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The price of development: The Penn–Balassa–Samuelson effect revisited☆

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ABSTRACT

The Penn–Balassa–Samuelson effect is the stylized fact about the positive correlation between cross-country price level and per-capita income. This paper provides evidence that the price–income relation is actually non-linear and turns negative among low income countries. The result is robust along both cross-section and panel dimensions. Additional robustness checks show that biases in PPP estimation and measurement error in low-income countries do not drive the result. Rather, the different stage of development between countries can explain this new finding. The paper shows that a model linking the price level to the process of structural transformation captures the non-monotonic pattern of the data. This provides additional understanding of real exchange rate determinants in developing countries.

1. Introduction

It is widely understood that market exchange rates do not give accurate measures of real income in different economies and that adjustment by purchasing power parity (PPP) factors is necessary for such measures. This understanding is based on an observed empirical regularity that richer countries have a higher price level than poorer countries.[1] The positive correlation between cross-country price level and per-capita income is generally regarded as a stylized fact. This result was documented for twelve developed countries in the seminal paper of Bela Balassa (1964), was confirmed for a large sample of countries as soon as data from the International Comparison Program (ICP) became available and is now renowned as the Penn–Balassa–Samuelson effect (Penn–BS).[2,3]

The paper makes an important qualification to this general understanding. Using non-parametric estimation, it provides evidence that the price–income relation is non-linear and turns negative in low-income countries, both along a cross-section and a panel dimension. Standard regression analysis in sub-samples of poor, middle-income and rich countries is consistent with this finding. The results of the paper are robust to possible sources of bias from PPP estimation and measurement error in low-income countries.

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[1] Adjustment by PPPs is necessary as long as price levels vary across countries, even if the variation is not systematic with income.

[2] The Penn–BS effect was documented also by Barro (1991), Summers and Heston (1991), and Rogoff (1996). Samuelson (1994) stresses that the proper name for it would be *Ricardo–Viner–Harrod–Balassa–Samuelson–Penn–Bhagwati–et al. effect.*

[3] The Penn–BS effect should not be confused with the Balassa–Samuelson hypothesis. The latter provides the mainstream explanation for the former. The Balassa–Samuleson hypothesis argues that richer countries have a higher relative productivity in the tradable sector; under certain assumptions, this leads to a higher relative price of non-tradables, hence to a higher aggregate price level.

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This paper argues that the non-monotonicity of the price–income relation is due to the different stages of development that characterize low- and high-income countries. We extend the standard Balassa–Samuelson model to a three sectors environment (agriculture, manufacturing and services) and trace the effects of agricultural productivity, sectoral expenditure and employment shares on the price level of low-income countries. This model captures the non-monotonic pattern of the data, in a way that the standard Balassa–Samuelson hypothesis, focused on productivity differences between tradables and non-tradables, does not. The intuition is that, when a poor country starts to develop, its productivity growth lies mainly in the agricultural sector. Since, at an early stage of development, agriculture is primarily non-traded and represents a big share of expenditure, this productivity growth reduces the relative price of agricultural goods, hence the overall price level. After a certain level of development, the role of agriculture becomes negligible and the overall price level is driven by the raise of the relative productivity of manufacturing respect to services, as in the classical Balassa–Samuelson hypothesis.

In economics, empirical regularities are rare and important. As Solow (1956) and Easterly and Levine (2001) point out, economists build models to match relevant empirical regularities and they use these models to understand economic events and give policy suggestions. The Penn–BS effect is the empirical regularity that the seminal models of Balassa (1964) and Samuelson (1964) try to reproduce. The mechanisms of these models are at the basis of our understanding of long-run real exchange rate movements, are incorporated into many new open-economy macroeconomic models and have been the initial point of reference for a vast literature on this subject.[4] The paper shows that the empirical regularity, which models in the literature are supposed to match, namely the Penn–BS effect, is not actually present in low income countries.[5]

The paper makes a significant empirical contribution by uncovering a twist to what has long been accepted as a well-established empirical regularity and offers a novel explanation of real exchange rate determinants in low income countries, based on the process of structural transformation. From a policy point of view, by showing that the price–income relation is negative in poor countries, the paper suggests that there is a "natural" depreciation of the real exchange rate along the development process. This is an important finding that central banks and governments of low-income countries should take into account as they formulate exchange rate policy. Moreover, the result of the paper suggests that current measures of real exchange rate undervaluation based on the Balassa–Samuelson hypothesis are biased for developing countries; for instance, once we account for the non-monotonic pattern of the price–income relationship, the Chinese Renminbi is 30% less undervalued than standard estimates suggest.[6] The new empirical regularity shown by the paper and its explanation can help us to better understand long-run real exchange rate movements in developing countries and lay the ground for further research on this subject.

The paper relates to the literature on PPPs and the Penn–BS effect as in Kravis et al. (1982), Heston and Summers (1992), and Feenstra et al. (2015). Our contribution is to identify the non-monotonic pattern of the price–income relation as a novel stylized fact and link this non-monotonicity to a plausible model of structural transformation.

The paper refers to the debate on PPPs and real exchange rate determinants in the long run, as in Balassa, 1964, Samuelson, 1964, Bhagwati (1984), De Gregorio et al. (1994), Rogoff (1996) and Taylor and Taylor (2004). Within this literature the papers close in spirit to our are Bergin et al. (2006) and Devereux (1999). The former shows that there is no Penn–BS effect before the 1970s; the latter presents a model of endogenous productivity growth in the distribution sector to explain real exchange rate depreciation in East Asian countries. Our paper provides a more generalized and systematic evidence of a counter Penn–BS effect and real exchange rate movements in developing countries.[7] Moreover, our explanation of this finding offers an original contribution of real exchange rate determinants in developing countries, based on structural transformation.

Finally, the paper is complementary to the literature on structural transformation and the role of agriculture as a driver of development as in Gollin et al. (2002, 2007) and Ngai and Pissarides (2007). We highlight the importance of structural transformation out of agriculture as a determinant of real exchange rates in developing countries.

The paper is structured as follows. Section 2 shows that the price–income relation is non-monotonic using both non-parametric and linear estimations. Section 3 establishes that the results are robust to measurement error, bias in the estimation of PPPs, and different databases. Section 4 argues that differences in economic structure can explain the results, derives a model that links the price level to the process of structural transformation, and analyzes the empirical prediction of the model, showing that it can capture the non-monotonicity of the data. Section 5 concludes by summarizing the main findings and discussing further research based on these results.

2. The price–income relation

In this section, we show that the price–income relation is non-monotonic. We provide evidence along a cross-section and panel dimension, through both linear and non-linear estimation. Following the literature on the Penn–BS effect, we measure income per capita in purchasing power parity (PPP) and define the price level as the ratio of PPP to the exchange rate with the US dollar.[8]

2.1. Cross-section dimension

In Fig. 1.1, we can see an example of the little attention that the literature has paid to the Penn–BS effect in developing countries. The figure illustrates the positive price–income relation reported in the review of the purchasing power parity puzzle by Rogoff (1996). Since observations with an income per capita lower than Syria are gathered in a cloud of points, it is difficult to properly disentangle the relation between price and income in poor countries.

Therefore, in Fig. 1.2, using the same data-set as in Rogoff (1996), we plot the log-values of income per capita.[9] We investigate the price–income relation using a non-parametric estimation technique

[4] The Balassa–Samuelson hypothesis hits more than 7000 entries on Google Scholar; see Rogoff (1996) and Taylor and Taylor (2004) for extended reviews and Bordo et al. (2014) and Berka et al. (2014) for the most recent applications at the time of writing.

[5] This can explain why there is not much evidence of the Balassa–Samuelson hypothesis in lower income countries as in Choudhri and Khan (2005) and Genius and Tzouvelekas (2008). Notice that they focus on the effect of relative productivity in the tradable sector on the real exchange rate (the Balassa–Samuelson hypothesis), whereas this paper focuses on the Penn effect which, to the best of our knowledge, is a novel contribution.

[6] Standard measures of undervaluation, as in Rodrik (2008), are the difference between the data and the fitted value of a linear regression of the price measure from Penn World Table on income.

[7] Notice that Feenstra et al. (2015) argue that the results of Bergin et al. (2006) are driven by interpolation issues of PPPs to past data; this critique does not apply to this paper because our main results are based on a cross-section dimension in benchmark years.

[8] We use income per capita at constant prices for the panel analysis and income at current prices for the cross-section analysis.

[9] This is Penn World Table 5.6 (prices' reference year 1985); he considers the year 1990.