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Measuring substitution bias in international comparisons based on additive purchasing power parity methods

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Abstract

This paper shows that additive purchasing power parity (PPP) methods, such as Geary–Khamis, are subject to substitution bias. As a result, Geary–Khamis comparisons tend to underestimate per capita income differentials across countries. The magnitude of the bias is measured for a cross-section of 64 countries, using International Comparison Programme (ICP) data. Geary–Khamis overestimates some poorer countries' per capita incomes, relative to richer countries, by as much as 70%. These results have important implications for much empirical work in development and international economics, since Geary–Khamis is the PPP method used by the World Bank, IMF, OECD, ICP and the Penn World Table. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

A purchasing power parity (PPP) method is additive if its quantity indexes literally add up over different levels of aggregation when measured in value terms. Algebraically, additivity requires the set of countries to be compared

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using the same vector of reference price weights. Additivity is extremely useful if international comparisons are required at various levels of aggregation, as for example in a national accounts comparison. However, using a single reference price vector to compare countries introduces substitution bias. As a result, additive methods tend to overestimate the per capita incomes of countries whose relative prices differ substantially from the reference prices used in the comparison. This tendency is sometimes referred to as the *Gerschenkron effect*.

The most widely used additive PPP method is Geary (1958) and Khamis (1972). Geary–Khamis is used to construct the Penn World Table. It is also used by the International Comparison Programme (ICP), World Bank, IMF and OECD. These organizations are important sources of data for economists. The Geary–Khamis reference price vector resembles more closely the price vectors of the richer countries in a comparison. Hence, it follows from the Gerschenkron effect, that Geary–Khamis will tend to underestimate per capita income differentials across countries.¹

This paper shows that Geary–Khamis overestimates some poorer countries' per capita incomes, relative to richer countries, by as much as 70%. Biases of this magnitude have important implications for much empirical work in development and international economics. For example, correction of the bias may stretch the ability of the Mankiw et al. (1992) model to explain per capita income differentials across countries in terms of just differences in factors of production. Nuxoll (1994) and Dowrick and Quiggin (1997) go further and argue that the ICP and Penn World Table may also tend to underestimate the rate of convergence in per capita income over time. This is a direct consequence of the Gerschenkron effect if differences in relative prices across countries are decreasing over time.

In spite of the significant implications of the Gerschenkron effect, the evidence for its existence remains largely anecdotal. In fact, recently Khamis wrote a short paper arguing in defence of the Geary–Khamis method, saying that there is no clear evidence for the existence of the Gerschenkron effect.

It is claimed that for a country whose price structure is very different from the structure of the average prices of the multilateral Geary–Khamis method one obtains a higher volume level than one obtains had the average prices used in the aggregation been more characteristic of that country's prices. Reference to the overall results, e.g., those on p. 96 of the Phase III of the ICP 1982 report (Kravis et al., 1982) do not justify a general statement along these lines and no valid proof has been provided for such a statement (Khamis, 1993).

Nevertheless, the World Bank is currently considering switching from Geary–Khamis to Iklé in the hope that this may reduce the Gerschenkron

¹ In contrast, exchange rate comparisons tend to overestimate per capita income differentials across countries. This is because nontradables tend to be more labour intensive and hence relatively cheaper in poorer labour abundant countries. See Kravis and Lipsey (1983) and Bhagwati (1984).

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