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ICP 2005 CONSTRUCTION PRICES: ARE THEY UNDERESTIMATED IN DEVELOPING COUNTRIES?

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Construction prices are lower in developing countries in ICP 2005, which has raised these countries' capital/output ratio in Penn World Tables 7 and 8 and affected growth analyses. We estimate the Colombia/U.S. price ratio for office and apartment buildings in 2005 as a test of the validity of the ICP 2005 methodology for estimating these prices. Our estimate of the Colombia/U.S. price ratio is almost twice the ICP 2005 estimate. We confirm the validity of our results by estimating the cost of constructing office and apartment buildings using 2005 prices for construction materials, equipment, and labor in both countries.

JEL Codes: E30, O47

Keywords: Colombia, construction prices, ICP 2005, Penn World Table, price indices

1. INTRODUCTION

The testing of macroeconomic growth models relies heavily on cross-country economic data, but national accounts data cannot be used directly because prices for the same goods and services are different in every country. The Penn World Table (PWT) addresses this problem by providing continually-updated multi-country economic data based on a uniform set of prices. These data are created by adjusting the data in the national accounts using the prices for a common set of goods and services collected periodically by the International Comparison Program (ICP).

Johnson *et al*. (2013) show that different versions of the PWT have not used historic ICP prices to adjust national accounts data in a consistent manner. As a result, economic data for the same year are different in different versions of the PWT. These differences are particularly large between PWT 7/8 and PWT 6 because the PWT 7/8 utilize prices from ICP 2005, which has different price relationships between developed and developing countries than earlier versions of the ICP (Breton, 2012).

Figure 1 shows the relationship between GDP/capita and the capital/output ratio in 2000 in PWT 6.3 and in PWT 7.0 (Heston *et al*., 2009, 2011).[1] In the Solow model the slope of this line is $\alpha/1 - \alpha$. In the PWT 6.3 data, this relationship is highly statistically significant, and the implied value of $\alpha \approx 0.6$. Since stocks of

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[1]We calculate the capital stock (K) using the perpetual inventory method, investment from 1960 to 1999, and a geometric depreciation rate of 6 percent.

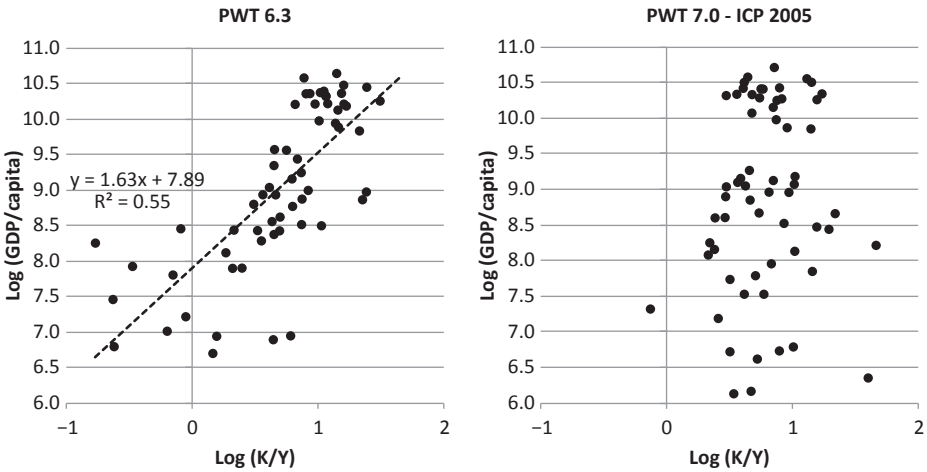

Figure 1. GDP/Capita vs. the Capital/Output Ratio in 2000 in PWT 6.3 and PWT 7.0

physical capital and human capital per worker are highly correlated across countries, α implicitly measures the total effect of these two types of capital on GDP/capita (Mankiw *et al*., 1992).

Figure 1 shows that there is no statistical relationship between GDP/capita and the capital/output ratio in PWT 7.0, so the implied value of $\alpha = 0$. This change occurred primarily because in countries with GDP/capita below $18,000/year (2005 USD), the prices for GDP (p) are higher and the price ratio for capital investment to GDP (pi/p) is much lower in ICP 2005 than in previous ICP versions. In PWT 7.0 these ICP prices were used inappropriately to adjust national accounts data all the way back to 1950 (Breton, 2012). As a result, the K/Y ratio in 2000 in developing countries is much higher in PWT 7.0 than in PWT 6.3.

In PWT 8.0 the prices in ICP 2005 are used to adjust only the more recent historic period (Feenstra *et al*., 2013). Surprisingly though, the relationship in 2000 between GDP/capita and K/Y in PWT 8.0 is very similar to the relationship in PWT 7.0. This relationship is shown in the online Appendix. Again there is no correlation between these variables, implying that $\alpha = 0$ in the PWT 8.0 data as well.

One of the most basic concepts in growth theory is that GDP/worker is a function of capital/worker, so the disappearance of this relationship in PWT 7 and 8 is unexpected. One possible explanation for the higher K/Y ratio in developing countries in 2000 is that the pi/p ratio in these countries is too low. In PWT 7.0 the K/Y ratio in 2000 is based entirely on ICP 2005 prices. In PWT 8.0 the K/Y ratio in 2000 relies on ICP 2005 investment prices for years since the previous ICP prices, which for developing countries is 1985 or 1990.

In 2005 the ICP experienced problems collecting data to estimate component weights for construction in many developing countries, so the construction prices in these countries could not be estimated using national data. Instead they had to be estimated using weights based on regional assumptions and econometric estimation (McCarthy, 2013b).

We decided to test whether this methodology may have produced construction prices that are too low in developing countries by calculating the Colombia/U.S. price ratio for similar types of construction in 2005 and comparing it to the ICP 2005 price ratio for these two countries. We chose Colombia and the U.S. to represent developing and developed countries because we were able to obtain proprietary data for the prices or costs of office and apartment buildings and for the prices of construction components in these two countries.

Overall in our various estimates, the Colombia/U.S. construction price ratio is almost twice the estimate in ICP 2005. We estimate a price ratio of 0.74 for office buildings and 0.52 for apartment buildings, while the ICP 2005 average price ratio for all types of construction is only 0.33. We corroborate our price ratios for buildings by estimating the cost of constructing these two types of buildings using 2005 prices for building components, equipment, and labor. Our estimates of the Colombia/U.S. price ratios for these buildings using these prices are 0.74 and 0.61. These estimates all indicate that the ICP 2005 estimate of the Colombia/U.S. construction price ratio is far too low. Since the ICP 2005 construction price for the U.S. is based on the OECD–Eurostat methodology, the U.S. price is likely to be more accurate than the Colombian price. The implication is that some problem with the ICP 2005 methodology resulted in low construction prices in Colombia and probably in other developing countries as well.

This paper is organized as follows. In Section 2 we describe the ICP methodologies used to estimate construction prices and the methodology that we used to estimate our prices. In Section 3 we present our estimates of construction prices in 2005 for office buildings and apartment buildings. In Section 4 we compare the construction prices in ICP 2005 to the prices in PWT 6. In Section 5 we present prices for some construction materials and labor categories in Colombia and the U.S., and we show that building prices created from these prices confirm our estimates of the prices for completed buildings. In Section 6 we estimate the Colombia/U.S. price ratio for office buildings in 1996 to confirm that our estimates of these ratios in 2005 are not unusually high. Section 7 concludes.

2. Methodologies for Estimating Construction Prices

The ICP price of capital investment in each country is derived from two components of GDP: construction and machinery/equipment, of which construction is usually the larger component. Since the prices of machinery and equipment in ICP 2005 were obtained directly from surveys in each country, these prices are likely to be reasonably accurate.

The methodology required to estimate construction prices is much more complex because there is no standard construction project. Large projects are rarely sold, so there are no market prices for these projects. Buildings or components of buildings are sold, but the characteristics of these buildings vary, so prices often are not comparable. In addition, sales prices include the land value, which varies considerably even within the same country. As a consequence, there is no standard construction product whose price can be surveyed, and the ICP considers construction to be a "comparison-resistant" component of GDP (ICP 2011 Global Office, 2011).

The methodology used to estimate construction prices has varied in different ICP exercises and even within the same exercise by type of country. In ICP 1996 construction prices were estimated using a model-based technique known as the bills of quantities (BOQ) approach (McCarthy, 2013a). This methodology was also used in the OECD countries in ICP 2005. In this methodology the costs of a standardized residential building, non-residential building, and civil engineering project are estimated in each country based on price estimates for a large number of components. The average price of these three types of construction is then weighted to produce a national construction price.

The data obtained from the non-OECD countries in ICP 1996 were insufficient to implement this methodology, so the ICP did not estimate construction prices for developing countries in 1996. As a consequence, in PWT 6 the 1996 construction prices in these countries were estimated from the construction prices in ICP 1985 and ICP 1990, which were based on the BOQ technique (McCarthy, 2013b).

In an effort to simplify the estimation process in the non-OECD countries in ICP 2005, the World Bank created a methodology called the Basket of Construction Components Approach (BCCA). The BCCA uses prices for 12 basic components and for 22 composite components, along with weights appropriate for each country, to create an aggregate construction price for each category of construction. The components include several types of labor, and the weights account for differences in labor productivity and construction techniques in each country (McCarthy, 2013a).

Unfortunately, many of the non-OECD countries did not obtain the information required to weight the component prices in different types of structures, so the prices in each country in ICP 2005 were estimated using country-specific dummy variables and the ring method, where a uniform set of weights is used for each country within a geographic region. The price estimates for Colombia were created using regional assumptions for South America, which are based on data for Chile and Brazil (McCarthy, 2013b). This approach could lead to biased prices in Colombia if the regional assumptions are not appropriate.

The BCCA methodology estimates prices for each category of construction in a country and then creates an overall price using the share of each category in overall construction. Our concern with this approach is that construction characteristics and construction quality vary considerably across countries and are more varied in some types of construction than in others. Modern office buildings are very similar across countries, but simple residential structures are not. If the price of a poor-quality, primitive dwelling in a developing country is compared to the price of a high-quality dwelling in a developed country, the relative construction price in the developing country will be biased downward. If the price of a poorly-constructed road in a developing country is compared to a high-quality road in a developed country, the same bias will occur. If these price estimates for low-quality construction projects are included in an average ratio based on prices for different kinds of construction, the overall national construction price in developing countries will be too low.

Figure 2 is a photograph of a typical three-story apartment building under construction in Colombia. Unlike the process used to construct larger buildings,

Figure 2. Construction of a Three-Story Apartment Building in Medellin, Colombia

the construction process in smaller buildings is usually quite primitive and the quality of both the design and the construction is often poor. As an example, the plumbing fixtures may be poor in quality and poorly installed, so that they soon must be repaired. The foundation for a structure may be so deficient that the floors are initially quite uneven, fissures soon appear in the walls, and the windows become inoperable. In our view it is not appropriate to compare the price of these structures to the price of a high-quality structure in a developed country. If one of these low-quality structures were constructed in a developed country, its price would be considerably lower than the price for a typical high-quality structure.

In our view a simpler and more reliable methodology for cross-country price comparisons is to compare prices only for buildings that are similar in construction characteristics and in quality. We follow this approach to estimate the Colombia/U.S. price relationship by comparing the cost of 11–20-story office buildings. These structures have similar features in both countries, including air-conditioning, elevators, and modern communication facilities. We also compare the costs of mid-rise apartment buildings. These structures are less similar, since they include air-conditioning and fire control systems in the U.S. but not in Colombia. In addition, apartment buildings may or may not include underground garages.

Since new office and apartment buildings typically are not sold, we estimate their construction cost per square meter in Colombia from proprietary data on the sales prices for individual offices and apartments in new buildings. We then compare these prices to proprietary data on the estimated cost to construct identical buildings in the U.S.

We create our overall Colombia/U.S. price relationship for office buildings using the average price relationship for three buildings constructed in Medellin, Colombia in 2005. We create our overall Colombia/U.S. price relationship for apartment buildings from the average price/square meter for all apartments sold in

2005 in two large neighborhoods within the Medellin metropolitan area (Laureles/Estadio and Envigado). These two neighborhoods are primarily middle and upper class, with a level of apartment quality that is likely to be similar to an apartment in the U.S. The prices of these buildings are likely to be representative of prices in other Colombian cities. In 2005 the construction costs in Bogota, Medellin, Cali, and Barranquilla for a comparable structure varied by only 2 percent [Construdata, 2005].

Our data for building and component prices in Colombia are primarily from the Cámara Colombiana de Construcción (Camacol, 2005a, 2005b, 2005c). Our data for U.S. building costs are primarily from RS Means (2005). Our data for labor costs are from the U.S. Bureau of Labor Statistics (2005), and our data for construction component prices are from various weekly editions of the *Engineering News Record* (2005).

3. Office and Apartment Building Construction Prices in 2005

Table 1 presents our estimates of the price per square meter for three office buildings in Colombia and the U.S. in 2005. The construction cost in Colombia is calculated by subtracting estimates of the land costs and the sales commissions from the total sale price for individual offices and dividing this cost by the area in these offices, as reported in Camacol (2005b). The area used in the calculation of prices/square meter includes the allocated share of the common space in the building. We obtained the estimated shares of land costs and sales commissions in the office prices from knowledgeable Camacol officials. The price comparison in U.S. dollars is based on the average Colombian peso/U.S. dollar exchange rate in 2005.

TABLE 1

Construction Prices/Costs for Office Buildings in Colombia and the U.S. in 2005

	San Fernando Plaza	Tesoro	Aguacatala
Buildings in Colombia			
Area/office, sq. m	600	40	78
Number of offices	55	115	150
Total area, sq. m	33,000	4,600	11,700
Price/office in Col. pesos	1,470,000,000	132,000,000	189,317,154
Price/sq. m in Col. pesos	2,450,000	3,300,000	2,427,143
Pesos/US dollar in 2005	2,321	2,321	2,321
Price/sq. m in US$	1,056	1,422	1,046
Sales commission (% of total)	4	4	4
Land cost (% of sale price)	18	18	18
Total adjustment (%)	–22	–22	–22
Adjusted price/sq. m in US$	824	1,109	816
Buildings in the U.S.			
Total area, sq. m.	24,164	24,164	24,164
Cost/sq. m.	1,128	1,128	1,128
Adjustment for scale	0.978	1.196	1.060
Site preparation costs (%)	1	2	1
Adjusted cost/sq. m	1,114	1,375	1,207
Price ratio, Colombia/U.S.	0.74	0.81	0.68

TABLE 2
CONSTRUCTION PRICES/COSTS FOR APARTMENT BUILDINGS IN COLOMBIA AND THE U.S. IN 2005

	Laureles/Estadio	Envigado
Buildings in Colombia		
Building size, stories	12	9
Price/sq. m, Colombian pesos	1,395,960	1,377,740
Pesos/U.S. dollar in 2005	2,321	2,321
Price/sq. m in US$	601	594
Sales commission (% of total)	4	4
Land cost (% of sale price)	13	13
Total adjustment (%)	–17	–17
Adjusted price/sq. m in US$	499	494
Buildings in the U.S.		
Building size, stories	6	6
Cost/sq. ft, 6-story apartment building	123.05	123.05
Reduction for HVAC & fire systems	–21.45	–21.45
Adjusted cost/sq. ft	101.60	101.60
Adjusted cost/sq. m	1,093	1,093
Adjustment for scale	0.94	0.97
Site preparation costs (%)	1	1.5
Adjusted cost/sq. m	1,039	1,077
Cost/sq. ft, underground garage	47.62	47.62
Cost/sq. m, underground garage	512	512
Cost/sq. m, apartments with garage	934	964
Price ratio, Colombia/U.S.	0.53	0.51

The construction cost in the U.S. for each building is based on RS Means' (2005) data on average U.S. costs for a standardized 11–14-story office building in 2005. The adjustments to these costs are based on their economy-of-scale and site-preparation–cost relationships for office buildings of different sizes. As shown in the table, the ratio of Colombia/U.S. prices for these three buildings ranged from 0.68 to 0.81, with an average ratio of 0.74.

Office buildings are the most comparable structure between the Colombia and the U.S., but they are not a very common type of construction, so this relative price may not be representative of all construction. In Colombia office buildings accounted for only 5 percent of building construction in urban and metropolitan areas in 2005, while apartment buildings accounted for 57 percent of building construction[2] (DANE, 2005). Apartment buildings are more difficult to compare because their features are more variable, but they clearly are more representative of overall construction costs.

Table 2 presents our estimates of the Colombia/U.S. construction price in mid-rise apartment buildings in Laureles/Estadio and Envigado in 2005, with cost estimates for similar structures in the U.S. These apartment buildings are likely to include underground garages, with one level of parking for four levels of apartments. The average height of these buildings was 12 stories in Laureles/Estadio and 9 stories in Envigado [Camacol, 2005c].

We compare Camacol's (2005c) estimates of the average price of apartments in these neighborhoods, net of land costs and sales commissions to RS Means'

[2]Shares are based on square meters of constructed space.

(2005) model estimate of the costs of a 6-story apartment building with underground parking in the U.S. Since the Colombian buildings do not include HVAC and fire control systems, we subtracted the cost of these systems from the U.S. costs. We also adjust the costs for the larger scale of the Colombian apartment buildings. The net effect is an estimate of the Colombia/U.S. construction price ratio of 0.51 to 0.53 for mid-rise apartment buildings.

4. Relative Construction Prices in ICP 2005 and in PWT 6

The ICP 2005 Colombia/U.S. construction price ratio is 0.33. This price is considerably lower than our estimates for the price ratio for office buildings and apartment buildings, but the ICP's Colombia/U.S. price ratio may not be representative of all developing and developed countries. One way to determine whether these countries are representative is to estimate the trends in the ratio of the price of construction (pi-construction) and the price of GDP (p) vs. GDP/capita across countries in ICP 2005. These price data were obtained from World Bank (2012). These data and the trend are shown in Figure 3. The price difference between Colombia and the U.S. and the trend line can be used to estimate the expected prices for construction in countries with GDP/capita similar to Colombia and the U.S. The Colombia/U.S. construction price ratio using these expected prices is 0.44, which is higher than 0.33, but still low compared to our estimates of office and apartment building costs.

Colombia did not participate in ICP 1996, so the PWT did not provide an estimate of Colombia's construction price in 1996, but the expected price for Colombia can be estimated from the trend in the PWT data for other countries (Heston *et al*., undated). The trend line for these data is also shown in Figure 3.

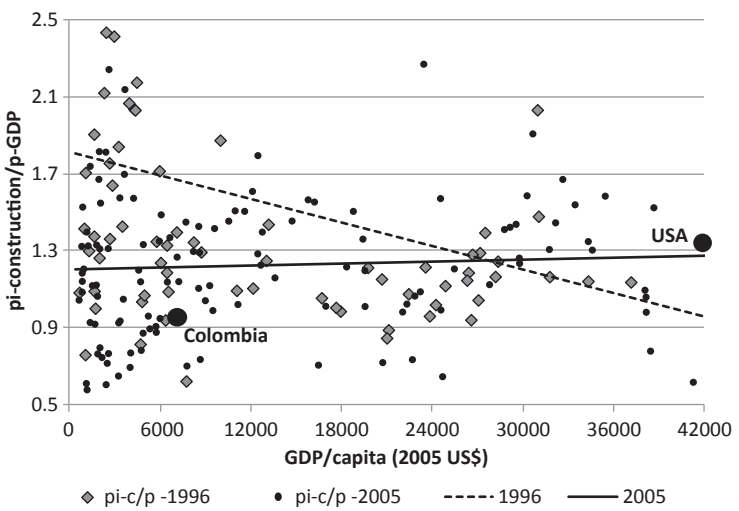

Figure 3. Ratio of Pi-Construction/p-GDP in PWT 6 (1985/90) and in ICP 2005

The shift in the trend line between PWT 6 and ICP 2005 shows that the pi-construction/p ratio declined substantially in developing countries in ICP 2005. The PWT 6 estimate of the ratio in 1996 of the construction price for a country like Colombia to the price in the U.S. is 0.58, which is considerably higher than the 0.44 ratio in 2005 in ICP 2005. The ratio in PWT 6 is more consistent with our estimates of the Colombia/U.S. price ratio in 2005. Although the PWT 6 construction price ratio is quite dated, it could be more accurate than the ICP 2005 estimate because it used the bills of quantities (BOQ) approach to estimate the price of construction projects in each country, while the ICP 2005 prices in developing countries are derived from the prices of construction components and regional assumptions for construction component weights.

5. Construction Component Prices in 2005

Since our construction price estimates for Colombia are calculated from office and apartment sales prices, these estimates could be too high if land costs were higher than we assumed or if construction companies made abnormally high profits on these sales. As a check on the validity of our Colombia/U.S. construction price ratio, we estimated the price ratios for identical construction components in Colombia and the U.S. and used these price ratios to estimate the construction price ratios in office and apartment buildings. Since component prices were the basis for the estimates of construction prices in developing countries in ICP 2005, these estimates are also a check on the reasonableness of the ICP 2005 BCCA construction price estimates in Colombia. Table 3 presents these component prices.

The Colombia/U.S. price ratio for materials ranges from 0.44 for masonry sand to 2.51 for PVC pipe. Our U.S. proprietary data did not include equipment rental costs, so we show the ICP 2005 Colombia/U.S. price ratio for machinery, which is 1.33. These data show that the Colombia/U.S. price ratio for components rises as value is added to the most basic materials. The average Colombian price for basic construction materials is about 60 percent of the U.S. price, while the

TABLE 3
Colombia/U.S. Ratio of Construction Component Prices in 2005

	Colombia Price		U.S. Price	Colombia/U.S.
	Pesos	US$	US$	Ratio
Standard concrete block	1,540	0.66	1.23	0.54
Concrete (cubic meter)	190,416	82.0	101.4	0.81
Masonry sand (m^3)	14,704	6.34	14.28	0.44
Steel, ½″ reinforcing bar (kg)	2,159	0.93	0.70	1.32
PVC, 8″ sewer pipe (meter)	72,690	31.31	12.46	2.51
Copper tubing, ½″ (meter)	10,166	4.38	3.11	1.41
Equipment (ICP 2005)				1.33
Electrician (hour)	7,832	3.37	21.94	0.15
Unskilled labor (hour)	3,131	1.35	13.97	0.10

average price for equipment and fabricated components, such as pipe and steel bars, is about 130 percent of the U.S. price. Many of these components are imported.

In contrast, unskilled and skilled labor is much cheaper in Colombia than in the U.S., with an hourly wage that is only 10–15 percent of the U.S. wage. The relatively low labor costs could make overall construction prices considerably lower in Colombia than in the U.S., but only if labor is a high proportion of total input costs and if Colombian labor productivity is similar to U.S. labor productivity.

The ICP 2011 Global Office (2011) estimates that materials and equipment rental account for about 70 percent of total costs in non-residential and residential buildings in developed countries and 80 percent of total costs in developing countries. Camacol's (2005b, 2005c) estimates of the share of labor costs in Colombian construction costs (19 percent) are similar to the ICP 2011 Global Office estimate for developing countries. This means Colombian labor costs would be 58 percent (0.25/0.43) of labor costs in the U.S. if material costs were the same, but that they actually are a smaller share of U.S. costs because the average cost of materials is lower in Colombia than in the U.S.

Table 4 presents our estimates of the Colombia/U.S. construction price ratio using assumptions for the average prices and shares of materials and labor costs in total building costs. The difference in the construction price ratios between office and apartment buildings is due to the different assumed share of basic materials in total material/equipment costs. Based on observed construction practices in Colombia, apartments are assumed to have a considerably higher share of basic materials than office buildings. We also use these relationships to estimate the implied Colombia/U.S. ratio of average labor productivity.

The results in Table 4 corroborate our estimates of the construction price ratio for office and apartment buildings estimated in Tables 1 and 2. The estimated price ratios based on component prices are 0.74 for office buildings and

TABLE 4

Colombia/U.S. Construction Price Ratios Calculated from Component Costs

	U.S. Price	U.S. Shares	U.S. Cost	Col/U.S. Price	Col/U.S. MatCost	Col Shares	Col/U.S. Cost	Col/U.S. Ratio
Office buildings								
Basic materials	1.00	0.45		0.60	0.27			
Fabricated/equip	1.00	0.25		1.30	0.33			
Average	1.00	0.70	1.0	0.85	0.60	0.80	0.85	
Labor	1.00	0.30	0.43	0.12		0.20	0.21	
Total cost ratio		1.00	1.43				1.06	0.74
Productivity @ 0.12								0.24
Apartment buildings								
Basic materials	1.00	0.60		0.60	0.36			
Fabricated/equip	1.00	0.10		1.30	0.13			
Average	1.00	0.70	1.0	0.70	0.49	0.80	0.70	
Labor	1.00	0.30	0.43	0.12		0.20	0.18	
Total cost ratio		1.00	1.43				0.88	0.61
Productivity @ 0.12								0.29

TABLE 5
RATIO OF CONSTRUCTION PRICES IN COLOMBIA AND THE U.S. IN 2005

	Colombia Price	U.S. Price	Colombia/U.S. Ratio
Office building prices			0.74
Office component prices			0.71
Apartment building prices			0.52
Apartment component prices			0.61
ICP 2005 actual	0.44	1.34	0.33
ICP 2005 expected	0.57	1.28	0.44
PWT 6 in 2005			0.58

0.61 for apartment buildings. The Colombia/U.S. labor price ratio of 0.12, combined with the ICP 2011 Global Office estimates of labor cost shares (30 percent in developed countries and 20 percent in developing countries), indicates that the Colombia/U.S. labor productivity ratio is 0.24 in office buildings and 0.29 in apartment buildings. Although these ratios may appear quite low, they are consistent with the low average skills of workers in the Colombian construction sector, who often are illiterate and require considerable supervision to be productive.

Table 5 summarizes the different estimates of the Colombia/U.S. price ratio for construction costs. The ICP 2005 Colombia/U.S. construction price ratio of 0.33 is considerably below all of the other estimates. This ratio is lower than the expected Colombia/U.S. price ratio, given the trend in ICP prices across countries, but the expected ratio of 0.44 is also considerably below our estimates of the actual Colombia/U.S. construction price ratio.

6. OFFICE BUILDING CONSTRUCTION PRICES IN 1996

Our estimates of the Colombia/U.S. ratio for construction prices in 2005 might be unrepresentative of other countries if construction prices were unusually high in Colombia or unusually low in the U.S. in 2005. As a check on this possibility we estimate the Colombia/U.S. price ratio for office buildings in 1996, using the same methodology used to estimate this ratio in 2005. In the Colombian cost estimates we include a higher share for land costs and construction profit margins than in 2005 because Colombia was experiencing a real estate boom in 1996.

Our results are shown in Table 6. In these estimates the average of the Colombian/U.S. price ratios for three buildings in 1996 was 1.01, or 36 percent higher than in 2005. These results show that the estimated Colombia/U.S. price ratio in 2005 is not unusually high. Our review of construction component prices in 1996 (not shown) confirmed that the Colombia/U.S. price ratio for construction components is consistent with the building prices, as this ratio also was higher in 1996 than in 2005. The higher ratio in 1996 than in 2005 is not unexpected since a real estate boom was underway in Colombia in 1996 and in the U.S. in 2005.

TABLE 6

Construction Prices/Costs for Office Buildings in Colombia and the U.S. in 1996

Buildings in Colombia	Centro Empresarial Dann	Centro de Negocios Alcalá	Centro Profesional El Cruzero
Area/office, sq. m	46	50	38
Number of offices	195	74	64
Total area, sq. m	8,970	3,700	2,432
Price/sq. m in Col. pesos	1,700,000	1,400,000	1,600,000
Pesos/US dollar in 2005	1,037	1,037	1,037
Price/sq. m in US$	1,639	1,350	1,543
Sales commission (% of total)	4	4	4
Land cost (% of sale price)	26	26	26
Total adjustment (%)	–30	–30	–30
Adjusted price/sq. m in US$	1,147	945	1,080
U.S. cost estimate			
Total area, sq. m	13,005	13,005	13,005
Cost/sq. m	923	923	923
Adjustment for scale	1.06	1.15	1.19
Site preparation costs (%)	1	2	3
Adjusted cost/sq. m	959	1,083	1,131
Price ratio, Colombia/U.S.	1.20	0.87	0.96

7. Conclusions

The construction price ratio in developing countries relative to developed countries is substantially lower in ICP 2005 compared to earlier versions of the ICP. This decline in relative prices raised the adjusted share of GDP attributed to investment in developing countries in PWT 7.0 and PWT 8.0, which raised the estimated capital/output ratio in these countries relative to earlier versions of the PWT. This change has eliminated the positive cross-sectional relationship between GDP/capita and the capital/output ratio in earlier versions of the PWT. This unexpected development raises the issue of whether the lower construction prices for developing countries in ICP 2005 are valid.

In this paper we investigate whether the ICP 2005 estimate of the Colombia/U.S. construction price ratio in 2005 is consistent with the prices for office buildings and for apartment buildings in 2005. We find that it is not. We estimate that the Colombia/U.S. construction price ratios for these two types of buildings are 0.74 and 0.52, or almost twice the ICP 2005 overall construction price ratio of 0.33.

We also examine whether the ICP 2005 Colombia/U.S. price ratio is consistent with estimates of building prices based on component prices in 2005, and again we find that it is not. Our estimates for the prices of these two building types based on component prices are 0.71 and 0.61, which are consistent with our estimates of building prices.

We could not find any construction materials with a Colombia/U.S. price ratio as low as the ICP 2005 construction price ratio of 0.33. The only component of construction costs that has a price ratio below this level is labor costs, and the ICP 2011 Global Office's estimates of the share of these costs in total building costs are too low to explain a Colombia/U.S. construction price ratio of 0.33. In addition, while the labor price/hour is very low in Colombia, the cost of labor is not that low once the low Colombian labor productivity is taken into account.

We also provide an analysis of the Colombian/U.S. ratio of prices for office buildings in 1996 to investigate whether the estimated ratio in 2005 is unusually high, and we find that it is not. The Colombia/U.S. ratio of building prices was 36 percent higher in 1996 than in 2005.

One possible explanation for our higher ratio of Colombia/U.S. prices is that our analysis is limited to mid and high-rise buildings, whereas the ICP 2005 construction prices are based on a mix of construction, including single-family homes, schools, roads, and bridges, which could have a price ratio that is different than the ratio in these buildings. However, it is not evident that the construction process and the mix of materials used in these other types of construction are that different from those in mid and high-rise buildings. We conclude that something is not right with the methodology used in ICP 2005 to estimate construction prices for Colombia and for other developing countries.

ICP 2011 provides a new set of prices for components of GDP in 2011, and these prices will be used to adjust the national accounts data in future versions of the PWT. But the ICP 2005 prices will continue to be used to adjust national accounts data for the relevant time period. If the ICP 2005 estimates of construction prices in developing countries are incorrect, they will bias cross-country econometric results that utilize economic data in future versions of the PWT for the period between 1985/90 and 2011.

We hope that our documented estimates of the Colombia/U.S. construction price ratio in 2005 will encourage the ICP staff to reexamine the methodology used to estimate construction prices for developing countries in ICP 2005. As part of this process, they could use the methodology shown in Table 4 to estimate construction prices from component prices in several developing countries, using the proprietary prices of these components that the ICP collected in these countries in 2005. If this methodology provides very different construction prices than those shown for these countries in ICP 2005, this would provide further evidence that there is a problem with the methodology used to estimate these prices. If there is a problem with this methodology, we hope the ICP will provide revisions to the ICP 2005 prices for construction as soon as possible.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix: Relationship of GDP/capita and the Capital/output Ratio in PWT 8.0
Figure A-1: GDP/Capita vs. the Capital/Output Ratio in 2000 in PWT 8.0