Purchasing Power Parities and Relative Productivity Levels in Latin America

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Purposes

- Present the LA KLEMS productivity level data base which compares the relative industry productivity levels and competitiveness in Latin America and the United States. The database has data on
  - The PPPs (or relative price levels) of output and capital, labour and intermediate inputs at the sector level in Latin America for benchmark year 2011.
  - The relative levels of output and inputs, and labour and total factor productivity levels at the sector level for 8 LA economies for the period 1990 to 2018.
- Summarize the main findings from the data base.

Outline

- The methodology and data sources for estimating PPPs of gross output, value added, intermediate inputs, and capital and labour inputs

- The methodology for estimating the relative levels of output and inputs and labour and total factor productivity using the estimated PPPs.

- The main findings on relative productivity levels in Latin America and the United States from the database

- Conclusions

Methodology

- The methodology for sectoral PPPs and industry productivity comparison was developed by Jorgenson et al. (1987) and Caves, Christensen and Diewert (1982).

- It has been adopted in international comparison initiative such as World KLEMS and many country level studies (Inklaar, Timmer and van Ark, 2006, Baldwin, Gu and Yan, 2008)

Estimating PPPs of gross output, value added and intermediate inputs

- The methodology starts with data on SUTs and PPPs at the product level.
  - Supply tables at basic prices and use tables at purchaser price. Those tables are published in most countries following SNA standards and are fully consistent with the data requirement for PPPs estimation for productivity level comparison
  - PPPs at the product level. Those data are collected for ICP project of the World Bank and UNSD and OECD-Eurostat PPP program and are used for the comparison of GDP per capita from the expenditure side.
- The PPPs at the product level are then aggregated to derive PPPs for gross output, intermediate inputs, and value added at the industry level, using information from SUTs as weights.

Aggregation method

- CCD multilateral translog index is used for such aggregation. For this method, an average of all counties is used as benchmark for comparison with other countries.

- CCD multilateral index is used to construct PPP for gross output and intermediate inputs.

- PPPs for value added is derived using double deflation based on CCD index aggregation.

- PPPs at the industry level is aggregated to total economy to derive PPPs for GDP for total economy (bottom-up approach).

Data sources for PPPs of output and intermediate inputs

- Supply table at basic price and use tables at purchaser price for LA economies and the United States for 72 products by 72 industries which are aggregated to the 9 sectors and 72 products.

- PPPs at 155 basic headings from ICP 2011, expressed as domestic currency per US dollar which are mapped to 72 products to obtain PPPs for the 72 products.

Transformation of ICP PPPs for productivity analysis

- ICP PPPs are not available for the products that are mainly used for intermediate inputs such as crude oil and mining products. Exchange rates or GDP PPPs are used as proxy.

- PPPs from ICP are based on market price. For productivity comparison, gross output is valued at basic price and intermediate inputs are valued at purchaser price.
  - To estimate PPPs for gross output, PPPs from ICP for purchaser price (market price) are converted to basic prices by peeling off transport and trade margins and net product taxes, which are available from SUTs.

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Estimating PPPs of labor input

- PPPs or the relative price of labour input is constructed using CC D index by comparing the price of labour input in a country in domestic currency with the price of labour input in the average economy:

$$\ln PPP\_L_c = \sum_l \hat{v}_{lc} \left(\ln p_{ic}^L - \overline{\ln p_i^L} \right)$$

- PPPs of labour input represents the relative hourly compensation for the same types of workers between the two countries.

PPPs of labor input

- For LA KLEMS, labour is cross-classified by gender (male and female) and age group (15–29, 30–49, and 50 and over) and skill levels (low skilled, medium skilled, and high skilled) for a total of 18 types of workers (Table 2).

- If hours worked is homogeneous and no distinction is made between the different types of workers, the PPPs or the relative price of labour input will be equal to the ratio of hourly compensation in domestic currency between the two countries.

- The PPPs of labour input takes into account the difference in the skill mix of hours worked in the two countries.
  - Essentially, difference in the hourly compensation in the two countries may reflect the difference in the skill mix in the two countries and the PPPs of labour input controls for the difference in the skill mix between two countries.

Estimating PPPs of capital input

- Capital input is the flow of capital services derived using capital assets in a period, and the price of capital input reflects the user cost of using capital assets over a period.

- The PPPs of capital input is the relative user cost of capital input in a country in domestic currency compared with the user cost of the average economy and it can be written as:

$$\ln PPP\_K_c = \sum_k \hat{v}_{kc}\left(\ln p_{kc}^K - \overline{\ln p_k^K}\right), \qquad p_{kc}^K = p_{kc}^I(\delta_k + \gamma)$$

PPPs of capital input

- For LA KLEMS, capital assets are classified into 8 asset types (table 3), residential structures, no-residential structures, transportation equipment, M&E, other products and 3 information technology and communication products (computing equipment, communication equipment, and software.

- The same depreciation rates are used to estimate capital stock for those 8 assets for all LA economies to provide comparability of capital stock estimates.

- The investment price of assets is from the ICP project (World Bank, 2015). For the estimation of the PPPs of capital input, we distinguish five asset types that include ICT, transportation equipment, other M&E, residential structures and non-residential construction. No PPPs are available for 3 separate ICT investments.

Data sources for estimating PPPs of labor input and capital input

- LA KLEMS and the US data from World KLEMS data base (Jorgenson et al.)

Estimating relative productivity levels

- It starts with the construction of relative productive levels in the benchmark year (2011 for this database). This includes the relative levels of output, intermediate input, capital and labour input and TFP and labour productivity levels at the sector level for benchmark year 2011.

- These relative levels of output, inputs and productivity in benchmark year are then extrapolated to other years using the growth rates of those variables that are from LA KLEMES and the World KLEMS data for the United States.

Productivity level accounting

- The relative levels of labour productivity are related to the relative levels of TFP and relative levels of capital and labour compensation according to the level accounting equation.

- According to the level accounting equation, the relative levels of labour productivity can be decomposed into the difference in capital intensity, difference in labour composition or skill levels and the relative MFP level differences.

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LA KLEMS productivity level database

- Eight LA economies: Chile, Colombia, Costa Rica, El Salvador, Honduras, Mexico, Peru, the Dominican Republic and United States.

- Sectors: total economy and 9 sectors of the total economy

- Period, 1990 to 2018

Labor productivity levels (gross output per hour worked), 2015, US =1

	Chile	Colombia	Costa Rica	Dominican	El Salvador	Honduras	Mexico	Peru	US
Total economy	0.50	0.25	0.25	0.21	0.11	0.13	0.42	0.17	1.00
Agriculture	0.22	0.08	0.08	0.08	0.03	0.05	0.16	0.04	1.00
Mining	0.25	0.34	0.16	0.43	0.08	0.03	0.31	0.20	1.00
Manufacturing	0.26	0.13	0.13	0.10	0.05	0.07	0.24	0.09	1.00
Utility	0.40	0.40	0.17	0.24	0.27	0.22	0.28	0.23	1.00
Construction	0.98	0.78	0.62	0.77	0.26	0.17	0.46	0.40	1.00
Wholesale &retail	0.42	0.16	0.22	0.23	0.07	0.10	0.41	0.12	1.00
Transport & communications	0.52	0.17	0.42	0.27	0.33	0.17	0.32	0.20	1.00
Finance	0.93	0.40	0.47	0.40	0.26	0.24	0.68	0.37	1.00
Community and other	0.64	0.53	0.30	0.28	0.22	0.28	0.74	0.31	1.00

Total factor productivity levels (on gross output), 2015, US=1

	Chile	Colombia	Costa Rica	Dominican	El Salvador	Honduras	Mexico	Peru	US
Total economy	0.97	0.74	0.71	0.71	0.59	0.57	0.86	0.63	1.00
Agriculture	0.85	0.91	0.65	1.21	0.39	0.66	0.78	0.73	1.00
Mining	0.50	0.74	0.68	0.46	0.46	0.32	0.64	0.62	1.00
Manufacturing	0.92	0.67	0.63	0.59	0.55	0.52	0.73	0.64	1.00
Utility	0.75	0.60	0.71	0.64	1.27	0.30	0.64	0.84	1.00
Construction	1.33	1.48	1.09	1.46	0.91	0.63	1.27	1.14	1.00
Wholesale &retail	0.96	0.57	0.62	0.72	0.41	0.55	0.80	0.54	1.00
Transport & communications	1.12	0.76	1.48	1.40	1.63	0.83	1.19	1.05	1.00
Finance	3.54	1.76	1.69	1.09	1.12	1.63	1.06	1.11	1.00
Community and other	1.07	0.82	0.56	0.75	0.63	1.15	1.66	0.56	1.00

Capital input per hour worked, 2015, US dollar per hour worked

	Chile	Colombia	Costa Rica	Dominican	El Salvador	Honduras	Mexico	Peru	US
Total economy	3.61	2.55	2.71	2.50	1.39	1.72	5.99	1.50	16.97
Agriculture	1.33	0.35	0.43	0.16	0.66	0.35	2.58	0.16	16.28
Mining	23.24	26.95	3.79	59.47	4.52	4.93	44.56	12.82	82.97
Manufacturing	2.64	2.12	3.64	2.75	1.43	1.39	4.44	1.09	20.30
Utility	29.51	52.39	20.10	18.63	11.95	71.88	33.52	16.06	110.91
Construction	1.21	0.32	0.82	0.72	0.64	0.68	0.52	0.37	2.54
Wholesale &retail	0.71	0.42	0.76	1.00	0.30	0.21	2.71	0.27	9.31
Transport & communications	6.33	2.78	2.95	2.45	1.80	3.23	3.58	1.07	44.65
Finance	5.04	7.67	8.43	18.63	10.69	4.41	45.84	14.06	87.37
Community and other	1.84	2.71	1.60	0.64	0.62	2.64	4.11	1.94	15.85

Labour input per hour worked, 2015 US =1

	Chile	Colombia	Costa Rica	Dominican	El Salvador	Honduras	Mexico	Peru	US
Total economy	1.31	1.02	1.08	1.06	0.91	0.75	0.94	1.14	1.00
Agriculture	0.94	0.78	0.85	0.87	0.80	0.66	0.77	0.83	1.00
Mining	1.12	0.95	1.86	1.09	0.80	0.30	0.76	1.04	1.00
Manufacturing	1.11	0.95	0.99	0.98	0.83	0.79	0.91	1.09	1.00
Utility	1.02	1.10	1.02	1.13	0.92	1.15	0.96	1.10	1.00
Construction	1.12	0.87	0.91	1.01	0.85	1.00	0.88	1.06	1.00
Wholesale &retail	1.12	0.94	0.99	0.99	0.85	0.71	0.92	0.99	1.00
Transport & communications	1.14	0.93	0.94	0.94	0.92	0.85	0.97	1.08	1.00
Finance	1.43	1.05	1.08	1.21	1.00	0.71	1.01	1.32	1.00

A summary of main findings

- The level of labour productivity in those eight LA economies was lower than that of the US in 2015.

- The relatively lower level of labour productivity is due to the lower level of total factor productivity, and the lower level of capital intensity in LA economies compared with that in the United States.

- The difference in skill levels between LA economies and the United States was small.

Conclusions

- We have constructed PPPs and completed the LA KLEMS productivity level database.

- Our work has also highlighted many data challenges.

- The ICP provides data on PPPs for products that are used for final expenditures. No data are available for products that are mainly used for intermediate inputs.

- The PPPs for investment goods need to be expanded to include more investment goods such as information and communication products.

- The other challenge is related to PPPs of services such as health and education and no-market services.

- The comparability of output and inputs needs to be carefully examined for constructing KLEMS productivity level database.