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journal homepage: [www.elsevier.com/locate/eer](http://www.elsevier.com/locate/eer)Price convergence in the EMU? Evidence from micro data<sup>☆</sup>

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## ABSTRACT

The establishment of the European Monetary Union (EMU) was widely expected to cause price convergence among member states. In an investigation of this claim, the present study avoids problems of comparability and representativeness by using an extremely detailed and comprehensive scanner database on washing machine prices and sales volumes for 17 European countries. A hedonic regression yields country-specific time series for quality-adjusted price differentials. Statistically and economically significant deviations from the Law of One Price emerge. Log *t* tests firmly reject price convergence among EMU countries. Small convergence clusters can be identified but they are unrelated to EMU membership.

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## 1. Introduction

One of the benefits which had been expected from the foundation of the European Monetary Union (EMU) was a reduction of product price differences between member countries. Within the EMU, the abandonment of national currencies should have raised transparency and eliminated all the costs associated with the exchange of currencies thus cutting transaction costs and narrowing the scope for deviations from the Law of One Price (LOP).

The difficulties of international price comparisons are well known. Most recent studies of price convergence in Europe use relative price level data for many categories of goods and services which are based on price collections of one or a few exemplary variants of the product category in a few outlets in a few cities. However, one may question the accuracy of such relative price levels in terms of representativeness for the product category and for the country in question as well as in terms of homogeneity and thus comparability of the items considered. The uncertainty around such figures is reflected in substantial revisions of economy-wide aggregated relative price levels.<sup>1</sup> A biasedly measured price level, however, may make the difference between convergence or divergence.

<sup>☆</sup> The paper represents the author's personal opinions and does not necessarily reflect the views of the Deutsche Bundesbank.

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<sup>1</sup> As an extreme example, China's PPP-based GDP has recently been revised downwards by about 40 per cent because its aggregate relative price level had been revised upwards correspondingly; cf IMF (2008). Among European countries, Germany's aggregate relative price level for 2005 as recorded in the European Commission's "Annual macro-economic database" has been revised downwards by 4%, Luxembourg's by 8% and Norway's by 11% in 2007.

The present study avoids these problems by using an extremely rich database for the European washing machine market. It contains prices, quantities sold as well as a large number of characteristic features of each washing machine model purchased in each of 17 larger EMU and non-EMU countries. The comprehensive coverage of the markets guarantees representativeness, the wealth of model characteristics makes it possible to establish homogeneity and comparability. Since the data is based in large part on scanner recording of transactions, actually paid prices inclusive of all discounts instead of list prices are recorded. All this contributes to an especially high reliability of the international price comparisons in this study.<sup>2</sup>

Admittedly, the selection of a specific product market precludes outright conclusions concerning entire economies. Washing machines, however, are especially suitable for an analysis of international price convergence since they are highly tradable and highly traded, they are non-perishable and each model belongs to a brand which facilitates international comparisons. If anywhere, a reduction in transaction costs caused by the introduction of the euro should be detectable in such a market (see also Allington et al., 2005).

In contrast to many earlier studies, the washing machine database covers a significant post-EMU period. This may be beneficial if the expected effects of the introduction of the euro take some time to materialise, as it is discussed in Engel and Rogers (2004). The finding of Parsley and Wei (2001) that price differentials are particularly small in those currency unions which have existed for a long time, as for instance in the Belgium–Luxembourg one, supports such a hypothesis.

Apart from the exceptionally high reliability of price comparisons and the long post-EMU data span, the present study's contribution to the literature includes the application of a newly developed convergence test, Phillips and Sul's (2007) "log *t*" test, which overcomes some problems of more traditional measures of convergence and enables the identification of convergence clusters.

Turning to the results, the study first confirms earlier findings of still statistically and economically significant deviations from the LOP in EMU by estimating a hedonic regression. Second, it is unable to provide any evidence in favour of price convergence across euro area countries. If anything, price dispersion has risen since the turn of the millennium. The log *t* convergence test suggests the existence of some smaller convergence clubs in Europe but their membership pattern is unrelated to participation in EMU.

Section 2 gives a short literature overview. In Section 3, a conceptual framework is presented which guides the empirical analysis thereafter. Section 4 gives an overview of the data and includes the results of the hedonic regression. Section 5 presents some insights into the validity of the LOP in Europe and Section 6 introduces the convergence test methods and results. Section 7 contains conclusions drawn.

## 2. Previous studies on deviations from the Law of One Price and price convergence in the EMU

First empirical investigations on price convergence effects of EMU were performed soon after its inception.<sup>3</sup> The evidence so far is mixed, however. Early studies such as those of Lutz (2004) and Engel and Rogers (2004) were unable to find any evidence of price convergence that could be ascribed to the foundation of EMU. Some of the more recent studies, for instance Cuaresma et al. (2007), who focus explicitly on the euro cash changeover, and Rogers (2007), yield similar results. Goldberg and Verboven (2004) who concentrate on the European car market come to slightly different conclusions: car price differentials fell significantly after 1999. Since 2002, however, price differentials in a non-EMU control group decreased even faster. Faber and Stokman (2009) and Fischer (2010) report slight indications of price level convergence which, however, do not arise until after 2002. Allington et al.'s (2005) study is clearly the most positive one: they report significant evidence in favour of a reduction of price dispersion caused by the establishment of EMU.

The difficulties in proving unambiguously that EMU caused a reduction in price dispersion or that there is evidence of price convergence in the EMU at all stand in stark contrast to the highly uncontroversial finding that, prior to EMU, European prices converged considerably: Engel and Rogers (2004), Faber and Stokman (2005 and 2009), Fischer (2010), Goldberg and Verboven (2005), Hill (2004), Rogers (2007) and Wolszczak-Derlacz (2006) are relevant examples, most of which suggest a particularly pronounced advance in price convergence in the early nineties.

*(footnote continued)*

Since the aggregate is computed from disaggregated relative prices for given products, some of which are revised upwards while others may have been revised downwards, the average absolute revision for a single product may be much larger than the figures given here.

<sup>2</sup> Goldberg and Verboven (2004, 2005) investigate price convergence issues on the European car market using a database of similarly extensive coverage and richness. The high degree of segmentation along borders through selective and exclusive distribution channels as well as national systems of type approval and registration, however, make the European car market rather peculiar and possibly much less susceptible to the effects of the introduction of the euro. Moreover, they use list prices and the post-EMU period covered in their studies is short. Imbs et al. (2010) consider European TV prices in 1999–2002.

<sup>3</sup> For such an analysis, a point in time needs to be determined where the introduction of the euro could possibly have started to trigger price convergence. Generally, the process of the establishment of EMU brought about two alternative times which may have been relevant in this respect. The first is the actual introduction of the euro on 1 January 1999. As of this date, the exchange rates between national currencies within the EMU were irrevocably fixed and the newly established Eurosystem was responsible for performing a common monetary policy. Coins and notes, however, continued to exist exclusively as national currencies, although they were manifestations of the common currency, the euro, just expressed in different units of account. At the start of 2002, euro coins and notes finally replaced national currencies. It has been claimed that both these events have reduced transaction costs and thus have contributed to price level convergence, the establishment of EMU by eliminating costs of exchange, the cash changeover by increasing price transparency.

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