	1.29481	1.13491	7.32867	7.58658
2015	1.13353	1.29509	1.30388	1.14123	7.32753	7.48287
2016	1.15580	1.29732	1.30328	1.16110	7.35640	7.32403
2017	1.18211	1.35126	1.32586	1.15989	7.23837	7.23837



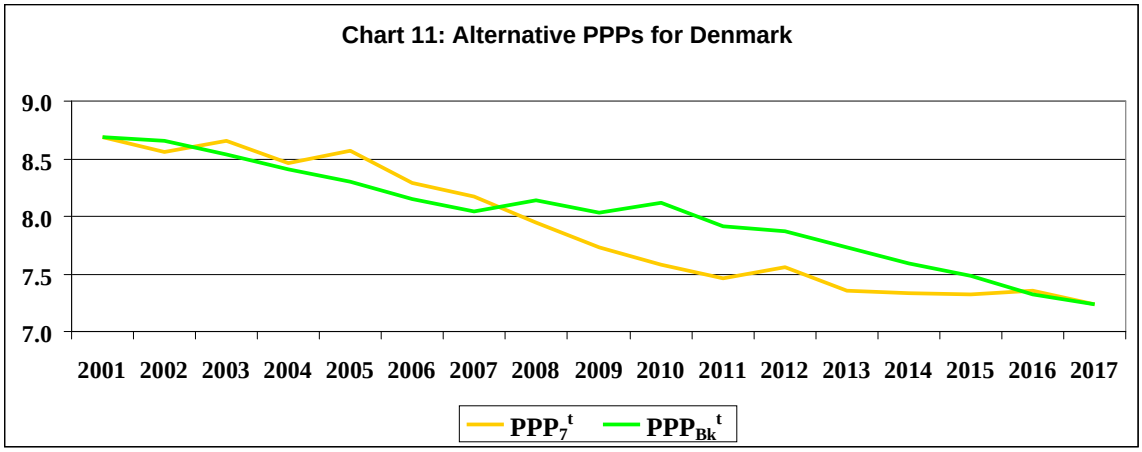


Table 10: PPP, Price and Volume Indexes for Estonia

Year t	Q_8^t/Q_8^1	q_8^t/q_8^1	P_8^t/P_8^1	ρ_8^t/ρ_8^1	PPP_8^t	PPP_{B8}^t
2001	1.00000	1.00000	1.00000	1.00000	0.48740	0.48740
2002	1.06076	1.09326	1.05047	1.01925	0.48624	0.49559
2003	1.13943	1.20745	1.09558	1.03386	0.48634	0.49895
2004	1.21115	1.29104	1.14891	1.07782	0.49392	0.50099
2005	1.32469	1.43249	1.21866	1.12695	0.50333	0.50672
2006	1.46076	1.59609	1.32685	1.21435	0.52126	0.52654
2007	1.57394	1.76091	1.47958	1.32248	0.55181	0.56221
2008	1.48864	1.75976	1.59044	1.34541	0.54505	0.58288
2009	1.26944	1.56601	1.59730	1.29481	0.51711	0.57124
2010	1.29812	1.62266	1.62502	1.30001	0.51164	0.56484
2011	1.39674	1.79429	1.71051	1.33152	0.51160	0.57264
2012	1.45690	1.85987	1.76456	1.38225	0.52106	0.56991
2013	1.48512	1.90842	1.82730	1.42199	0.52242	0.57028
2014	1.52801	1.97815	1.88191	1.45367	0.52689	0.56677
2015	1.55705	1.97864	1.90120	1.49611	0.53919	0.55704
2016	1.61138	2.05019	1.92878	1.51595	0.53910	0.54964
2017	1.68964	2.15239	2.00339	1.57267	0.55087	0.55087

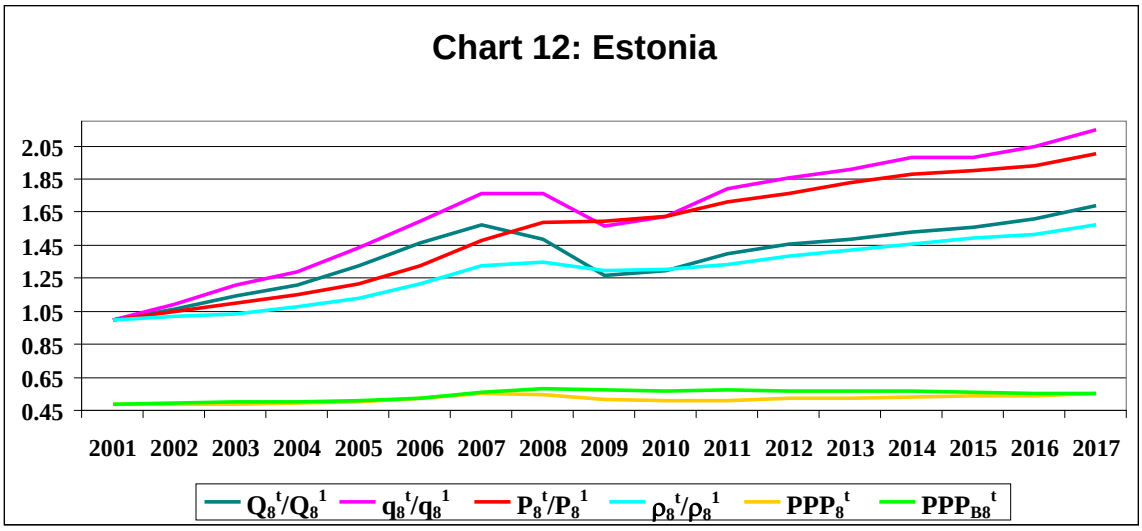


Table 11: PPP, Price and Volume Indexes for Finland

Year t	Q_9^t/Q_9^1	q_9^t/q_9^1	P_9^t/P_9^1	ρ_9^t/ρ_9^1	PPP_9^t	PPP_{B9}^t
2001	1.00000	1.00000	1.00000	1.00000	1.00168	1.00168
2002	1.01680	1.00847	1.00970	1.01805	0.99813	0.99286
2003	1.03708	1.01129	1.01186	1.03766	1.00318	0.97409
2004	1.07779	1.06120	1.01801	1.03393	0.97375	0.95164
2005	1.10776	1.06662	1.02741	1.06704	0.97942	0.92880
2006	1.15268	1.10543	1.03679	1.08110	0.95373	0.90719
2007	1.21244	1.18364	1.06545	1.09138	0.93588	0.90533
2008	1.22118	1.22419	1.09824	1.09553	0.91212	0.91281
2009	1.12020	1.14749	1.11886	1.09225	0.89648	0.92032
2010	1.15372	1.16459	1.12278	1.11230	0.89967	0.91034

2011	1.18338	1.19843	1.15179	1.13733	0.89807	0.91219
2012	1.16650	1.17958	1.18581	1.17267	0.90850	0.91887
2013	1.15766	1.17406	1.21607	1.19909	0.90536	0.92346
2014	1.15035	1.16807	1.23666	1.21790	0.90721	0.91907
2015	1.15190	1.18214	1.25981	1.22759	0.90922	0.92376
2016	1.18044	1.20807	1.26752	1.23853	0.90518	0.91678
2017	1.21346	1.23416	1.27714	1.25572	0.90396	0.90396

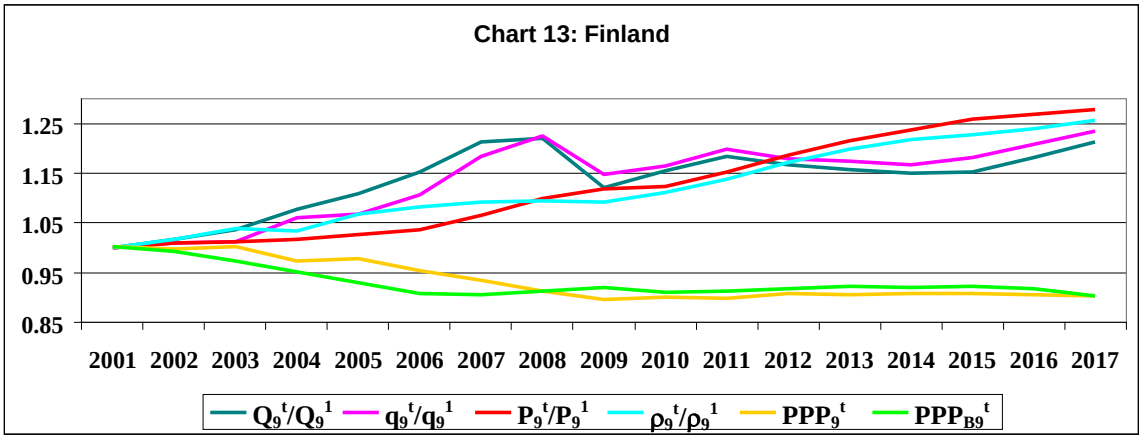


Table 12: PPP, Price and Volume Indexes for France

Year t	Q_{10}^t/Q_{10}^1	q_{10}^t/q_{10}^1	P_{10}^t/P_{10}^1	ρ_{10}^t/ρ_{10}^1	PPP_{10}^t	PPP_{B10}^t
2001	1.00000	1.00000	1.00000	1.00000	0.91081	0.91081
2002	1.01118	1.02173	1.02085	1.01031	0.90068	0.91240
2003	1.01947	1.00099	1.03987	1.05907	0.93099	0.90955
2004	1.04788	1.01392	1.05718	1.09259	0.93564	0.89759
2005	1.06473	1.04551	1.07824	1.09806	0.91646	0.88499
2006	1.09001	1.07625	1.10228	1.11638	0.89550	0.87536
2007	1.11575	1.10598	1.13116	1.14116	0.88979	0.87201
2008	1.11793	1.11193	1.15863	1.16488	0.88187	0.87335
2009	1.08505	1.08873	1.16021	1.15629	0.86294	0.86516
2010	1.10638	1.11727	1.17244	1.16101	0.85387	0.86146
2011	1.12938	1.14195	1.18487	1.17182	0.84136	0.85006
2012	1.13145	1.13300	1.20019	1.19854	0.84430	0.84217
2013	1.13797	1.16425	1.20953	1.18222	0.81164	0.83143
2014	1.14875	1.17218	1.21662	1.19230	0.80756	0.81816
2015	1.16101	1.18271	1.23102	1.20843	0.81383	0.81648
2016	1.17480	1.19464	1.23325	1.21276	0.80594	0.80653
2017	1.19617	1.22388	1.24552	1.21733	0.79682	0.79682

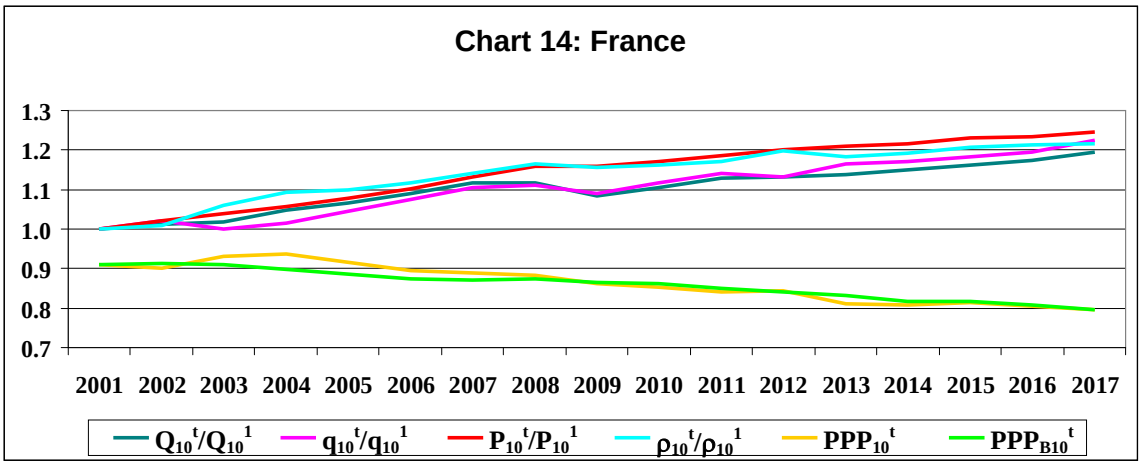


Table 13: PPP, Price and Volume Indexes for Germany

Year t	Q_{11}^t/Q_{11}^1	q_{11}^t/q_{11}^1	P_{11}^t/P_{11}^1	ρ_{11}^t/ρ_{11}^1	PPP_{11}^t	PPP_{B11}^t
2001	1.00000	1.00000	1.00000	1.00000	0.92880	0.92880
2002	1.00000	1.00890	1.01351	1.00457	0.91326	0.92206
2003	0.99290	1.01782	1.02574	1.00062	0.89699	0.91160
2004	1.00452	1.03893	1.03696	1.00261	0.87555	0.89293
2005	1.01162	1.02937	1.04339	1.02540	0.87272	0.86698
2006	1.04905	1.05862	1.04656	1.03710	0.84835	0.83986
2007	1.08325	1.09362	1.06433	1.05424	0.83826	0.82762
2008	1.09498	1.10587	1.07326	1.06269	0.82040	0.81455
2009	1.03345	1.05902	1.09211	1.06575	0.81109	0.81848
2010	1.07562	1.10364	1.10039	1.07245	0.80432	0.81111
2011	1.11498	1.15113	1.11217	1.07725	0.78874	0.79901
2012	1.12047	1.15462	1.12930	1.09590	0.78725	0.79207
2013	1.12595	1.17156	1.15149	1.10667	0.77478	0.78975
2014	1.15048	1.21091	1.17175	1.11327	0.76894	0.78478
2015	1.17049	1.23255	1.19494	1.13476	0.77932	0.78789
2016	1.19673	1.25924	1.21124	1.15112	0.78008	0.78605
2017	1.22254	1.28779	1.22979	1.16748	0.77929	0.77929

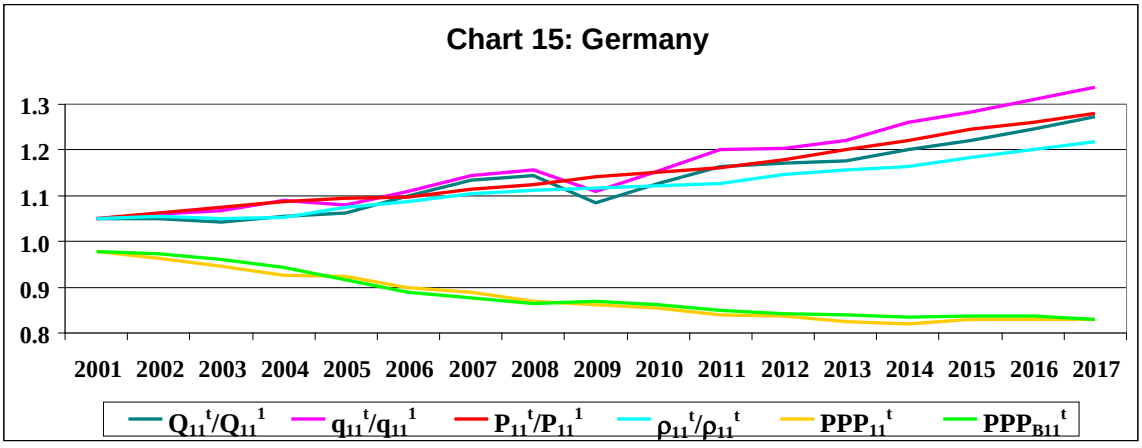


Table 14: PPP, Price and Volume Indexes for Greece

Year t	Q_{12}^t/Q_{12}^1	q_{12}^t/q_{12}^1	P_{12}^t/P_{12}^1	ρ_{12}^t/ρ_{12}^1	PPP_{12}^t	PPP_{B12}^t
2001	1.00000	1.00000	1.00000	1.00000	0.66781	0.66781
2002	1.03923	1.05893	1.03349	1.01426	0.66297	0.67867
2003	1.09945	1.10464	1.06918	1.06415	0.68589	0.68853
2004	1.15509	1.15008	1.10192	1.10673	0.69490	0.69023
2005	1.16201	1.12997	1.12661	1.15855	0.70898	0.68361
2006	1.22769	1.21473	1.16599	1.17843	0.69308	0.68595
2007	1.26789	1.21547	1.20589	1.25789	0.71914	0.69009
2008	1.26364	1.24667	1.25829	1.27541	0.70795	0.70554
2009	1.20929	1.21239	1.29062	1.28732	0.70441	0.71739
2010	1.14304	1.11025	1.29931	1.33767	0.72133	0.71309
2011	1.03865	1.00414	1.30968	1.35469	0.71316	0.70328
2012	0.96282	0.94775	1.30483	1.32558	0.68466	0.68672
2013	0.93161	0.94650	1.27413	1.25410	0.63129	0.65826
2014	0.93851	0.95391	1.25079	1.23060	0.61113	0.63349
2015	0.93578	0.93729	1.23798	1.23597	0.61031	0.61967
2016	0.93349	0.92338	1.22614	1.23957	0.60398	0.60642
2017	0.94610	0.93660	1.23435	1.24688	0.59842	0.59842

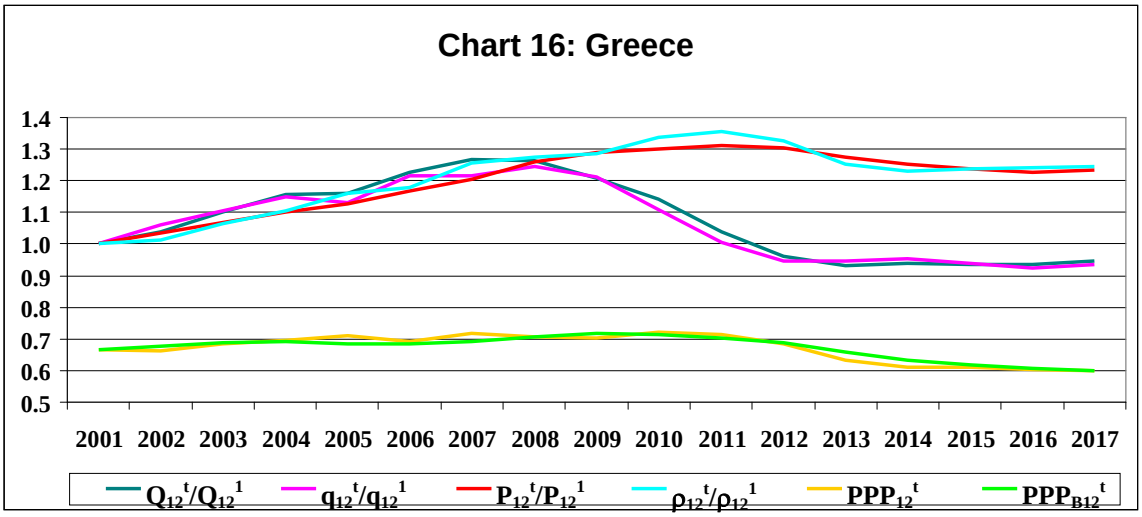
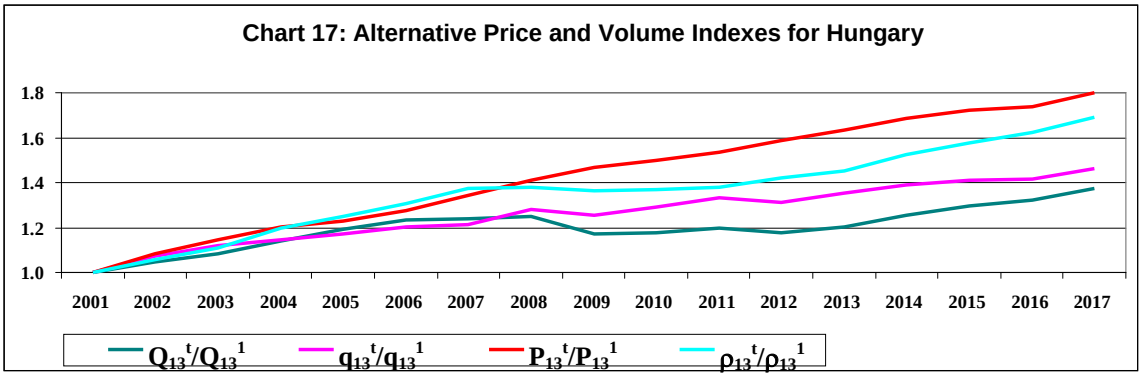


Table 15: PPP, Price and Volume Indexes for Hungary

Year t	Q_{13}^t/Q_{13}^1	q_{13}^t/q_{13}^1	P_{13}^t/P_{13}^1	ρ_{13}^t/ρ_{13}^1	PPP_{13}^t	PPP_{B13}^t
2001	1.00000	1.00000	1.00000	1.00000	114.297	114.297
2002	1.04528	1.07238	1.08341	1.05603	118.141	121.215
2003	1.08551	1.12091	1.14347	1.10735	122.156	124.893
2004	1.13984	1.14477	1.20049	1.19532	128.453	126.964
2005	1.18986	1.17040	1.22965	1.25010	130.930	125.408
2006	1.23568	1.20323	1.27312	1.30745	131.610	125.316
2007	1.24105	1.21414	1.34199	1.37173	134.220	127.914
2008	1.25167	1.27894	1.40902	1.37898	131.005	130.997
2009	1.16906	1.25697	1.46592	1.36340	127.687	134.494
2010	1.17704	1.29024	1.50007	1.36846	126.298	135.274
2011	1.19660	1.33094	1.53410	1.37925	124.272	134.748
2012	1.17693	1.31349	1.58597	1.42108	125.624	135.912
2013	1.20160	1.35225	1.63254	1.45066	124.979	136.714
2014	1.25240	1.38824	1.68773	1.52259	129.415	137.929
2015	1.29457	1.41066	1.71954	1.57803	133.364	138.258

2016	1.32322	1.41724	1.73604	1.62087	135.170	137.295
2017	1.37600	1.46460	1.79967	1.69081	138.885	138.885



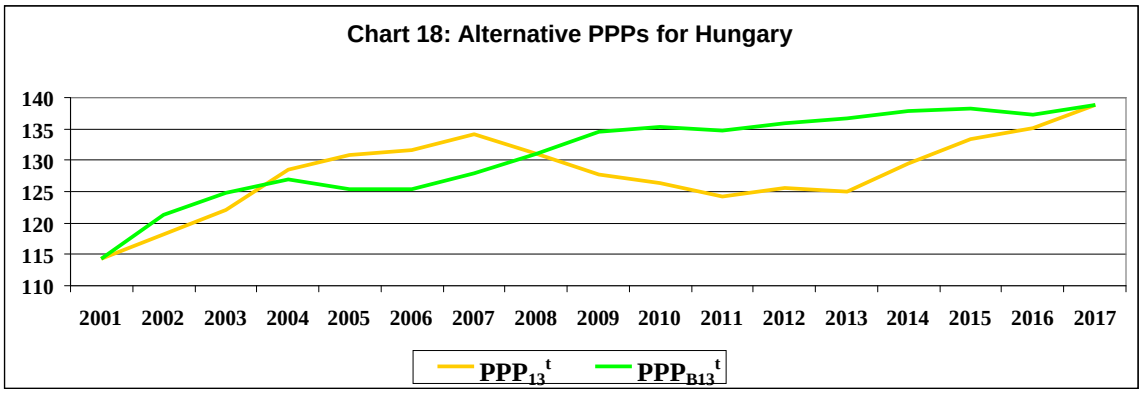
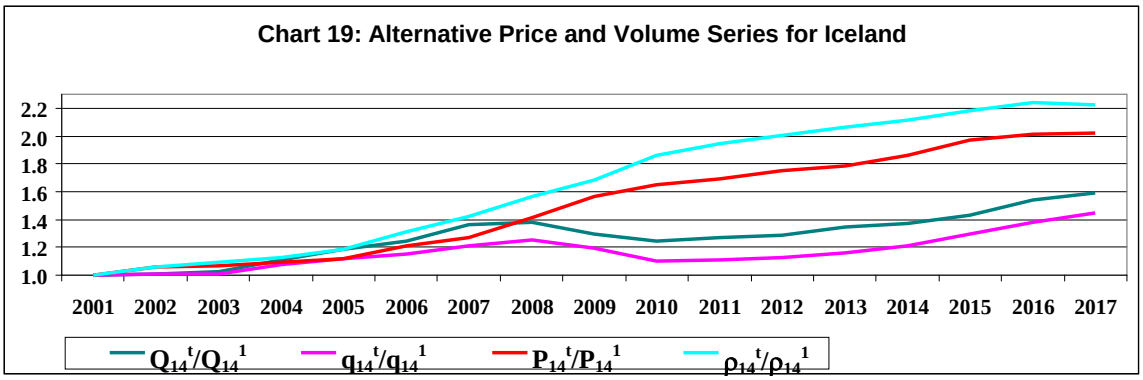


Table 16: PPP, Price and Volume Indexes for Iceland

Year t	Q_{14}^t/Q_{14}^1	q_{14}^t/q_{14}^1	P_{14}^t/P_{14}^1	ρ_{14}^t/ρ_{14}^1	PPP_{14}^t	PPP_{B14}^t
2001	1.00000	1.00000	1.00000	1.00000	88.211	88.211
2002	1.00551	1.00903	1.05890	1.05520	91.105	92.334
2003	1.02920	1.00557	1.06404	1.08905	92.717	91.469
2004	1.11230	1.07973	1.09247	1.12542	93.338	91.830
2005	1.18338	1.11852	1.12069	1.18569	95.841	91.737
2006	1.24276	1.15272	1.21456	1.30942	101.725	96.901
2007	1.35993	1.21041	1.26685	1.42334	107.483	98.838
2008	1.38249	1.25426	1.41716	1.56203	114.527	108.906
2009	1.29255	1.19639	1.56199	1.68754	121.973	119.623
2010	1.24595	1.10127	1.64747	1.86391	132.762	125.234
2011	1.27041	1.10882	1.69640	1.94361	135.152	126.839
2012	1.28717	1.12334	1.75210	2.00762	136.968	129.073
2013	1.34262	1.16292	1.78496	2.06079	137.023	129.763
2014	1.37216	1.20686	1.85766	2.11210	138.548	133.091
2015	1.43132	1.29296	1.96989	2.18069	142.234	140.219
2016	1.53840	1.38208	2.01152	2.23903	144.105	142.221
2017	1.59444	1.45074	2.02121	2.22141	140.824	140.824



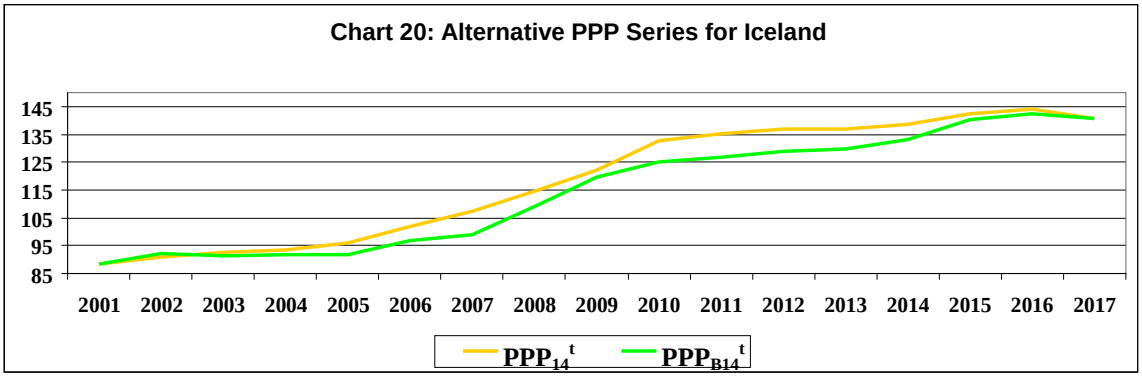
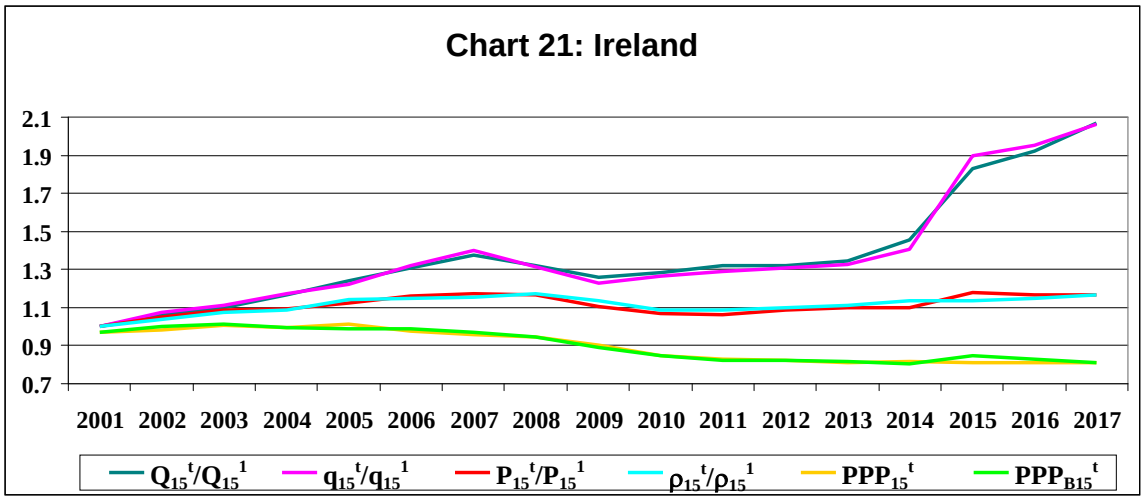


Table 17: PPP, Price and Volume Indexes for Ireland

Year t	Q_{15}^t/Q_{15}^1	q_{15}^t/q_{15}^1	P_{15}^t/P_{15}^1	ρ_{15}^t/ρ_{15}^1	PPP_{15}^t	PPP_{B15}^t
2001	1.00000	1.00000	1.00000	1.00000	0.96842	0.96842
2002	1.06309	1.07606	1.04864	1.03600	0.98200	0.99821
2003	1.09626	1.10983	1.08869	1.07538	1.00512	1.01592
2004	1.16950	1.17549	1.09474	1.08916	0.99170	0.99330
2005	1.23974	1.22400	1.12559	1.14007	1.01171	0.98896
2006	1.30820	1.32129	1.15950	1.14801	0.97912	0.98735
2007	1.37634	1.39800	1.17483	1.15662	0.95888	0.97277
2008	1.32217	1.31218	1.16446	1.17332	0.94445	0.94438
2009	1.26099	1.22798	1.10606	1.13580	0.90126	0.88890
2010	1.28371	1.26704	1.07129	1.08539	0.84874	0.84976
2011	1.32203	1.28833	1.06145	1.08921	0.83151	0.82349
2012	1.32252	1.30738	1.08632	1.09890	0.82307	0.82570
2013	1.34420	1.32749	1.09751	1.11133	0.81123	0.81859
2014	1.45615	1.40798	1.09969	1.13731	0.81904	0.80378
2015	1.82830	1.89629	1.17710	1.13490	0.81266	0.84999
2016	1.92230	1.95018	1.16549	1.14883	0.81174	0.83125
2017	2.07228	2.06368	1.16372	1.16857	0.81329	0.81329



There is a huge jump of 26% in the real GDP of Ireland from 2014 to 2015. This was due to multinational companies switching their corporate headquarters to Ireland to take advantage of the low Irish corporate tax rate. What is interesting is that this huge jump in GDP did not affect the closeness of three sets of competing price and volume series to each other.

Table 18: PPP, Price and Volume Indexes for Israel

Year t	Q_{16}^t/Q_{16}^1	q_{16}^t/q_{16}^1	P_{16}^t/P_{16}^1	ρ_{16}^t/ρ_{16}^1	PPP_{16}^t	PPP_{B16}^t
2001	1.00000	1.00000	1.00000	1.00000	3.42412	3.42412
2002	0.99840	1.01000	1.04518	1.03318	3.46268	3.55123
2003	1.00944	0.95697	1.04101	1.09808	3.62892	3.50026
2004	1.05968	1.00552	1.04163	1.09773	3.53401	3.43775
2005	1.10357	0.98169	1.05378	1.18462	3.71694	3.39974
2006	1.16728	0.99391	1.06956	1.25612	3.78798	3.37601
2007	1.23755	1.05326	1.07966	1.26858	3.71859	3.34524
2008	1.27686	1.03766	1.10425	1.35879	3.86720	3.38292
2009	1.29383	1.05104	1.14728	1.41229	3.96241	3.51600
2010	1.36552	1.10628	1.16455	1.43744	3.97435	3.55597
2011	1.43584	1.16598	1.18676	1.46143	3.94476	3.57799
2012	1.46763	1.20936	1.23072	1.49356	3.95536	3.66976
2013	1.53050	1.29368	1.25745	1.48763	3.83957	3.71421
2014	1.59030	1.30425	1.26913	1.54748	3.94039	3.70847
2015	1.63143	1.39194	1.30260	1.52671	3.86540	3.79607
2016	1.69681	1.45491	1.31537	1.53407	3.83259	3.82209
2017	1.75547	1.50294	1.31808	1.53955	3.78852	3.78852

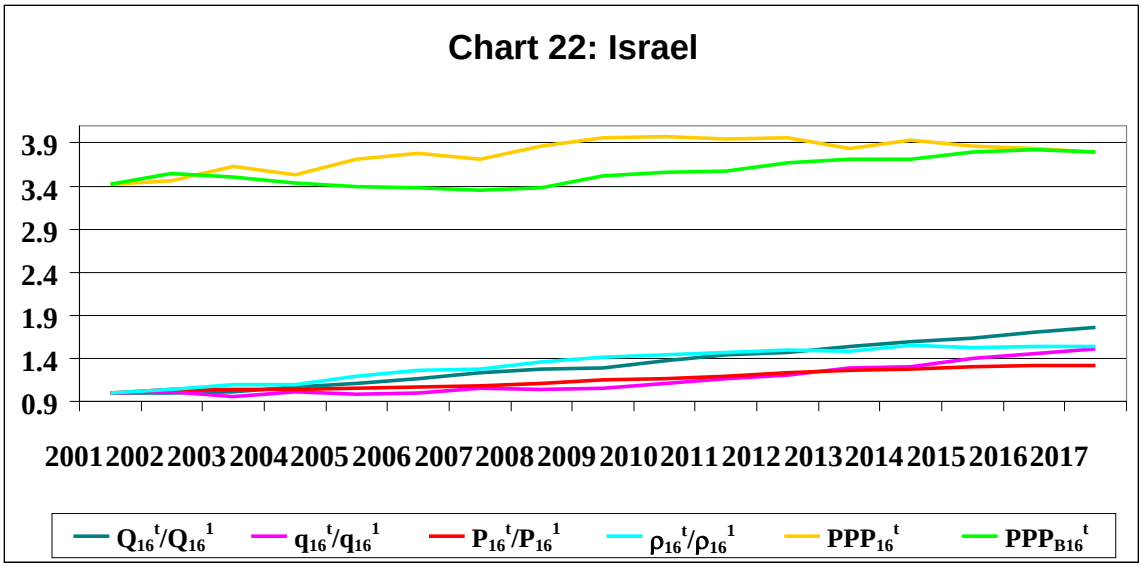


Table 19: PPP, Price and Volume Indexes for Italy

Year t	Q_{17}^t/Q_{17}^1	q_{17}^t/q_{17}^1	P_{17}^t/P_{17}^1	ρ_{17}^t/ρ_{17}^1	PPP_{17}^t	PPP_{B17}^t
2001	1.00000	1.00000	1.00000	1.00000	0.81550	0.81550
2002	1.00249	1.00429	1.03354	1.03169	0.82349	0.82473
2003	1.00400	1.00991	1.06642	1.06019	0.83444	0.83042
2004	1.01989	1.00309	1.09334	1.11164	0.85233	0.82406
2005	1.02957	1.00226	1.11398	1.14434	0.85514	0.80935
2006	1.05023	1.03961	1.13513	1.14673	0.82359	0.79568
2007	1.06571	1.06762	1.16277	1.16068	0.81030	0.78895
2008	1.05451	1.08683	1.19161	1.15619	0.78369	0.78831
2009	0.99671	1.04907	1.21494	1.15429	0.77130	0.79286
2010	1.01352	1.05307	1.21882	1.17304	0.77244	0.78150
2011	1.01936	1.06820	1.23672	1.18018	0.75869	0.77207
2012	0.99062	1.04767	1.25379	1.18552	0.74773	0.76337
2013	0.97350	1.02994	1.26898	1.19946	0.73730	0.75472
2014	0.97461	1.02376	1.28115	1.21965	0.73964	0.74331
2015	0.98362	1.03267	1.29311	1.23168	0.74269	0.73783
2016	0.99488	1.07150	1.30761	1.21411	0.72240	0.73359
2017	1.01052	1.08222	1.31420	1.22712	0.71918	0.71918

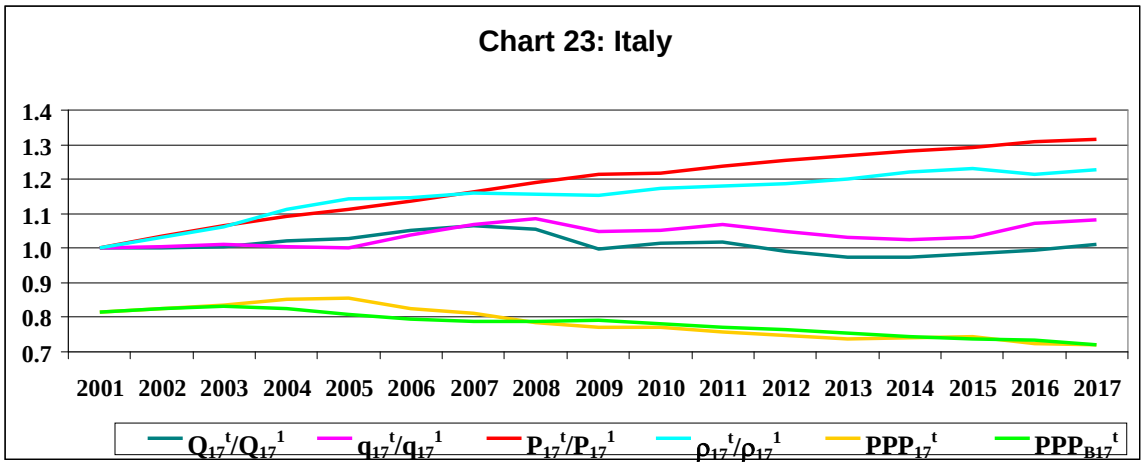
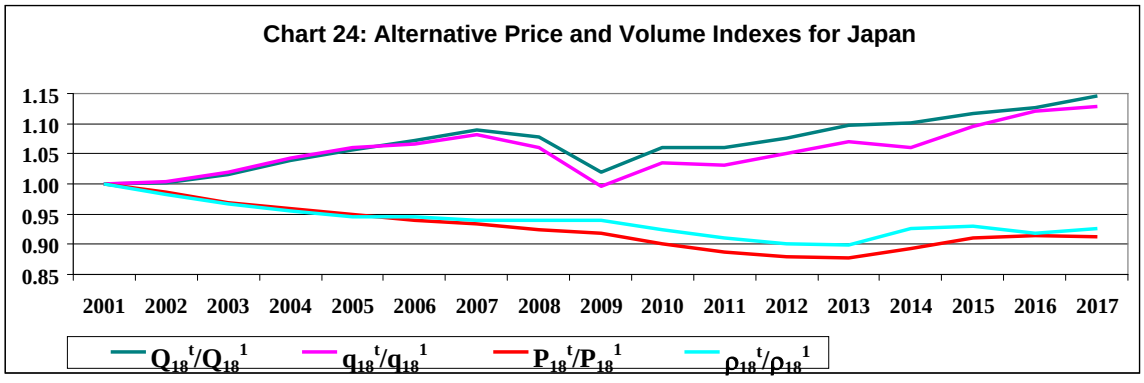


Table 20: PPP, Price and Volume Indexes for Japan

Year t	Q_{18}^t/Q_{18}^1	q_{18}^t/q_{18}^1	P_{18}^t/P_{18}^1	ρ_{18}^t/ρ_{18}^1	PPP_{18}^t	PPP_{B18}^t
2001	1.00000	1.00000	1.00000	1.00000	149.599	149.599
2002	1.00118	1.00477	0.98542	0.98189	143.774	145.015
2003	1.01648	1.01974	0.96948	0.96638	139.531	139.965
2004	1.03889	1.04321	0.95881	0.95484	134.302	134.696
2005	1.05616	1.06042	0.94886	0.94505	129.552	129.176
2006	1.07116	1.06605	0.94048	0.94499	124.504	124.182
2007	1.08888	1.08142	0.93362	0.94006	120.392	119.962
2008	1.07697	1.05951	0.92446	0.93970	116.846	116.433
2009	1.01864	0.99614	0.91881	0.93956	115.171	114.761
2010	1.06134	1.03531	0.90140	0.92406	111.624	111.207
2011	1.06011	1.03118	0.88631	0.91118	107.454	107.028
2012	1.07596	1.05010	0.87956	0.90122	104.274	104.137
2013	1.09749	1.07092	0.87663	0.89837	101.303	101.925
2014	1.10160	1.06069	0.89193	0.92632	103.052	101.703
2015	1.11651	1.09490	0.91103	0.92901	102.763	102.706
2016	1.12699	1.12060	0.91352	0.91872	100.279	101.797
2017	1.14653	1.12803	0.91141	0.92636	99.594	99.594



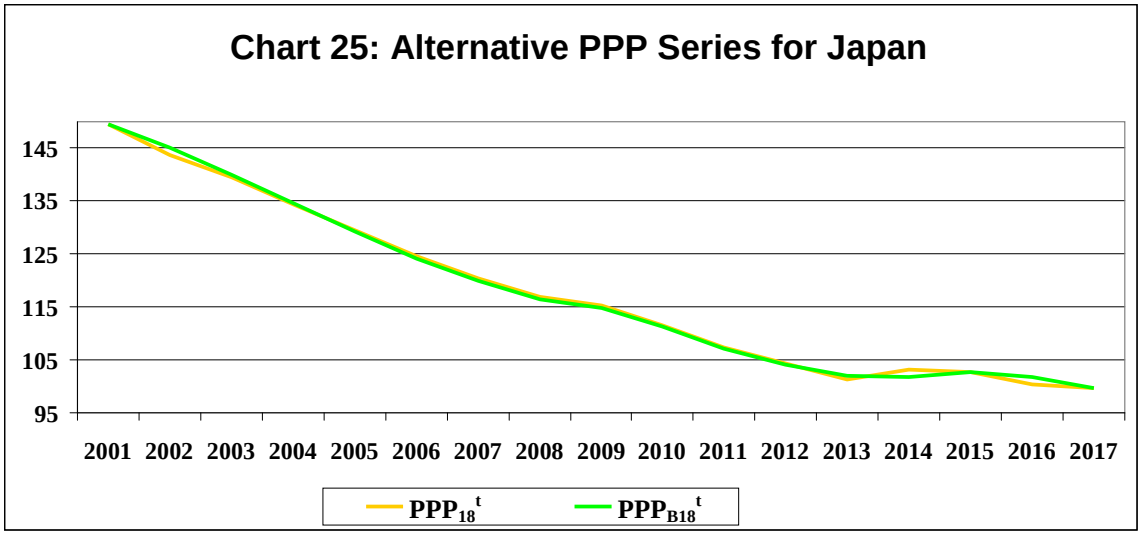
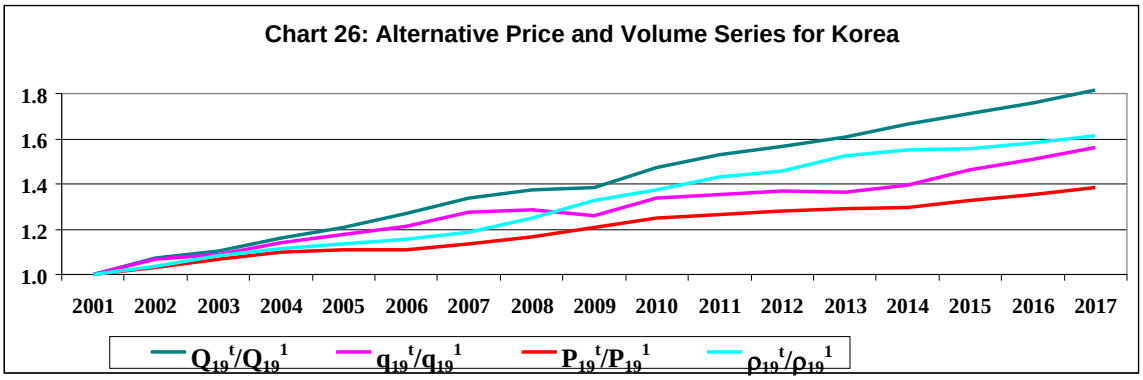


Table 21: PPP, Price and Volume Indexes for Korea

Year t	Q_{19}^t/Q_{19}^1	q_{19}^t/q_{19}^1	P_{19}^t/P_{19}^1	ρ_{19}^t/ρ_{19}^1	PPP_{19}^t	PPP_{B19}^t
2001	1.00000	1.00000	1.00000	1.00000	757.251	757.251
2002	1.07432	1.06609	1.03060	1.03857	769.772	774.170
2003	1.10584	1.08718	1.06559	1.08388	792.161	791.891
2004	1.16002	1.14153	1.09739	1.11517	793.968	800.236
2005	1.20554	1.17562	1.10871	1.13693	788.920	790.086
2006	1.26794	1.21241	1.10716	1.15787	772.192	771.683
2007	1.33721	1.27598	1.13370	1.18811	770.206	775.417
2008	1.37504	1.28570	1.16722	1.24833	785.718	789.121
2009	1.38477	1.25907	1.20857	1.32923	824.761	817.115
2010	1.47474	1.33751	1.24678	1.37469	840.569	839.633
2011	1.52903	1.35273	1.26654	1.43160	854.586	841.897
2012	1.56408	1.37130	1.27975	1.45966	854.887	841.081
2013	1.60938	1.36424	1.29067	1.52259	869.081	840.026
2014	1.66316	1.39476	1.29842	1.54828	871.878	835.744
2015	1.70956	1.46124	1.32951	1.55545	870.933	853.201
2016	1.75964	1.50709	1.35581	1.58302	874.629	867.271
2017	1.81354	1.56025	1.38652	1.61161	877.052	877.052



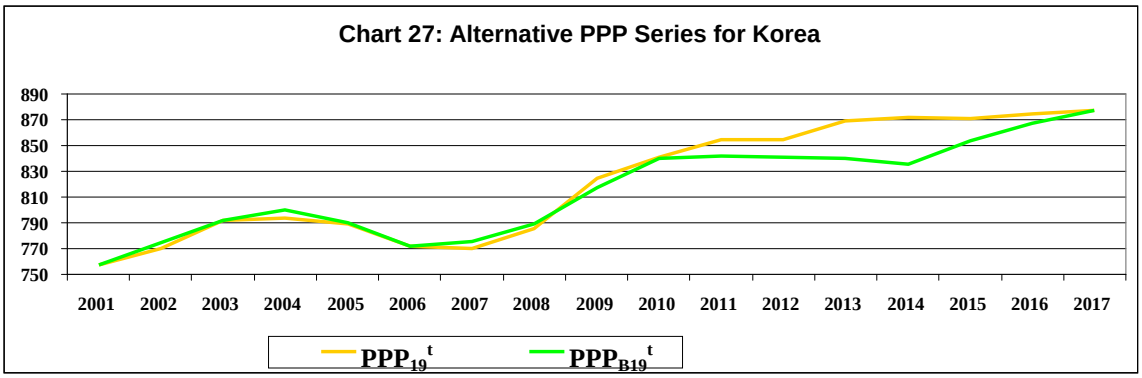


Table 22: PPP, Price and Volume Indexes for Latvia

Year t	Q_{20}^t/Q_{20}^1	q_{20}^t/q_{20}^1	P_{20}^t/P_{20}^1	ρ_{20}^t/ρ_{20}^1	PPP_{20}^t	PPP_{B20}^t
2001	1.00000	1.00000	1.00000	1.00000	0.35299	0.35299
2002	1.07104	1.07741	1.05095	1.04473	0.36095	0.36334
2003	1.16133	1.15205	1.10262	1.11150	0.37867	0.37236
2004	1.25813	1.23020	1.17717	1.20390	0.39955	0.38515
2005	1.39272	1.34420	1.30870	1.35595	0.43859	0.41315
2006	1.55830	1.45640	1.47112	1.57405	0.48934	0.44849
2007	1.71381	1.61555	1.76704	1.87452	0.56645	0.52195
2008	1.65301	1.66401	1.97470	1.96164	0.57554	0.56926
2009	1.41495	1.40068	1.78355	1.80172	0.52112	0.50768
2010	1.35919	1.40856	1.76908	1.70708	0.48657	0.49524
2011	1.44592	1.51913	1.88221	1.79150	0.49850	0.51351
2012	1.50425	1.58222	1.95026	1.85416	0.50620	0.51941
2013	1.54081	1.62778	1.98238	1.87646	0.49927	0.51623
2014	1.56944	1.67025	2.01724	1.89549	0.49756	0.51294
2015	1.61608	1.69578	2.01726	1.92245	0.50177	0.50494
2016	1.65177	1.73091	2.02279	1.93031	0.49715	0.49831
2017	1.72692	1.82135	2.08466	1.97657	0.50142	0.50142

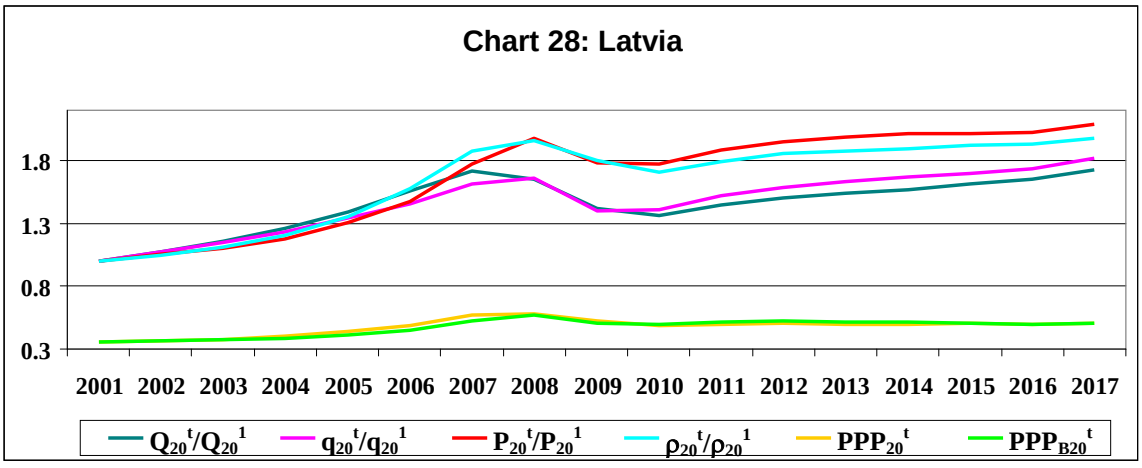


Table 23: PPP, Price and Volume Indexes for Lithuania

Year t	Q_{21}^t/Q_{21}^1	q_{21}^t/q_{21}^1	P_{21}^t/P_{21}^1	ρ_{21}^t/ρ_{21}^1	PPP_{21}^t	PPP_{B21}^t
2001	1.00000	1.00000	1.00000	1.00000	0.43234	0.43234

2002	1.06761	1.07719	1.00317	0.99424	0.42073	0.42413
2003	1.18012	1.21146	0.99506	0.96932	0.40447	0.41030
2004	1.25741	1.26071	1.02181	1.01914	0.41427	0.40757
2005	1.35458	1.34704	1.09230	1.09842	0.43516	0.41973
2006	1.45491	1.44610	1.16597	1.17307	0.44666	0.43200
2007	1.61621	1.60860	1.26587	1.27186	0.47073	0.45372
2008	1.65869	1.67958	1.38872	1.37144	0.49283	0.48502
2009	1.41297	1.43211	1.34295	1.32500	0.46938	0.46241
2010	1.43614	1.53191	1.37490	1.28894	0.44997	0.46486
2011	1.52292	1.66163	1.44678	1.32601	0.45192	0.47599
2012	1.58121	1.73551	1.48583	1.35372	0.45265	0.47646
2013	1.63653	1.81035	1.50495	1.36046	0.44335	0.47113
2014	1.69442	1.87128	1.52042	1.37672	0.44262	0.46405
2015	1.72889	1.88307	1.52508	1.40021	0.44761	0.45750
2016	1.76944	1.90343	1.53957	1.43119	0.45146	0.45383
2017	1.83718	1.98642	1.60507	1.48449	0.46124	0.46124

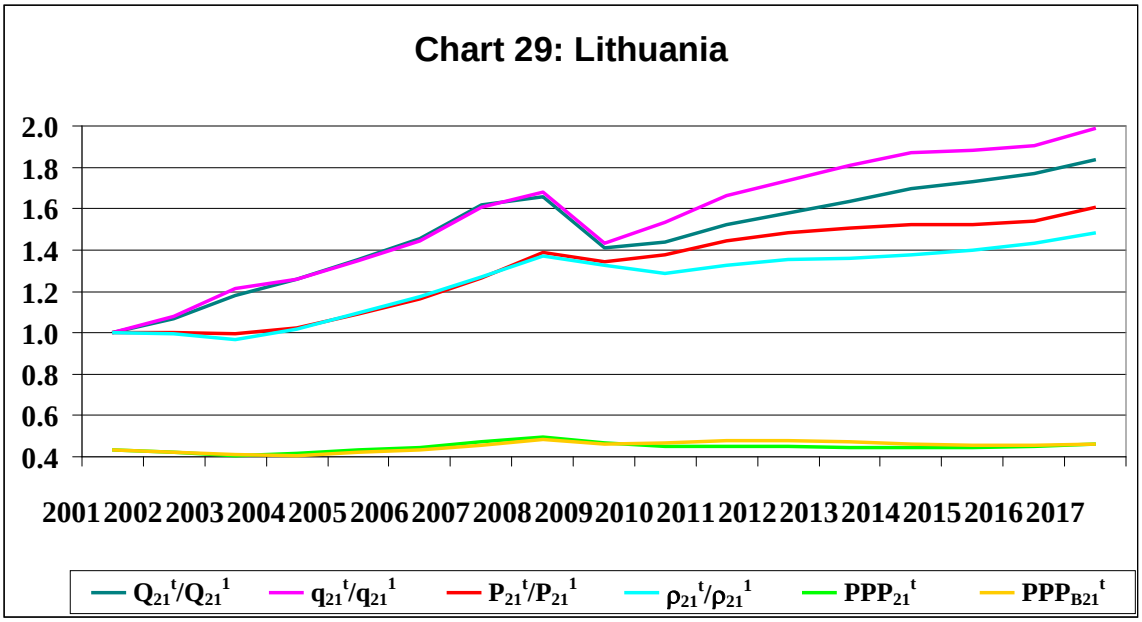


Table 24: PPP, Price and Volume Indexes for Luxembourg

Year t	Q_{22}^t/Q_{22}^1	q_{22}^t/q_{22}^1	P_{22}^t/P_{22}^1	ρ_{22}^t/ρ_{22}^1	PPP_{22}^t	PPP_{B22}^t
2001	1.00000	1.00000	1.00000	1.00000	0.96244	0.96244
2002	1.03820	1.03914	1.01681	1.01589	0.95700	0.95230
2003	1.05511	1.05948	1.04409	1.03978	0.96585	0.94897
2004	1.09322	1.11732	1.07494	1.05176	0.95173	0.94045
2005	1.12791	1.17729	1.12004	1.07306	0.94636	0.93937
2006	1.18631	1.31385	1.19884	1.08247	0.91752	0.96470
2007	1.28543	1.39691	1.21671	1.11960	0.92247	0.94249
2008	1.26898	1.42559	1.26396	1.12510	0.90004	0.94936
2009	1.21367	1.35846	1.28163	1.14503	0.90298	0.94436
2010	1.27271	1.42028	1.32798	1.19000	0.92481	0.95611
2011	1.30503	1.52208	1.39138	1.19296	0.90510	0.96996
2012	1.30043	1.52328	1.42695	1.21819	0.90679	0.96481
2013	1.34795	1.58509	1.45115	1.23405	0.89525	0.95316
2014	1.42575	1.70242	1.47503	1.23532	0.88414	0.93991
2015	1.46655	1.74811	1.49449	1.25378	0.89224	0.93139

2016	**1.51176**	**1.76035**	**1.47492**	**1.26664**	**0.88946**	**0.89879**
2017	**1.54648**	**1.80950**	**1.50636**	**1.28740**	**0.89046**	**0.89046**

The national growth rates for GDP for Luxembourg (Q_{22}^t/Q_{22}^1) differ substantially from their comparable across countries growth rates (q_{22}^t/q_{22}^1). It is difficult to obtain PPPs for financial services and government activities and perhaps this accounts for the large differences in the two series. Of course, large differences in the volume series translate into large differences in the corresponding price series, P_{22}^t/P_{22}^1 and ρ_{22}^t/ρ_{22}^1.

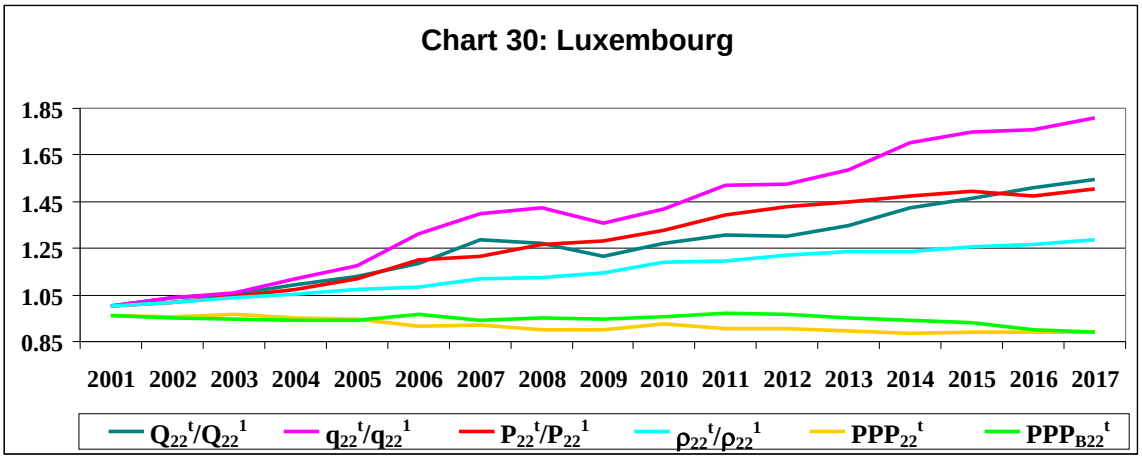
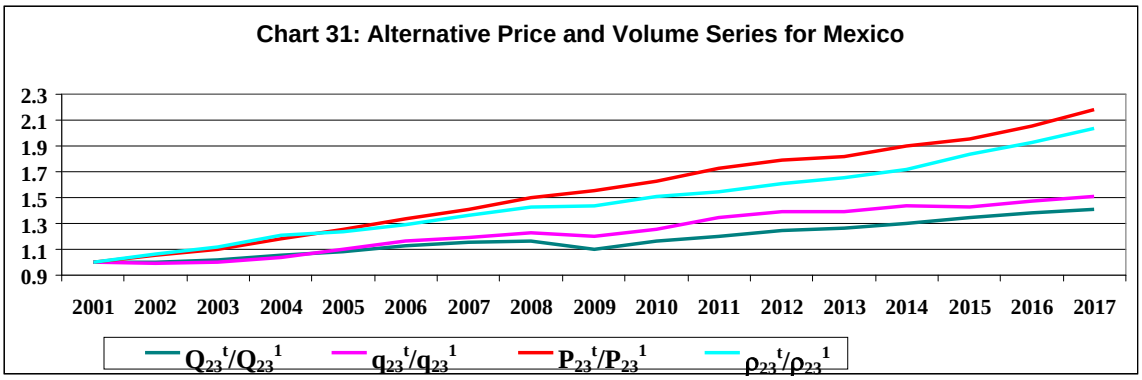


Table 25: PPP, Price and Volume Indexes for Mexico

Year t	Q_{23}^t/Q_{23}^1	q_{23}^t/q_{23}^1	P_{23}^t/P_{23}^1	ρ_{23}^t/ρ_{23}^1	PPP_{23}^t	PPP_{B23}^t
2001	**1.00000**	**1.00000**	**1.00000**	**1.00000**	**6.30487**	**6.30487**
2002	**0.99960**	**0.99305**	**1.05503**	**1.06199**	**6.55370**	**6.50826**
2003	**1.01406**	**0.99612**	**1.09765**	**1.11742**	**6.79963**	**6.60709**
2004	**1.05382**	**1.03238**	**1.18504**	**1.20965**	**7.17068**	**6.90368**
2005	**1.07814**	**1.09656**	**1.25465**	**1.23357**	**7.12686**	**7.04509**
2006	**1.12660**	**1.16198**	**1.33481**	**1.29418**	**7.18615**	**7.23060**
2007	**1.15242**	**1.19541**	**1.41209**	**1.36130**	**7.34753**	**7.40357**
2008	**1.16559**	**1.22603**	**1.49925**	**1.42535**	**7.46953**	**7.66346**
2009	**1.10398**	**1.19627**	**1.55843**	**1.43821**	**7.42992**	**7.85741**
2010	**1.16049**	**1.25536**	**1.62927**	**1.50614**	**7.66778**	**8.07031**
2011	**1.20300**	**1.34376**	**1.72446**	**1.54382**	**7.67301**	**8.31595**
2012	**1.24681**	**1.38837**	**1.79458**	**1.61161**	**7.85871**	**8.43934**
2013	**1.26370**	**1.38786**	**1.82203**	**1.65902**	**7.88436**	**8.36921**
2014	**1.29965**	**1.44028**	**1.90161**	**1.71594**	**8.04532**	**8.52018**
2015	**1.34216**	**1.43119**	**1.95364**	**1.83210**	**8.54110**	**8.60777**
2016	**1.38126**	**1.47476**	**2.05841**	**1.92791**	**8.86871**	**8.91646**
2017	**1.40946**	**1.51158**	**2.18464**	**2.03704**	**9.23002**	**9.23002**



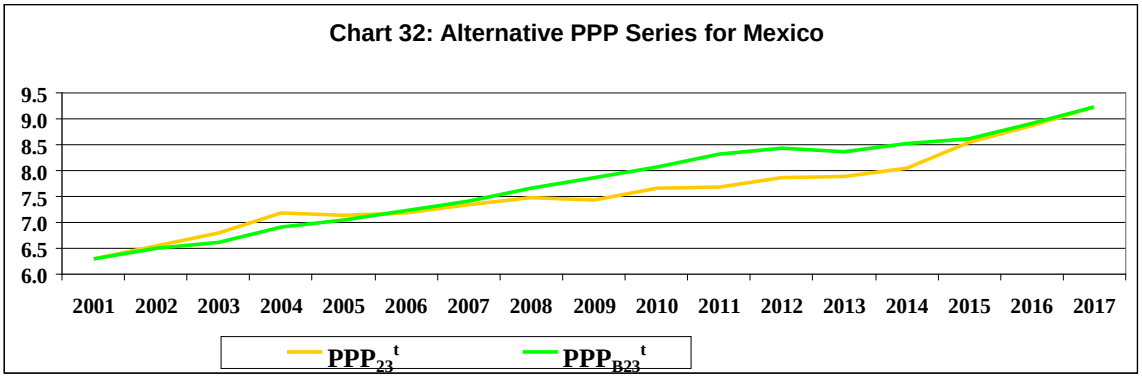


Table 26: PPP, Price and Volume Indexes for the Netherlands

Year t	Q_{24}^t/Q_{24}^1	q_{24}^t/q_{24}^1	P_{24}^t/P_{24}^1	ρ_{24}^t/ρ_{24}^1	PPP_{24}^t	PPP_{B24}^t
2001	1.00000	1.00000	1.00000	1.00000	0.90395	0.90395
2002	1.00104	1.02139	1.03888	1.01818	0.90086	0.92308
2003	1.00388	1.00200	1.06007	1.06206	0.92659	0.92334
2004	1.02426	1.02776	1.07236	1.06870	0.90830	0.90818
2005	1.04639	1.05552	1.09251	1.08306	0.89714	0.89594
2006	1.08321	1.10658	1.11987	1.09621	0.87271	0.89005
2007	1.12327	1.15461	1.14389	1.11285	0.86118	0.88403
2008	1.14236	1.19031	1.17570	1.12833	0.84777	0.88992
2009	1.09932	1.13215	1.17952	1.14532	0.84832	0.88473
2010	1.11474	1.13467	1.18991	1.16901	0.85328	0.88090
2011	1.13328	1.15030	1.19090	1.17328	0.83606	0.86229
2012	1.12130	1.14914	1.20845	1.17918	0.82441	0.85723
2013	1.11917	1.17004	1.22465	1.17141	0.79817	0.85246
2014	1.13506	1.15829	1.22780	1.20317	0.80880	0.83751
2015	1.16072	1.17489	1.23364	1.21876	0.81461	0.83133
2016	1.18637	1.18756	1.23902	1.23778	0.81637	0.82468
2017	1.22389	1.21911	1.24973	1.25463	0.81506	0.81506

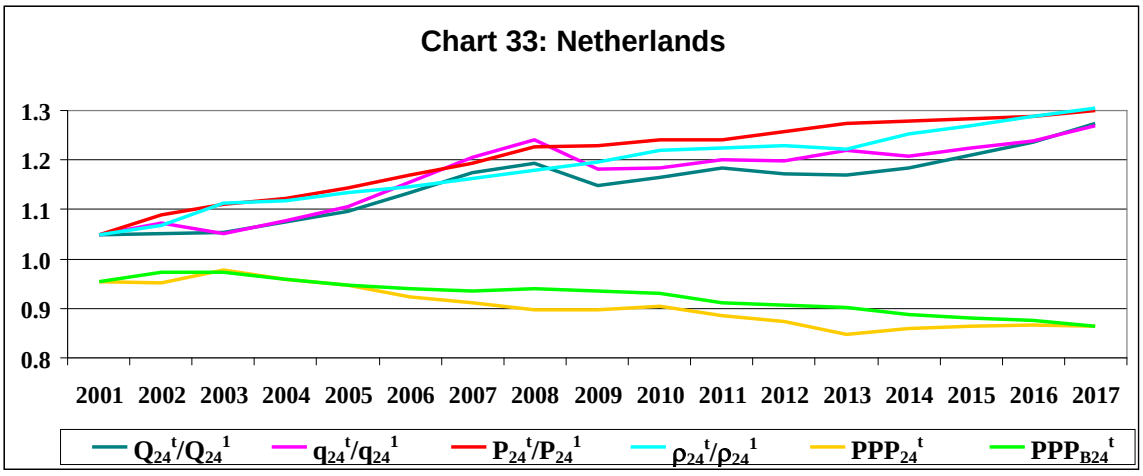


Table 27: PPP, Price and Volume Indexes for New Zealand

Year t	Q_{25}^t/Q_{25}^1	q_{25}^t/q_{25}^1	P_{25}^t/P_{25}^1	ρ_{25}^t/ρ_{25}^1	PPP_{25}^t	PPP_{B25}^t
2001	1.00000	1.00000	1.00000	1.00000	1.47305	1.47305
2002	1.05061	1.03084	0.99967	1.01884	1.46896	1.44444
2003	1.09831	1.06598	1.02219	1.05319	1.49733	1.44486
2004	1.13422	1.10332	1.05871	1.08835	1.50734	1.45202
2005	1.17186	1.11317	1.08024	1.13719	1.53500	1.43165
2006	1.20201	1.17114	1.11246	1.14179	1.48125	1.42592
2007	1.24721	1.21610	1.16392	1.19370	1.50531	1.44766
2008	1.22794	1.20998	1.19973	1.21753	1.49071	1.45848
2009	1.25146	1.23870	1.20594	1.21836	1.47055	1.44973
2010	1.26350	1.25705	1.25091	1.25733	1.49553	1.48115
2011	1.29757	1.29469	1.27680	1.27963	1.48592	1.47556
2012	1.33000	1.28705	1.27038	1.31277	1.49562	1.43535
2013	1.35684	1.38793	1.33213	1.30229	1.44598	1.47387
2014	1.40494	1.43094	1.33957	1.31523	1.44073	1.44938
2015	1.46724	1.47257	1.34870	1.34382	1.46368	1.43865
2016	1.51817	1.54660	1.39153	1.36595	1.46808	1.46301
2017	1.56098	1.60738	1.42998	1.38870	1.47011	1.47011

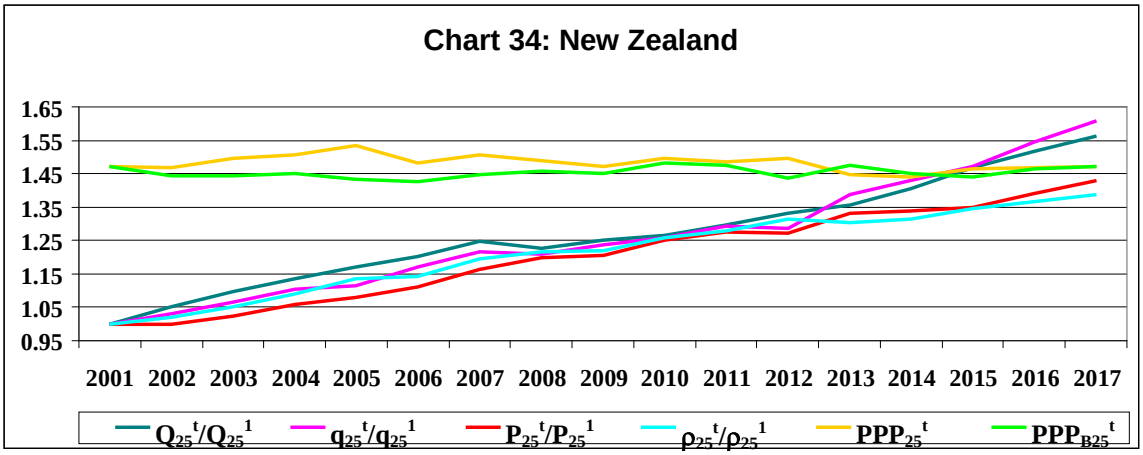
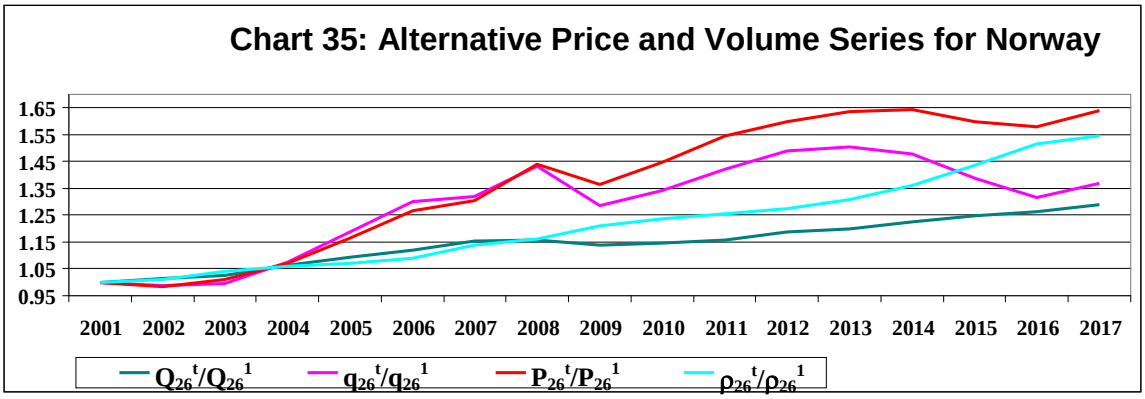
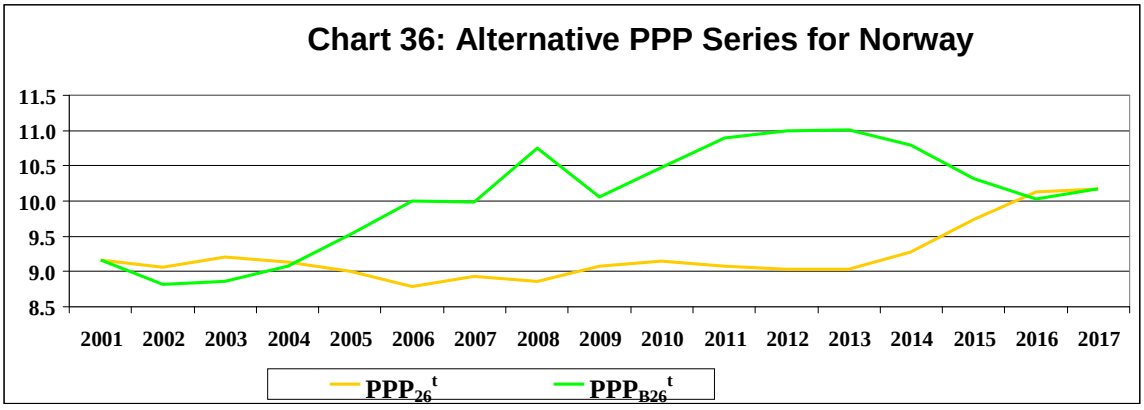


Table 28: PPP, Price and Volume Indexes for Norway

Year t	Q_{26}^t/Q_{26}^1	q_{26}^t/q_{26}^1	P_{26}^t/P_{26}^1	ρ_{26}^t/ρ_{26}^1	PPP_{26}^t	PPP_{B26}^t
2001	1.00000	1.00000	1.00000	1.00000	9.16557	9.16557
2002	1.01438	0.98776	0.98305	1.00954	9.05673	8.82118
2003	1.02371	0.99445	1.01120	1.04094	9.20832	8.85934
2004	1.06424	1.07494	1.07020	1.05955	9.13070	9.08030
2005	1.09217	1.18563	1.16395	1.07220	9.00520	9.52472
2006	1.11833	1.30055	1.26610	1.08870	8.78810	10.00102
2007	1.15171	1.31986	1.30471	1.13850	8.93312	9.98129
2008	1.15725	1.43384	1.44084	1.16290	8.85928	10.75297
2009	1.13768	1.28471	1.36585	1.20953	9.08368	10.06055
2010	1.14555	1.34191	1.44715	1.23539	9.14305	10.47874
2011	1.15668	1.42146	1.54485	1.25708	9.08274	10.89705
2012	1.18816	1.48816	1.59671	1.27483	9.03708	10.99021
2013	1.20057	1.50407	1.63734	1.30695	9.02935	11.01462
2014	1.22428	1.47741	1.64274	1.36129	9.27846	10.78615
2015	1.24840	1.38764	1.59639	1.43620	9.73337	10.31389
2016	1.26323	1.31671	1.57825	1.51415	10.12570	10.03099
2017	1.28824	1.36801	1.63946	1.54387	10.16944	10.16944





The national series for Norway do not match up well with the corresponding harmonized series and the blended interpolated series PPP_{B26}^t is often far from the corresponding annual OECD time series of Purchasing Power Parities, PPP_{26}^t. This lack of matching is probably due to large changes in Norway's terms of trade as the price of oil fluctuates on world markets.

Table 29: PPP, Price and Volume Indexes for Poland

Year t	Q_{27}^t/Q_{27}^1	q_{27}^t/q_{27}^1	P_{27}^t/P_{27}^1	ρ_{27}^t/ρ_{27}^1	PPP_{27}^t	PPP_{B27}^t
2001	1.00000	1.00000	1.00000	1.00000	1.83531	1.83531
2002	1.02042	1.03732	1.01849	1.00190	1.79980	1.83385
2003	1.05677	1.06340	1.02630	1.01990	1.80659	1.80801
2004	1.11104	1.12736	1.07672	1.06113	1.83106	1.84077
2005	1.14986	1.14353	1.10438	1.11049	1.86759	1.82477
2006	1.22091	1.19701	1.12343	1.14587	1.85213	1.79557
2007	1.30680	1.28891	1.16515	1.18132	1.85605	1.80732
2008	1.36234	1.36535	1.21032	1.20765	1.84224	1.83526
2009	1.40076	1.41547	1.25596	1.24291	1.86911	1.88360
2010	1.45128	1.52290	1.27681	1.21676	1.80320	1.88633
2011	1.52410	1.61334	1.31804	1.24513	1.80142	1.90087
2012	1.54860	1.65095	1.34901	1.26538	1.79617	1.90240
2013	1.57016	1.66780	1.35292	1.27371	1.76205	1.86859
2014	1.62171	1.70292	1.35962	1.29478	1.76714	1.83668
2015	1.68405	1.75769	1.36990	1.31251	1.78115	1.82472
2016	1.73406	1.78490	1.37407	1.33494	1.78759	1.80428
2017	1.81469	1.86384	1.40036	1.36343	1.79832	1.79832

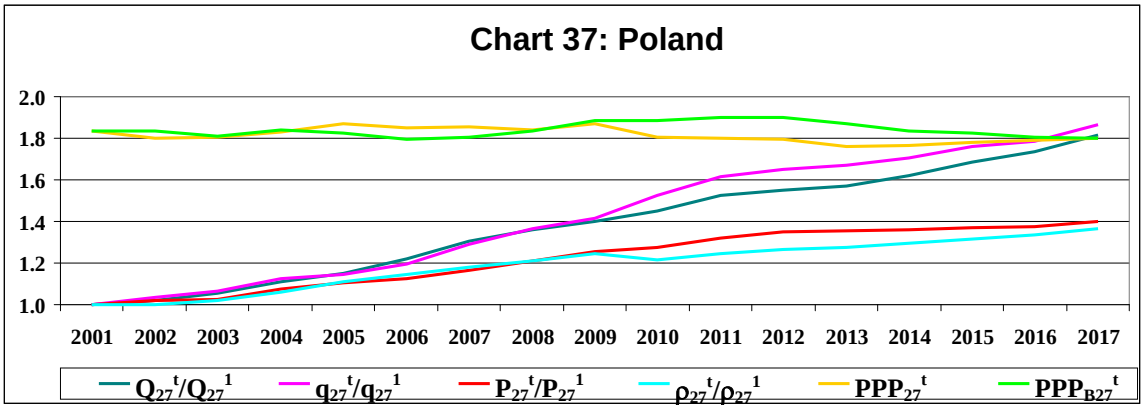


Table 30: PPP, Price and Volume Indexes for Portugal

Year t	Q_{28}^t/Q_{28}^1	q_{28}^t/q_{28}^1	P_{28}^t/P_{28}^1	ρ_{28}^t/ρ_{28}^1	PPP_{28}^t	PPP_{B28}^t
2001	1.00000	1.00000	1.00000	1.00000	0.67022	0.67022
2002	1.00769	1.02496	1.04208	1.02452	0.67208	0.68223
2003	0.99827	1.03798	1.07792	1.03669	0.67059	0.68748
2004	1.01636	1.04490	1.10375	1.07360	0.67652	0.68021
2005	1.02415	1.07993	1.14050	1.08159	0.66426	0.67636
2006	1.04006	1.12754	1.17683	1.08552	0.64074	0.67217
2007	1.06598	1.14462	1.21189	1.12863	0.64755	0.66889
2008	1.06810	1.15321	1.23295	1.14195	0.63615	0.66237
2009	1.03629	1.13078	1.24646	1.14231	0.62731	0.65943
2010	1.05597	1.15153	1.25448	1.15038	0.62257	0.65097
2011	1.03668	1.09976	1.25110	1.17934	0.62308	0.63102
2012	0.99492	1.06155	1.24613	1.16791	0.60540	0.61192
2013	0.98367	1.08513	1.27438	1.15523	0.58361	0.61025
2014	0.99246	1.09713	1.28394	1.16145	0.57887	0.59876
2015	1.01054	1.11607	1.31000	1.18613	0.58781	0.59978
2016	1.03000	1.14575	1.33293	1.19827	0.58596	0.59902
2017	1.05879	1.16537	1.35324	1.22948	0.59219	0.59219

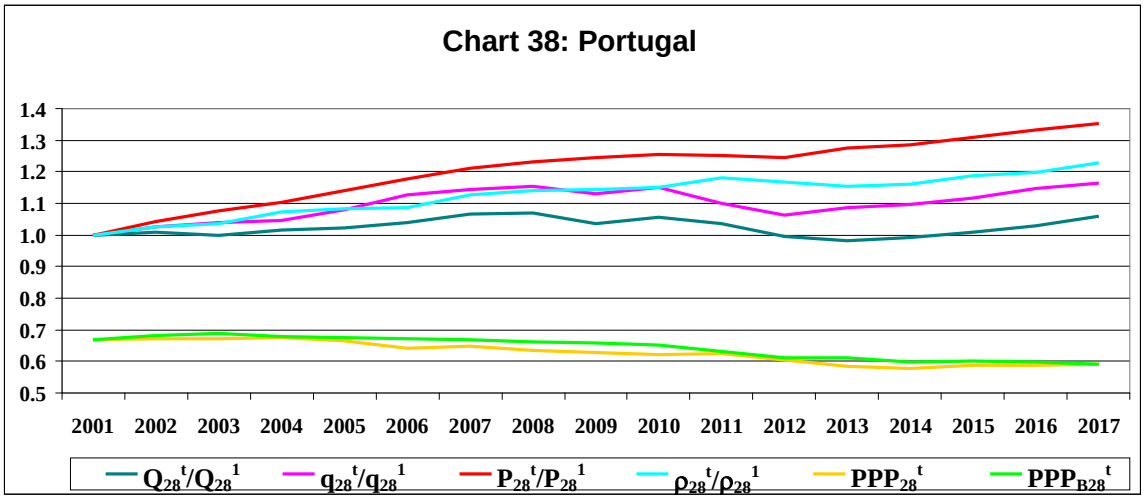


Table 31: PPP, Price and Volume Indexes for the Slovak Republic

Year t	Q_{29}^t/Q_{29}^1	q_{29}^t/q_{29}^1	P_{29}^t/P_{29}^1	ρ_{29}^t/ρ_{29}^1	PPP_{29}^t	PPP_{B29}^t
2001	1.00000	1.00000	1.00000	1.00000	0.51518	0.51518
2002	1.04523	1.05057	1.03952	1.03424	0.52152	0.52684
2003	1.10187	1.10099	1.09519	1.09606	0.54499	0.54456
2004	1.15981	1.15232	1.15851	1.16604	0.56480	0.56056
2005	1.23811	1.22835	1.18679	1.19622	0.56471	0.55652
2006	1.34277	1.34055	1.22143	1.22345	0.55510	0.55556
2007	1.48778	1.46196	1.23522	1.25703	0.55439	0.54676
2008	1.57154	1.59053	1.27023	1.25506	0.53743	0.55116
2009	1.48632	1.52786	1.25544	1.22131	0.51555	0.54025
2010	1.56126	1.63332	1.26153	1.20587	0.50164	0.53625
2011	1.60527	1.65081	1.28232	1.24695	0.50641	0.53357
2012	1.63187	1.67342	1.29850	1.26626	0.50454	0.52977
2013	1.65620	1.70925	1.30523	1.26472	0.49112	0.52298
2014	1.70175	1.75025	1.30314	1.26703	0.48541	0.51210
2015	1.76727	1.77774	1.30115	1.29348	0.49273	0.50556
2016	1.82602	1.81229	1.29531	1.30513	0.49058	0.49751
2017	1.88811	1.85593	1.31186	1.33461	0.49413	0.49413

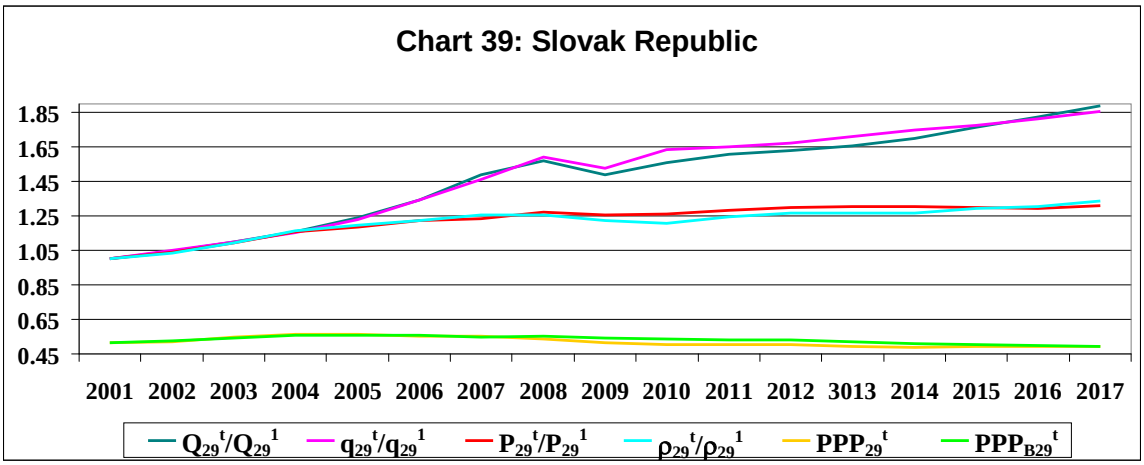


Table 32: PPP, Price and Volume Indexes for Slovenia

Year t	Q_{30}^t/Q_{30}^1	q_{30}^t/q_{30}^1	P_{30}^t/P_{30}^1	ρ_{30}^t/ρ_{30}^1	PPP_{30}^t	PPP_{B30}^t
2001	1.00000	1.00000	1.00000	1.00000	0.55956	0.55956
2002	1.03836	1.04891	1.07580	1.06498	0.58329	0.59222
2003	1.06787	1.07707	1.13663	1.12692	0.60861	0.61389
2004	1.11434	1.13203	1.17432	1.15597	0.60816	0.61722
2005	1.15895	1.16149	1.19253	1.18992	0.61013	0.60746
2006	1.22450	1.20506	1.21862	1.23829	0.61024	0.60212
2007	1.30950	1.26179	1.26942	1.31742	0.63108	0.61042
2008	1.35272	1.31699	1.32670	1.36269	0.63379	0.62538
2009	1.24724	1.21486	1.37122	1.40777	0.64546	0.64105
2010	1.26268	1.21537	1.35769	1.41054	0.63733	0.62701
2011	1.27088	1.23344	1.37289	1.41456	0.62397	0.62065
2012	1.23695	1.21675	1.37918	1.40209	0.60679	0.61136
2013	1.22295	1.22425	1.40128	1.39979	0.59041	0.61005
2014	1.25938	1.25190	1.41240	1.42085	0.59124	0.60307
2015	1.28783	1.27051	1.42606	1.44550	0.59808	0.60207
2016	1.32838	1.30462	1.43883	1.46503	0.59813	0.60050
2017	1.39481	1.37041	1.46727	1.49339	0.60055	0.60055

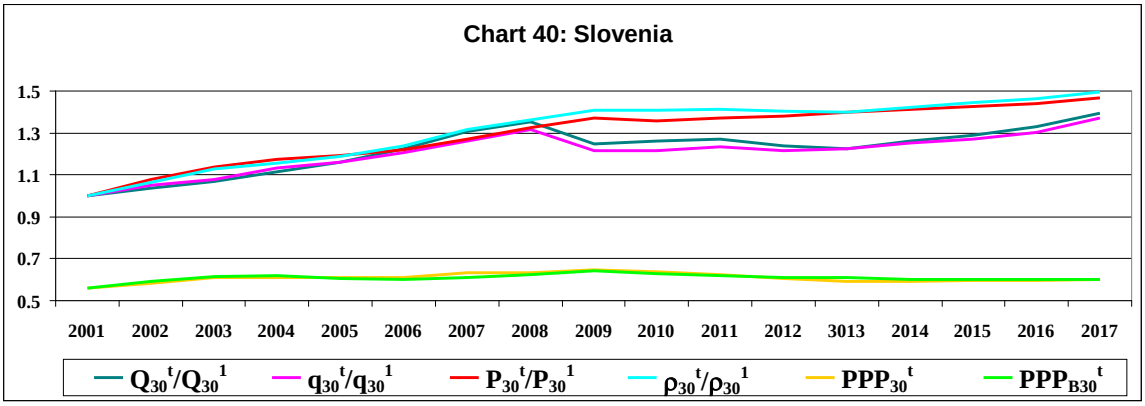


Table 33: PPP, Price and Volume Indexes for Spain

Year t	Q_{31}^t/Q_{31}^1	q_{31}^t/q_{31}^1	P_{31}^t/P_{31}^1	ρ_{31}^t/ρ_{31}^1	PPP_{31}^t	PPP_{B31}^t
2001	1.00000	1.00000	1.00000	1.00000	0.74681	0.74681
2002	1.02880	1.05476	1.04115	1.01553	0.74231	0.76053
2003	1.06159	1.08909	1.08195	1.05464	0.76016	0.77095
2004	1.09521	1.12832	1.12438	1.09139	0.76632	0.77518
2005	1.13599	1.18303	1.17103	1.12447	0.76951	0.77794
2006	1.18340	1.28650	1.21762	1.12005	0.73667	0.78010
2007	1.22800	1.34714	1.25818	1.14691	0.73325	0.77997
2008	1.24173	1.36457	1.28505	1.16936	0.72586	0.77643
2009	1.19735	1.31343	1.28829	1.17444	0.71866	0.76755
2010	1.19752	1.28301	1.29036	1.20438	0.72627	0.75506
2011	1.18556	1.26149	1.29073	1.21304	0.71413	0.73508
2012	1.15085	1.23539	1.29161	1.20322	0.69498	0.71712
2013	1.13122	1.22316	1.29618	1.19875	0.67480	0.70271
2014	1.14683	1.24393	1.29365	1.19267	0.66236	0.68391
2015	1.18863	1.27792	1.30029	1.20944	0.66785	0.67579
2016	1.22634	1.31480	1.30411	1.21637	0.66278	0.66615
2017	1.26288	1.36083	1.32024	1.22520	0.65757	0.65757

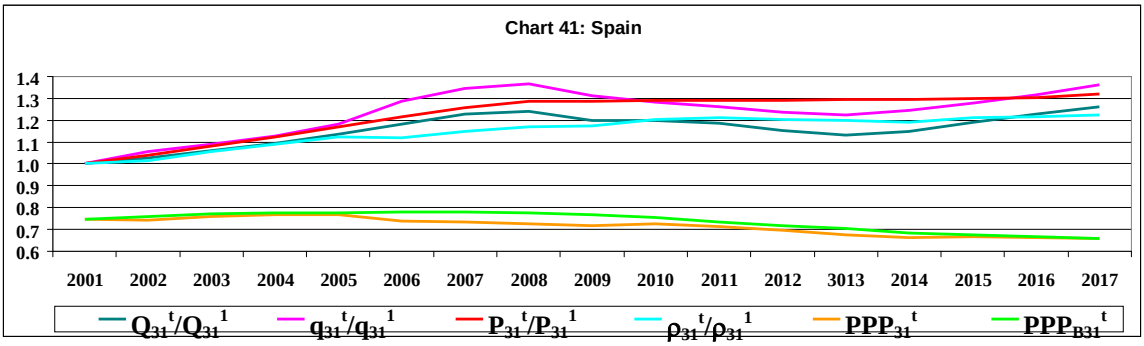
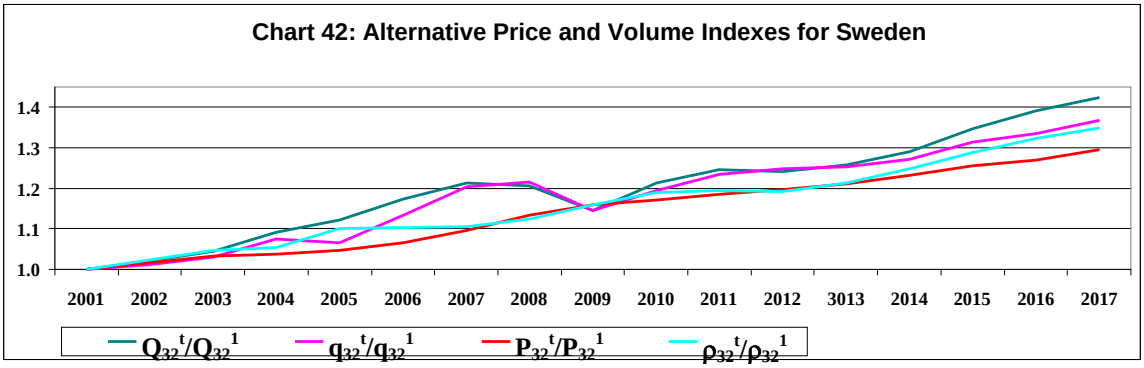


Table 34: PPP, Price and Volume Indexes for Sweden

Year t	Q_{32}^t/Q_{32}^1	q_{32}^t/q_{32}^1	P_{32}^t/P_{32}^1	ρ_{32}^t/ρ_{32}^1	PPP_{32}^t	PPP_{B32}^t
2001	1.00000	1.00000	1.00000	1.00000	9.39247	9.39247
2002	1.02074	1.01280	1.01602	1.02398	9.41366	9.40086
2003	1.04509	1.03102	1.03356	1.04766	9.49715	9.39532
2004	1.09024	1.07453	1.03789	1.05306	9.29945	9.19371
2005	1.12097	1.06482	1.04620	1.10137	9.47918	8.99366
2006	1.17352	1.13396	1.06532	1.10249	9.11974	8.89522
2007	1.21348	1.20389	1.09603	1.10476	8.88302	8.91846
2008	1.20672	1.21524	1.13246	1.12452	8.77899	9.04530
2009	1.14415	1.14433	1.15928	1.15911	8.92051	9.19590
2010	1.21268	1.19425	1.17080	1.18886	9.01655	9.18665
2011	1.24499	1.23492	1.18482	1.19448	8.84404	9.11279
2012	1.24142	1.24752	1.19726	1.19140	8.65477	9.04143
2013	1.25683	1.25211	1.20985	1.21441	8.59768	8.98520
2014	1.28956	1.27082	1.23131	1.24947	8.72713	8.98106
2015	1.34788	1.31372	1.25595	1.28861	8.94929	9.07012
2016	1.39148	1.33407	1.26986	1.32450	9.07675	9.07769
2017	1.26288	1.36083	1.32024	1.22520	0.65757	0.65757



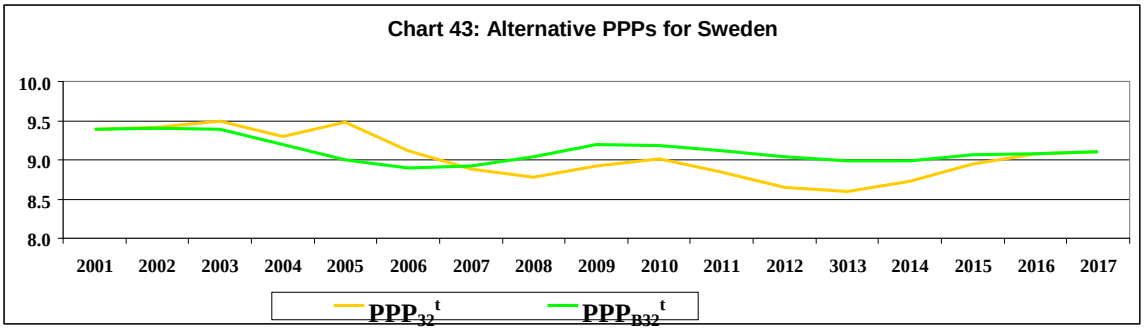


Table 35: PPP, Price and Volume Indexes for Switzerland

Year t	Q_{33}^t/Q_{33}^1	q_{33}^t/q_{33}^1	P_{33}^t/P_{33}^1	ρ_{33}^t/ρ_{33}^1	PPP_{33}^t	PPP_{B33}^t
2001	1.00000	1.00000	1.00000	1.00000	1.76693	1.76693
2002	1.00163	1.01059	0.99746	0.98861	1.70976	1.71926
2003	1.00202	1.00373	1.00870	1.00699	1.71727	1.69144
2004	1.02984	1.02300	1.01217	1.01894	1.69274	1.63776
2005	1.06192	1.03900	1.01915	1.04164	1.68655	1.58473
2006	1.10428	1.11731	1.04051	1.02838	1.60030	1.55617
2007	1.14969	1.20818	1.06564	1.01405	1.53388	1.53796
2008	1.17446	1.25605	1.08724	1.01662	1.49305	1.52523
2009	1.14836	1.23412	1.09118	1.01535	1.47002	1.50538
2010	1.18284	1.26119	1.09464	1.02663	1.46475	1.47922
2011	1.20287	1.31684	1.09838	1.00332	1.39750	1.44071
2012	1.21497	1.34449	1.09647	0.99084	1.35407	1.39833
2013	1.23747	1.37723	1.09675	0.98545	1.31248	1.36209
2014	1.26778	1.41646	1.08989	0.97549	1.28176	1.31638
2015	1.28332	1.46471	1.08334	0.94919	1.24011	1.28288
2016	1.30098	1.46654	1.07721	0.95560	1.23196	1.25037
2017	1.31512	1.47949	1.08102	0.96092	1.22021	1.22021

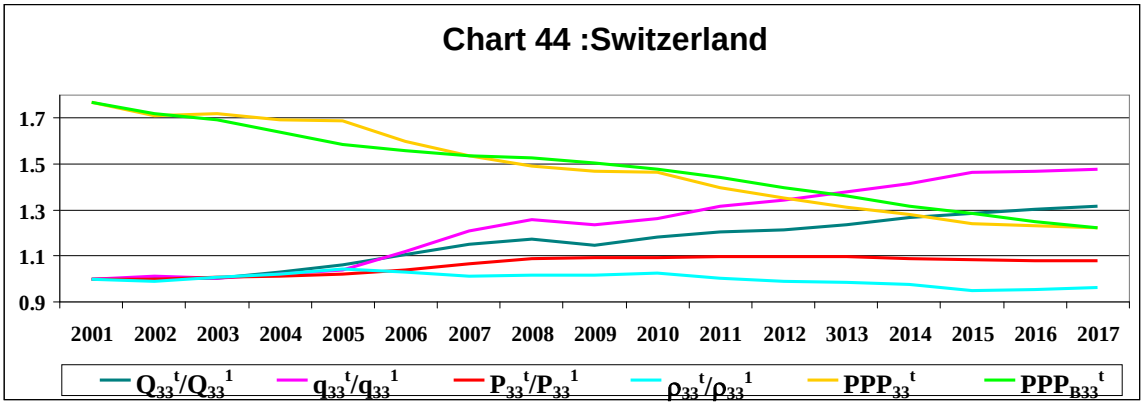


Table 36: PPP, Price and Volume Indexes for Turkey

Year t	Q_{34}^t/Q_{34}^1	q_{34}^t/q_{34}^1	P_{34}^t/P_{34}^1	ρ_{34}^t/ρ_{34}^1	PPP_{34}^t	PPP_{B34}^t
2001	1.00000	1.00000	1.00000	1.00000	0.41455	0.41455
2002	1.06430	1.00485	1.37574	1.45715	0.59125	0.55855
2003	1.12399	1.03466	1.69657	1.84305	0.73741	0.67278
2004	1.23239	1.15614	1.90774	2.03355	0.79261	0.73290

2005	1.34343	1.24942	2.04328	2.19702	0.83459	0.75735
2006	1.43894	1.39341	2.23477	2.30780	0.84257	0.79986
2007	1.51133	1.49381	2.37370	2.40154	0.85228	0.82311
2008	1.52410	1.58715	2.65943	2.55379	0.87996	0.89995
2009	1.45240	1.52873	2.80309	2.66313	0.90460	0.93655
2010	1.57567	1.72068	2.99966	2.74686	0.91949	0.98559
2011	1.75079	1.92178	3.24529	2.95654	0.96618	1.03911
2012	1.83465	2.01067	3.48603	3.18085	1.01986	1.08956
2013	1.99043	2.15278	3.70456	3.42519	1.07029	1.13205
2014	2.09327	2.32505	3.97950	3.58279	1.10450	1.18736
2015	2.22067	2.42875	4.29097	3.92334	1.20261	1.26024
2016	2.29137	2.47401	4.63847	4.29605	1.29941	1.34063
2017	2.46187	2.59927	5.14144	4.86967	1.45080	1.45080

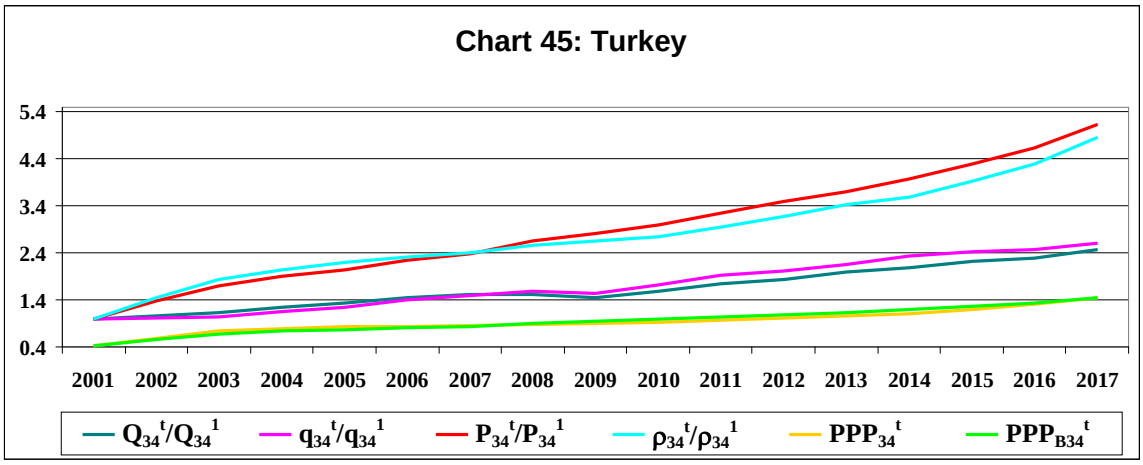


Table 37: PPP, Price and Volume Indexes for the United Kingdom

Year t	Q_{35}^t/Q_{35}^1	q_{35}^t/q_{35}^1	P_{35}^t/P_{35}^1	ρ_{35}^t/ρ_{35}^1	PPP_{35}^t	PPP_{B35}^t
2001	1.00000	1.00000	1.00000	1.00000	0.69381	0.69381
2002	1.02500	1.03101	1.02184	1.01587	0.68988	0.69827
2003	1.05923	1.06532	1.04640	1.04042	0.69670	0.70237
2004	1.08410	1.10177	1.07222	1.05502	0.68822	0.70118
2005	1.11823	1.10475	1.09959	1.11300	0.70762	0.69769
2006	1.14672	1.13764	1.13183	1.14087	0.69712	0.69740
2007	1.17591	1.14164	1.16061	1.19545	0.71005	0.69677
2008	1.17185	1.14956	1.19362	1.21676	0.70169	0.70326
2009	1.12208	1.08970	1.21296	1.24900	0.71005	0.70960
2010	1.14128	1.12231	1.23153	1.25235	0.70161	0.71252
2011	1.16006	1.12793	1.25517	1.29092	0.70605	0.71169
2012	1.17684	1.14737	1.27479	1.30753	0.70163	0.70956
2013	1.20092	1.17306	1.29857	1.32941	0.69525	0.71068
2014	1.23632	1.20627	1.32079	1.35370	0.69844	0.70977
2015	1.26537	1.23468	1.32654	1.35951	0.69745	0.70567
2016	1.28801	1.25807	1.35388	1.38609	0.70167	0.71277
2017	1.30934	1.26303	1.37992	1.43051	0.71328	0.71328

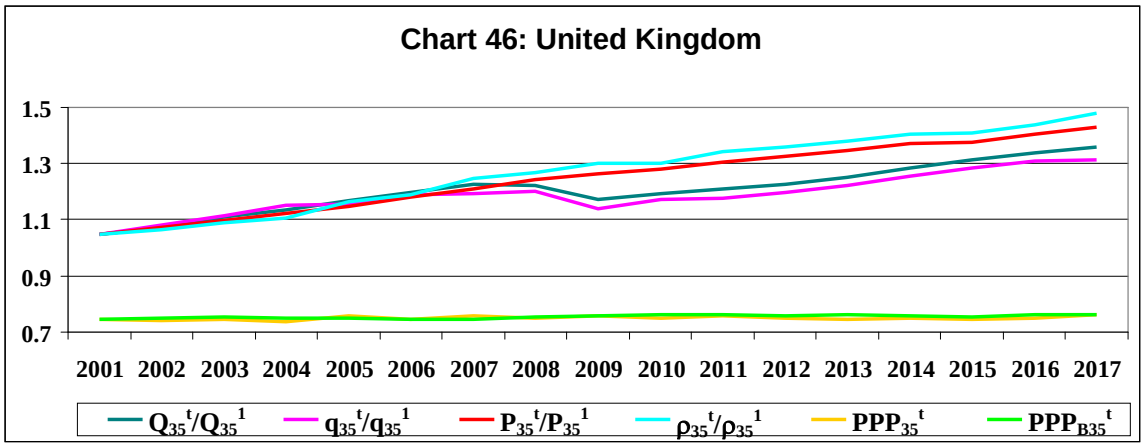
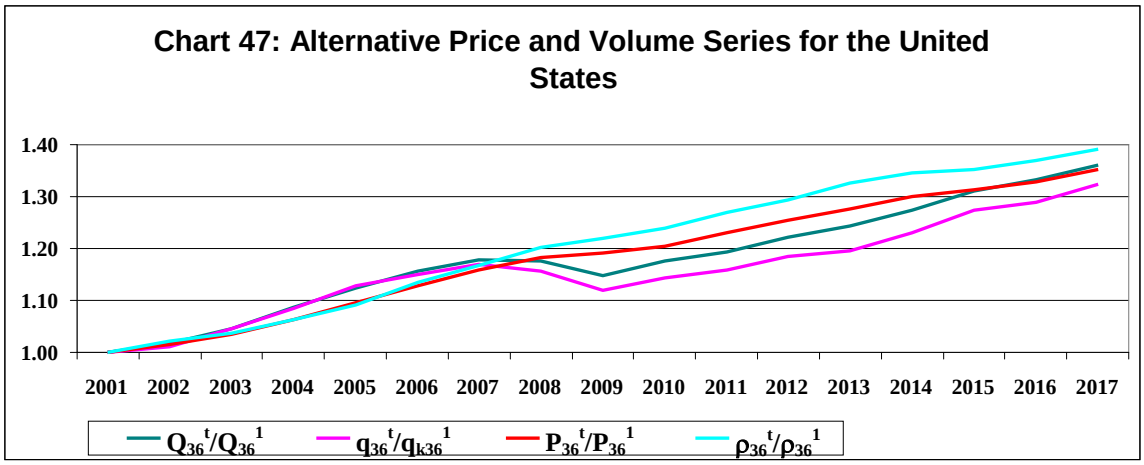


Table 38: PPP, Price and Volume Indexes for the United States

Year t	Q_{36}^t/Q_{36}^1	q_{36}^t/q_{36}^1	P_{36}^t/P_{36}^1	ρ_{36}^t/ρ_{36}^1	PPP_{36}^t	PPP_{B36}^t
2001	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2002	1.01742	1.01159	1.01582	1.02167	1.00000	1.00000
2003	1.04653	1.04508	1.03468	1.03611	1.00000	1.00000
2004	1.08628	1.08521	1.06254	1.06359	1.00000	1.00000
2005	1.12445	1.12892	1.09564	1.09129	1.00000	1.00000
2006	1.15655	1.14976	1.12879	1.13546	1.00000	1.00000
2007	1.17825	1.16916	1.15911	1.16812	1.00000	1.00000
2008	1.17664	1.15567	1.18166	1.20310	1.00000	1.00000
2009	1.14679	1.11883	1.19067	1.22043	1.00000	1.00000
2010	1.17619	1.14401	1.20454	1.23843	1.00000	1.00000
2011	1.19443	1.15786	1.22971	1.26855	1.00000	1.00000
2012	1.22130	1.18383	1.25329	1.29296	1.00000	1.00000
2013	1.24380	1.19562	1.27528	1.32667	1.00000	1.00000
2014	1.27430	1.23135	1.29941	1.34473	1.00000	1.00000
2015	1.31101	1.27309	1.31331	1.35242	1.00000	1.00000
2016	1.33155	1.28987	1.32767	1.37057	1.00000	1.00000
2017	1.36108	1.32335	1.35290	1.39147	1.00000	1.00000



It is not necessary to plot the US OECD PPP series, PPP_{36}^{t}, or its blended approximation series, PPP_{B36}^{t}, since both series are identically equal to 1.

Define the *GDP cumulative growth factor for country k* over the 17 year period as Q_k^{17}/Q_k^{1} (equal to Q_k^{2017}/Q_k^{2001}).[14] The cumulative growth factors for the 7 largest OECD countries are as follows: France (1.20), Germany (1.22), Italy (1.01), Japan (1.15), Spain (1.26), UK (1.31) and US (1.36).

The following 15 OECD countries had cumulative growth factors equal to or greater than 1.5: Australia (1.57), Chile (1.82), Czech Republic (1.54), Estonia (1.69), Iceland (1.59), Ireland (2.07), Israel (1.76), Korea (1.81), Latvia (1.73), Lithuania (1.84), Luxembourg (1.55), New Zealand (1.56), Poland (1.81), Slovak Republic (1.89) and Turkey (2.46).

The following countries had cumulative growth factors equal to or less than 1.2: Denmark (1.18), France (1.20), Greece (0.95), Italy (1.01), Japan (1.15) and Portugal (1.06).

There were relatively large differences between the national cumulative GDP growth factors, Q_k^{17}/Q_k^{1}, and their consistent across country counterpart growth factors, q_k^{17}/q_k^{1}, for one or more years for the following 17 countries: Canada, Chile, Hungary, Iceland, Italy, Korea, Lithuania, Luxembourg, Mexico, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey and the US. These differences illustrate the fact that the cross sectional comparisons of real GDP and time series comparisons of national GDP growth are not completely consistent with each other. Since it is likely that the cross sectional comparisons are not as accurate as the time series comparisons, users of the harmonized real GDP estimates, q_k^{t}, should be aware that these estimates are subject to a considerable amount of measurement error.

There were relatively large differences between the "true" OECD Purchasing Power Parities, PPP_k^{t}, and their blended approximations, PPP_{Bk}^{t}, for one or more years for the following 14 countries: Canada, Chile, Czech Republic, Denmark, Hungary, Iceland, Israel, Korea, Luxembourg, Mexico, Norway, Poland, Sweden and Switzerland. However, the blended estimates will surely be much closer to the true PPPs if the period between benchmarks is reduced from 17 years to a much smaller number. Thus the DF blended method is a very useful method for interpolation of PPPs between benchmark PPPs.

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[14] The domestic growth factors, Q_k^{17}/Q_k^{1}, will generally be more accurate than their harmonized, comparable across countries, growth factors, q_k^{17}/q_k^{1}.

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