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# Journal of International Money and Finance

journal homepage: [www.elsevier.com/locate/jimf](http://www.elsevier.com/locate/jimf)



## Productivity shocks, the real exchange rate, and the euro puzzle

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### A B S T R A C T

#### JEL classification:

F30  
F40  
F41  
F43

#### Keywords:

Productivity  
Euro  
Real exchange rate  
Euro puzzle

This paper utilizes a large country open economy intertemporal model to obtain the effects of alternative types of productivity shocks on the real exchange rate. It then explores the conditions under which the model is consistent with the large swings in the real value of the euro. The main theoretical conclusion is that the effect of a productivity shock on the real exchange rate can change signs, depending on whether the shock applies to the productivity of new capital or old (existing) capital.

The growth accounting literature suggests that the underlying reason(s) for US productivity growth changed abruptly between the 1995–2001 and 2002–2004 intervals. In the earlier period increases in the productivity of new capital were relatively more important, while increases in the productivity of old capital completely dominated in the later period. Thus, the model appears to be consistent with the abrupt switch (from negative to positive) around 2002 in the correlation between the real value of the euro (vis-a-vis the dollar) and the US minus EU productivity growth differential.

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### 1. Introduction

Scholarly studies during the early 2000s found a strong negative relationship during the 1990s between the real value for the euro and the difference between US and EU productivity growth rates. More specifically, from the mid-1990s until approximately 2001 the euro and/or a synthetic euro<sup>1</sup> depreciated in real terms relative to the dollar when the productivity gap (as measured by the US

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<sup>1</sup> The value for the so-called “synthetic” euro is simply the calculated weighted average of the dollar values for currencies within the euro, using their current weights.

productivity growth rate minus the EU productivity growth rate) increased.<sup>2</sup> In nominal terms the actual euro began with an initial value of \$1.17 and was at 84 cents in July of 2002.

These facts were puzzling because the highly respected theoretical works of Dornbusch et al. (1977), Stockman (1980, 1987), and Lucas (1982) conclude that a positive productivity shock in the home country (holding productivity constant abroad) will lower the relative price of home goods. If the home country is the US and the foreign country is the EU, then the dollar will depreciate and the euro will appreciate in real terms. This, of course, is exactly the opposite of what was observed in the last half of the 1990s.

On the other hand, the Samuelson–Balassa theory is consistent with the observed real appreciation of the dollar during the last half of the 1990s. In their well known model, a positive productivity shock in the home tradable goods sector eventually increases the relative price of home nontraded goods, and, thereby appreciates the home currency in real terms. Tille et al. (2001) explore this idea with regard to the euro puzzle, and find some evidence in support of it. However, Meredith (2001) finds that the actual change in the relative price of US nontraded goods is consistent with a cumulative real appreciation of the dollar of 5% during the last half of the 1990s, when in fact the cumulative appreciation was 42%.

Therefore, in the early 2000s, there appeared to be a strong negative relationship between the real value of the euro and the US minus EU productivity growth gap, but no acceptable theory to explain it. This led to two related (but not identical) theories by Alquist and Chinn (2002) and Corsetti (2004). A key idea in both papers is that a positive home productivity shock generates wealth effects domestically. In Alquist and Chinn (2002) the increase in home wealth results from the higher permanent income associated with a positive productivity shock. This stimulates home consumption, and, if home goods are preferred over foreign goods, the relative price of home goods will increase, i.e., the dollar will appreciate in real terms. In Corsetti (2004) the increased home output (associated with a positive productivity shock) will be completely purchased only if the home terms of trade improve, implying a real appreciation of home money. The improved home terms of trade raises home wealth and stimulates the demand for home goods relative to foreign goods, on the assumption that home and foreign residents prefer their own goods.

Then, near the middle of 2002, the euro began to appreciate steadily, reaching a nominal value of over \$1.30 in 2004, even though the productivity gap increased in favor of the US.<sup>3</sup> In other words, the negative correlation between the real value of the euro and the US minus EU productivity growth gap that existed in the 1990s had evaporated, and was replaced by an apparent correlation of the opposite sign. That is, higher US productivity growth (relative to that in the EU) was associated with a real appreciation of the euro.

It is possible that the observed statistical relationships between the real value of the euro and the US minus EU productivity growth gap are strictly spurious. Many plausible reasons that have nothing to do with productivity growth rates have been offered for the observed movements in the euros' value during that period. Indeed, it would be naïve to believe that monetary and/or fiscal shocks do not affect the real exchange rate, at least in the short run. However, it seems reasonable that productivity shocks might dominate the influence of other shocks during some time intervals, but it remains a mystery as to why the relationship between the real exchange rate and the US minus the EU productivity growth differential changed signs in the early 2000s.

Independently of the euro puzzle is the growth accounting literature that explores the causes of the upsurge in US labor productivity since the mid-1990s, and the reasons why labor productivity growth rates in the EU have fallen. With regard to the 1995–2001 time interval, a consensus seems to have

<sup>2</sup> Maeso-Fernandez et al. (2001) find several fundamentals that appear to influence the value of the euro, but conclude that the euro effective exchange rate is driven mainly by the productivity differential. The research of Dopke et al. (2001) is consistent with this in that they find that supply shocks are the most important cause of fluctuations in the synthetic and actual euro from 1980 to 2000. Alquist and Chinn (2002) find a remarkably close relationship between the real value of the euro and the US minus EU productivity growth differential from 1985 to 2000. Finally, Corsetti (2004) also finds the same type of empirical relationship.

<sup>3</sup> From 1996 to 2001 labor productivity in the USA increased annually by 2.5%. Then from 2002 to 2004 it grew by 4.25% annually, cf. Yellen (2005b) and the references therein.

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