EUROPEAN CENTRAL BANK

EUROSYSTEM

Research Bulletin

No 6, June 2007

Editorial

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*Over the past few years global capital markets experienced a substantial increase in so-called **carry trades**, whereby international investors borrow funds in low interest rate currencies and invest the proceeds in high interest rate currencies. The profitability of this strategy, however, rests on the existence of significant and sustained deviations from uncovered interest rate parity (UIP), a relationship which states that cross-country interest rate differentials need to be offset by a relative appreciation of the borrowing currency. How then is it possible that such a strategy can remain profitable for so long, and that market interest and exchange rates do not adjust swiftly until UIP holds?*

*The lead article of this Bulletin, **"Explaining financial market puzzles with learning"**, provides some fresh answers to this and other so-called puzzles in the financial markets. It presents a novel line of research that derives feedback mechanisms in asset prices for rational traders that have imperfect information about the fundamentals, and update their priors as new data are released. This article shows how such learning behaviour can not only explain systematic violations of UIP, but also the high volatility of equity markets relative to their fundamentals (the "excess volatility puzzle"), as well as the high returns of equities compared to bonds (the "equity premium puzzle").*

*The second article of this Bulletin, **"Financial integration and capital flows in the new EU Member States"**, tracks the progress these countries have made in integrating their money and corporate loan markets, both among themselves as well as with euro area countries. It also discusses how institutional reforms in these countries may account for the significant volume of net capital inflows that they have received, which is in contrast to emerging markets in other parts of the world experiencing net capital outflows.*

*The last article, **"Productivity growth in the euro area"**, presents evidence suggesting that the relative abundance of labour in the euro area has promoted capital-augmenting technical progress, unlike in the United States, where technical progress has been labour-augmenting in a full employment environment. The capital-augmenting component of total factor productivity (TFP) growth was, however, insufficient to compensate for a marked decline in labour augmentation, leaving overall euro area TFP on a decelerating path from the late 1990s until recently.*

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The opinions expressed in this publication are those of the authors and do not necessarily reflect those of the European Central Bank.
Editors: Günter Coenen, Carsten Detken, Gabriel Fagan, Philipp Hartmann. Responsible editor for this edition: Philipp Hartmann with the support of Elias Papaioannou.
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Assistance to editors: Juanita Samengo-Turner.

ISSN 1977011-1

9 771977 011009

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ISSN 1977-0111 (print)
ISSN 1977-012X (online)

Explaining financial market puzzles with learning

By Klaus Adam, ECB

Asset prices often do not seem to follow the predictions of standard economic models that assume investors possess fully rational expectations. For example, such models suggest (1) that basic arbitrage relationships in foreign exchange markets are consistently violated (the "uncovered interest rate parity puzzle"); (2) that stock prices are excessively volatile given the volatility of fundamentals (the "excess volatility puzzle"), and (3) that the historical returns earned on equities are far too high in comparison with the returns on risk-free assets (the "equity premium puzzle"). This article examines the implications that imperfect knowledge and learning have for the determination of exchange rates and equity prices. It illustrates how the above-mentioned empirical phenomena can be reconciled with efficient and well-functioning asset markets in which investors possess small amounts of imperfect knowledge.

Expectations of future developments are crucial determinants in many economic decisions and are especially important for the determination of asset prices. For example, the value of a firm's equity mostly depends on expectations of its future profitability. To form these expectations in a fully informed manner, an investor would ideally need to process a voluminous amount of information, e.g. on all details of the firm's activity, on its main competitors and on the broader macroeconomic prospects. Investors would not only need to have a correct understanding of how these various elements affect profitability, but also of how these elements translate into the price of the stock.

The academic literature on imperfect knowledge starts from the assumption that real-world investors neither have the capacity nor the desire to process all of the available information, and thus their decisions are inevitably based on much more limited information sets. More specifically, economic agents will typically neither know all the "true" determinants of a certain economic phenomenon – e.g. the firm's profitability – nor how exactly these determinants translate into the equilibrium price of the stock. **Agents therefore try to gauge this information from past data and then systematically revise their perceptions – i.e. "learn" – as new data become available.** Over time, investors may learn the "full truth" (in the absence of structural breaks), but this transition may take considerable time, during which asset prices may display rather different behaviour than under conditions of full information.

Foreign exchange markets: Why do high interest rate currencies not depreciate?

Standard arbitrage considerations imply that a currency offering a high short-term nominal interest rate should depreciate (on average) relative to another currency offering lower nominal rates. The rate of depreciation should be such that the expected nominal returns from investment in both currencies are exactly equal when measured in a given currency. The relationship between the nominal interest rate differential and the rate of depreciation is known as the **uncovered interest rate parity (UIP)** condition. However, it is a well-documented empirical fact that UIP **fails to hold in many foreign exchange markets: the rate of depreciation of high interest rate currencies tends to be close to zero and often even negative, so that currencies offering high interest rates tend to appreciate vis-à-vis low-yield currencies.** This is illustrated in the table below, which presents estimates from standard UIP regressions.[1] While UIP predicts the regression coefficient to be equal to one, the estimated coefficients reported in the table tend to be negative and often significantly so. It has been shown that this feature of exchange rates could in principle be exploited to generate excess returns (Burnside et al., 2006). While some investors do indeed seem to pursue such investment strategies, e.g. via so-called carry trades, it remains a puzzling question why the phenomenon continues to exist in the market.

The answer supplied by models of learning is that **prices are arbitrage-free but reflect investors' subjective beliefs, which differ from those imputed by models assuming perfect knowledge.** This is the viewpoint taken by Chakraborty and Evans (2006), who consider a model of learning in which investors are uncertain about the true relationship between the fundamentals and the equilibrium exchange rate.[2] As a result of this uncertainty, agents use past data to estimate this relationship and to update their estimates over time as more data become available. **This updating process will lead an econometrician who assumes that investors know the truth from the beginning erroneously to conclude that unexploited arbitrage opportunities must exist.** In particular, the presence of learning implies that the estimated UIP regression coefficients should be

1 *The table reports the coefficient b obtained from estimating (S(t+1)/S(t)-1) = a + b*(F(t)/S(t)-1), where S(t) denotes the spot exchange rate in t and F(t) the forward exchange rate for t+1 quoted in t. F(t) and S(t) are both expressed in units of foreign currency per unit of reference currency.*

2 *An alternative view is provided by Alvarez et al. (2006), who consider agents with full knowledge facing fixed costs to participate in asset markets. UIP violations in their model are the result of time-varying participation in asset markets.*

Uncovered interest rate parity (UIP) regressions

	Belgium	Canada	France	Germany	Italy	Japan	Netherlands	Switzerland	US
Coefficient estimate	-1.531	-3.487	-0.468	-0.732	-0.660	-3.822	-2.187	-1.211	-1.681
(std. dev.)	(0.714)	(0.803)	(0.589)	(0.704)	(0.415)	(0.924)	(1.040)	(0.533)	(0.880)

Source: Burnside et al. (2006).
Note: Numbers in parentheses are standard errors of the estimates. All exchange rates are vis-à-vis the British pound, forward rates are for a one-month horizon, and results are based on non-overlapping observations. Data cover the period 1/1976-12/2005, except for Japan where data begin 7/1978, and current euro area currencies, which end 12/1998.

zero or negative instead of equal to one, consistent with the findings reported in the table. Indeed, what appear to be arbitrage opportunities from an econometrician's viewpoint could be arbitrage-free prices, given agents' estimates of the structural relationships at the time. Models of learning and incomplete knowledge are thus able to reconcile the empirical evidence with the presence of efficiently functioning foreign exchange and bond markets.

Why are stock markets so volatile?

It is widely accepted that aggregate stock returns appear excessively volatile, at least when compared to the relatively smooth evolution of important fundamentals such as dividends, earnings or interest rates.[3] Occasionally, stock markets also seem to display long and sustained price increases, as well as sudden price decreases, and these price developments are often hard to link to the development of the fundamentals.[4] The volatility of stock prices thus appears puzzling from the viewpoint of fully rational investment behaviour.[5]

The ability to interpret volatile asset price movements increases dramatically once the assumption of full information and knowledge is somewhat relaxed. Evidence from experimental asset market studies indeed suggests that limited information about fundamental prices might play an important role in the determination of asset price volatility (see Heemeijer et al., 2006). Investors seem to find it particularly difficult to coordinate on fundamental prices in markets where current prices are positively related to expected future prices and where this relationship is particularly strong. Both features are present in asset markets, where investors' beliefs in high prices tends to generate high asset demand and thus produces the high prices that they had originally expected. **Strong complementarity between beliefs and outcomes suggests that events which are unrelated to fundamentals but affect price expectations (e.g. a "confidence crisis") can lead to sizeable and largely self-fulfilling asset price movements.** The variability of stock prices may thus partly be explained by variability in price expectations that is unrelated to movements in fundamentals. The question which remains is: is it possible to identify convincingly the factors that trigger such movements in price expectations?

Adam et al. (2006) pursue this question by considering investors whose beliefs about future prices are largely rational, but are slightly influenced by past price behaviour observed. This influence arises because investors are uncertain about the long-run growth trend of prices and try to infer it from past data. As a result, **if prices have been growing at a higher rate than in the past, investors become slightly more optimistic about future price growth.** Empirically, such behaviour seems plausible given the popularity of chartism and other trend-chasing forecast behaviour. Moreover, such learning processes are able to reconcile in quantitative terms the smooth behaviour of the fundamentals with the volatile behaviour of stock returns. Learning-driven revisions in investors' beliefs add to the overall volatility of asset prices and prove to be a powerful amplification mechanism. Higher expectations about future price growth, for example, justify a higher equilibrium price level. Therefore, **an upward revision in expected price growth above the price growth justified by fundamentals tends to induce the higher-than-fundamental price growth that the investors initially expected.** Given that observations of higher realised price growth feed back into expectations, the learning mechanism then implies further upward revisions of price growth expectations. This allows the model to match many salient features of stock price data, including the persistent and volatile behaviour of the price dividend ratio.

3 *This finding is documented in two seminal studies by Shiller (1981) and LeRoy and Porter (1981).*
4 *Campbell (2003), for example, documents that the price-dividend ratio (PDR) displays large fluctuations. At the same time, the PDR does not seem able to predict future fundamentals, i.e, dividends, earnings and interest rates. Instead, a high (low) PDR predicts low (high) future stock returns.*
5 *Campbell and Cochrane (1999) are able to match the evidence with a fully rational investment model by constructing suitable investor preferences.*

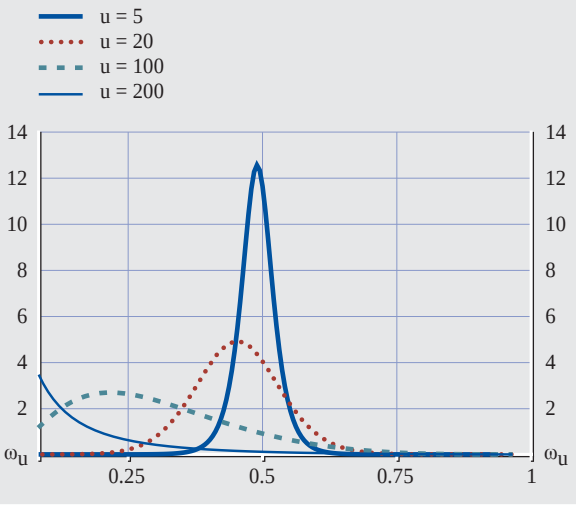
Why do fully rational investors not take over?

A common argument put forward against explanations of asset price phenomena that involve learning and imperfect knowledge is that markets favour traders with more accurate information, and as these traders become wealthier, market prices come to reflect their views. Deviations from rational beliefs are thus at most of transitory importance.

Surprisingly, the market mechanism does not necessarily select traders with rational beliefs. Blume and Easley (2006) show that, in the long run, market prices may be determined by investors holding incorrect beliefs, even though these exist alongside traders holding rational beliefs. If traders differ not only with respect to the subjective likelihood they assign to different states of nature but also with regard to their subjective discount factors, then prices in the long run will not necessarily be determined by those investors whose subjective beliefs are "closest" to the objective ones. This happens even if all investors make rational investment and consumption decisions (given their beliefs), and even if frictionless and efficient markets determine prices and thus the evolution of wealth over time. In particular, a low rate of time preference (patience) can compensate for inaccurate subjective beliefs, implying that more impatient traders with more accurate beliefs may become eventually irrelevant with regard to the determination of market prices. Prices may thus never reflect the most accurate beliefs in the market, not even in the long run, and not even if agents exist whose subjective beliefs exactly coincide with the objective ones.

Complementary insights are provided by Dumas et al. (2006), who consider an equilibrium asset-pricing model where agents share the same rate of time preference. While one set of investors is fully rational, another set holds excessively volatile beliefs, i.e. opinions that are either excessively optimistic or excessively pessimistic. The questions then asked are: Can rational investors exploit the excessive volatility of beliefs to generate excess returns? Will investors with volatile beliefs be driven out of the market quickly? The answer to the first question is indeed "yes", whereas the answer to the second turns out to be "no". Generating excess returns requires rather sophisticated portfolio strategies with returns that will only materialise over a long investment horizon, possibly one that is too long to be of practical relevance. The reason for this finding is the observation that deviations from fully rational prices by themselves do not indicate the presence of an arbitrage opportunity, as such deviations may persist or even increase. Simple arbitrage strategies therefore do not exist. Moreover, the additional risk introduced by investors with excessively volatile beliefs limits the size of the arbitrage positions that rational investors wish to take. As a result, prices can deviate from fully rational ones over long periods of time. This is illustrated in the chart, which shows simulations by Dumas et al. (2006) concerning how the share of investors with volatile beliefs evolves over time, given that initially their share is equal to one half. The fact that the dotted red curve is centered only slightly to the left of one half suggests that even after 20 years, their importance has not significantly decreased.

Probability density functions showing the consumption share of investors with volative beliefs (ω_u) as a function of years passed (u)



Note: Initial share in year zero is equal to one half.

Why are average stock returns so high?

It is a well-established empirical fact that **over the last 100 years, investors have received on average a large premium for holding stocks instead of short-term nominal bonds.**[6] For most OECD countries and most time spans, the annual premium for holding equity instead of bonds is above 5% in real terms. These sizeable premia do not seem to be a compensation for risk alone, as economic models have strong difficulties in reconciling such levels with reasonable degrees of investor risk aversion.[7] Cogley and Sargent (2006) offer a new explanation for the historically observed equity premium

6 *See Campbell (2003). A non-technical survey on the topic is provided by Siegel and Thaler (1997).*

7 *This was first noted by Mehra and Prescott (1985).*

based on initially pessimistic investors whose beliefs about future economic prospects were shattered by the experience of the Great Depression.[8] Following Friedman and Schwartz (1963), who argue that this experience generated "exaggerated fear of continued economic instability, of the danger of stagnation, of the possibility of recurrent unemployment", the authors assume that **investors, following the 1930s experience, initially tended to assign a larger likelihood than with hindsight seems rational to experiencing another contraction of a similar magnitude and duration.** As the economy gradually developed after World War II, this excessive pessimism started to disappear. Yet learning about rare events requires many observations, so that this initial pessimism was extremely slow to dissipate. As a result, equilibrium stock prices moved upwards very slowly, i.e., equities earned a significant premium over bonds for a protracted period of time. **This interpretation of the equity premium implies that the high returns on equities are only a transitional (albeit protracted) phenomenon, and that the outlook for future equity returns is much more moderate.** Whether this is indeed the case is, of course, an open question.

The insights provided in this article are based on the most relevant findings from a recent ECB conference on "Monetary Policy, Asset Markets, and Learning". The conference programme and papers are available at http://www.ecb.int/events/conferences/html/mopo_asset-markets.en.html.

8 Stock prices fell by more than 90% between the 1929 peak and the 1932 trough, and did not rebound to reach their former high point until the early 1950s.

Financial integration and capital flows in the new EU Member States

By Lorenzo Cappiello and Simone Manganelli, ECB

Recent empirical evidence shows that the financial markets in new EU Member States are significantly less integrated than the corresponding euro area markets. Nevertheless, the integration process is well under way and has even accelerated following EU accession. Progress in financial integration is also confirmed by capital inflows into these economies. This finding is however at odds with the capital outflows typically observed in other emerging economies. According to a recent strand of the literature, capital flows crucially depend, inter alia, on the quality of institutions. We argue that the reforms triggered by the accession process in the new EU Member States have contributed to improving their institutional framework and may therefore help to explain the observed capital flow patterns.

The ECB and the Eurosystem are devoting increasing attention to developments in EU financial market integration (see, for instance, ECB, 2005, 2006 and 2007).[1] Financial integration issues play an important role in the EU policy debate, as a well-integrated financial system can foster economic growth by reducing the cost of capital, increasing risk-sharing and improving the efficient allocation of financial resources. Moreover, financial integration may contribute to reducing any asymmetries in the transmission of a common monetary policy.

Financial integration in the new EU Member States

According to Baele et al. (2004), the market for a given financial instrument is considered fully integrated if all economic agents with the same relevant characteristics in that market are governed by a single set of rules, have equal access, and are treated equally. Although this definition refers to an ideal state of perfect integration, so that its conditions are rarely met in practice, it does provide a useful benchmark.

Baltzer et al. (2007) provide a recent and comprehensive overview about the state of financial integration in the new EU Member States.[2] These countries have joined the EU and will eventually become part of the euro area in the near future.[3] **Financial markets in the new EU Member States are found to be significantly less integrated than the corresponding euro area markets. However, there is strong evidence that the process of integration is well under way and has accelerated with EU accession.** In particular, money and banking markets are becoming increasingly integrated, both among themselves and vis-à-vis the euro area.

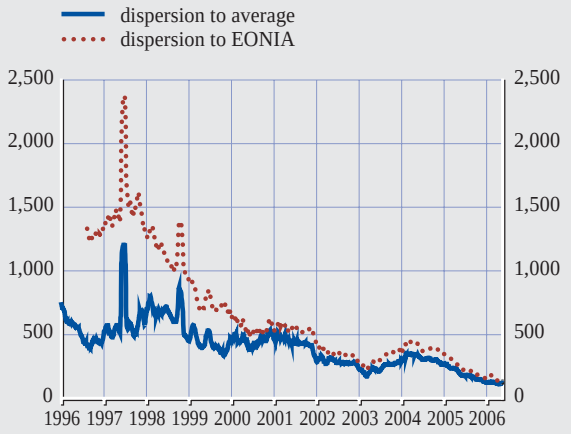
To illustrate this, we report two charts drawn from this paper. Chart 1 shows that, **until the end of the 1990s,** the

1 See also Adam et al. (2002), Hartmann et al. (2003), and Baele et al. (2004).

2 Other recent contributions include, for instance, Dvorak and Geiregat (2004), Reininger and Walko (2006), Cappiello et al. (2006) and Abiad et al. (2007).

3 The new EU Member States comprise Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovenia and Slovakia, which joined the EU on 1 May 2004, and Romania and Bulgaria, which entered on 1 January 2007. Of these, Slovenia became the first to join the euro area on 1 January 2007.

Chart 1 Dispersion of overnight interbank lending rates



Sources: Datastream, ECB, Global Financial Data and authors' calculations.
Note: Chart 1 plots the standard deviations of overnight lending bid rates relative to the cross-sectional average (blue line) and overnight benchmark rate (red dotted line). The lines represent 30-day moving averages in basis points. The benchmark rates are the German FIBOR before 1999, and afterwards the EONIA. The countries included are the Czech Republic, Hungary, Lithuania (from January 1999 until December 2005), Latvia (from December 1997), Poland, Slovenia and Slovakia.

Chart 2 Dispersion of corporate loan rates

Sources: Global Financial Data and authors' calculations.
Note: Chart 2 plots average cross-sectional standard deviations of interest rates on short and long-term loans to enterprises relative to the cross-sectional averages. Data for short-term loans are available for the Czech Republic, Estonia, Hungary, Lithuania (until September 2005) and Latvia (until December 2004). Data for medium and long-term loans are available for the Czech Republic, Estonia, Lithuania, Latvia, Malta (from January 2000), Slovenia (until December 2005) and Slovakia.

dispersion of overnight lending rates in the new EU Member States vis-à-vis the FIBOR rate (red dotted line)[4] was much larger than the corresponding dispersion relative to the average across countries (blue line). This indicates that the **money market rates of the new EU Member States were closer to each other than to the EONIA. After 2000 the divergence between the red and blue lines shrinks, and towards the end of the sample almost disappears.** Chart 1 also suggests that convergence has been substantial over the past ten years, since dispersion has decreased from about 1,500 basis points in the second half of the 1990s to around 100 basis points in 2006. To put these figures into perspective, it is worth noting that in 1998 the corresponding indicator for the euro area was hovering around 100 basis points before dropping to almost zero before the introduction of the euro (see Chart 1 of Baele et al., 2004).

In a similar vein, Chart 2 plots the dispersion across countries of loans to enterprises in the new EU Member States. **Starting in 1995, dispersions have broadly decreased for all corporate loan rates.** This decrease in dispersion indicates that rates across the new EU Member States have become progressively more homogeneous. This evidence, compounded with other indicators reported in Baltzer et al. (2007), suggests that integration across these markets is increasing.

While increased integration in the money markets may reflect overall convergence in macroeconomic policies, the banking market dynamics can be partly ascribed to the strong foreign (mainly EU) banking presence in the new EU Member States.[5]

Determinants of capital flows in the new EU Member States

Alternative quantity-based indicators of financial integration can be constructed from data on cross-border financial flows. As pointed out by Guiso et al. (2005), regional financial integration should increase the supply of finance in the less financially developed countries of the integrating area. Furthermore, according to neoclassical theories, capital should flow to emerging countries since their relative scarcity of capital implies higher rates of return (see Lucas, 1990).

This is indeed the case for the **new EU Member States,** which from 2001 onwards have received an increasing amount of capital (see Tables 3 and 5 of Baltzer et al., 2007). In addition, these countries show on average current account deficits, which indicates that they **are net recipients of capital** (see, for instance, Abiad et al., 2007).

4 *Before 1999 the EONIA did not exist and is proxied with the Frankfurt Interbank Overnight Rate (FIBOR).*
5 *According to the European Bank for Reconstruction and Development (EBRD), the percentage of asset shares of foreign-owned banks relative to total bank sector assets has increased, rising from 30% in 1997 to around 75% in 2005. See EBRD (2006).*

This evidence is at odds with what is observed in other emerging economies. **On average, East Asian and Latin American countries** have in recent years run current account surpluses, which in many cases translated into capital account deficits (see Prasad et al., 2006). These countries **are** therefore **net exporters of capital**, contradicting the predictions of neoclassical theory.

A recent strand of the literature has provided a possible explanation for the path of capital flows as well as their composition, by highlighting the importance of sound economic institutions (see for instance Caballero, 2006; Caballero et al., 2007; Ju and Wei, 2006; Stulz, 2005; and Shleifer and Wolfenzon, 2002).[6] Economic institutions, such as the structure of property rights or the presence of well-functioning markets, provide the necessary conditions for investing in physical and human capital, and contribute to an efficient allocation of resources (see Acemoglu et al., 2005).

Caballero (2006) argues that institutional factors affect the ability of emerging economies to generate the supply of financial assets, i.e. the possibility of selling rights over output in advance. For this reason, emerging economies may enjoy high growth rates, but are not necessarily able to generate assets that appeal to international investors. By contrast, developed economies have been able to match sound growth conditions with an unrivalled ability to create high-quality financial assets. If there are no capital flow restrictions, investors in emerging economies can satisfy their appetite by buying assets abroad. In a similar vein, Stulz (2005) focuses on investor protection, arguing that poor corporate governance and high political risk prevent the providers of capital from fully accruing their investment returns (the so-called twin agency problem).

The accession process in the new EU Member States has certainly helped to improve their economies as well as their institutions. For instance, on the real economy side, they have made the transition in little more than a decade from centrally planned to market and to fully open economies participating in a free trade area. Moreover, they went through a very rapid development and liberalisation of their financial markets, changes that occurred at roughly the same pace. More importantly, these economic and financial developments have been accompanied by a parallel institutional change driven by compliance with the accession criteria. A particular prerequisite for accession was the adoption of the acquis communautaire (the entire European legislation) and its effective implementation through appropriate administrative and judicial structures. This may explain why, contrary to other emerging economies, capital has flown "downhill" in the new EU Member States, contributing to increasing the degree of financial integration.

6 *More generally, it is the lack of complementary factors to capital that determines its marginal productivity. In addition to economic institutions, another important complementary factor is represented by human capital (see, for instance, Caselli and Fryer, 2007).*

Productivity growth in the euro area

By Peter McAdam and Alpo Willman, ECB

We explain total factor productivity (TFP) growth in the euro area, using a constant elasticity of substitution (CES) production function which allows for technical progress to increase the efficiency of both labour and capital. Our results suggest that the elasticity of substitution (i.e. the elasticity of the demand for labour and capital with respect to their relative price) lies in the 0.6-0.7 range and that – until the late 1990s – technical progress increased labour efficiency at an approximately constant rate, while that of capital tended to decelerate. However, thereafter we find a structural break in TFP growth which we attribute to "directed technical change" in favour of capital. This may shed light on the puzzling deceleration in average labour productivity as well as TFP growth that took place from the late 1990s until recently.

Total factor productivity (TFP) is an important determinant of the non-inflationary potential growth of the economy. Since Solow (1957), it has been known that **changes in TFP typically account for a greater proportion of output growth than changes in factor inputs** (i.e. growth in physical capital and labour). TFP growth therefore enables more output for given factor inputs and captures features such as organisational enhancements, improved factor efficiency and quality, entrepreneurial skills, etc.

TFP can moreover be presented as a (not necessarily fixed) weighted average of efficiency improvements in *both* labour and capital. Indeed, there has recently been renewed interest in models of so-called biased (or augmented) technical change (e.g. Acemoglu, 2003; Jones, 2005; Klump et al., 2007). In such models, **scarcity generates incentives to invest in factor-saving innovations, whereby firms reduce their need for scarce factors and increase their use of abundant ones.** With such a framework in mind, we examine recent developments in euro area productivity.

Euro area/US productivity growth and output growth

	1971-1980	1981-1990	1991-1995	1996-2005
	Euro area			
Growth of average labour productivity	2.9	1.8	1.8	0.9
Average per capita output growth [1)]	2.5	1.5	1.2	1.1
	US			
Growth of average labour productivity	1.1	1.4	1.4	2.1
Average per capita output growth [1)]	0.9	1.6	1.4	2.1

1) In terms of labour force.

The table shows that the profile of **euro area labour productivity growth is decelerating compared to the US**. One notable aspect is that of the last ten years, whereupon average labour productivity growth has been about half of that over the previous 15 years, seemingly marking some form of structural break. What makes this especially puzzling is that in the US, productivity has markedly accelerated, most probably owing to the recent IT boom. The fact that growth in IT-related capital stock did not differ significantly between the US and the euro area makes this outcome even more puzzling.

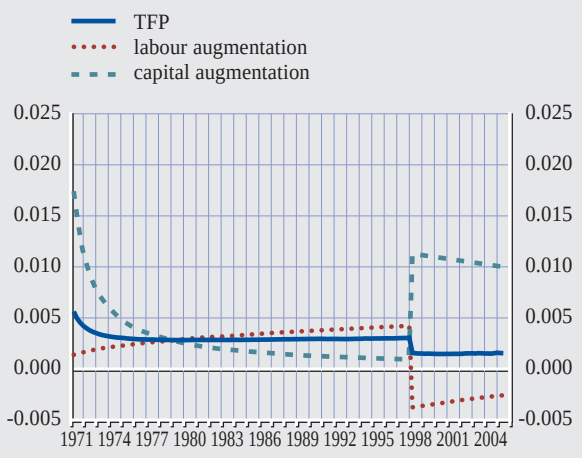
In this article, we draw upon recent research (McAdam and Willman, 2007) to explain TFP and (potential) output growth developments in the euro area. We employ a quite general functional form for production, namely a "factor-augmenting" constant elasticity of substitution (CES) function, which allows the price elasticity of capital and labour with respect to their relative price to be any constant between zero and infinity. Setting that elasticity to unity yields the familiar Cobb-Douglas (CD) function. Finally, it is *factor augmenting* because both capital and labour are allowed to increase their technical efficiency.

Neoclassical growth theory suggests that, for an economy to possess a balanced growth path (i.e. constant growth and factor income shares), the substitution parameter must be unity (i.e. CD), or technical change must be labour-augmenting. In the light of euro area experience, however, both assumptions are questionable. The intuition for the labour-augmenting condition reflects the feature that while capital can be accumulated limitlessly, labour cannot. Thus labour tends to represent the constraining factor and in order to avoid an explosion of wage income (or labour share), **firms tend to bias technical improvements towards labour so that factor income shares remain constant**. However, given the persistently high levels of unemployment in the euro area, considering labour to be a constraining factor for medium-run growth may be anomalous. Accordingly, **over periods of transition, growth in capital-augmenting progress can also be expected as a result of endogenous changes in the direction of innovations towards more profitable factors (i.e. capital)**, as the observed increase in the capital income share indicates. Thus any exogenous shock (such as a burst of IT improvements) may lead to directed technical change in favour of the more profitable factor, i.e. capital rather than labour.

Earlier work on CES functions, moreover, generally assumed constant technical growth. However, following recent debates about biases in technical progress, it is not obvious that growth rates should always be constant; accordingly, we have modelled technical progress using a flexible, time-varying functional form. Given this functional form, we can demonstrate that technical progress attributable to either factor or both may display constant growth (i.e. the text-book case) or, though initially positive, decline to zero over time.

For the euro area (taking the sample 1970-2005) we estimated the elasticity of substitution to be around

Time-varying growth rates of euro area TFP



0.6-0.7. This suggests that we should reject the CD form, and that (biased) factor augmentation may well be important in describing TFP growth. The chart shows our estimates of time-varying progress components **for the euro area** and TFP (their weighted average). We found that **labour makes a dominant contribution to technical progress, while capital plays an important, although declining, role over time**. As the capital component fades over time, our findings tend (albeit in the very long run) to a conventional steady state where TFP growth is driven by labour. **This pattern was stable until the late 1990s, when there appeared to be a structural break in both TFP growth[1] and directed technical change in favour of capital.** (Note that a similar structural break in euro area labour productivity has also been confirmed by other studies, e.g. Gomez-Salvador et al., 2006). This sheds light on the puzzle of why, amidst a global IT boom, euro area TFP growth actually decelerated: **although the upward shift in capital augmentation is somewhat higher than the drop in labour-augmenting progress, TFP growth declined owing to the relatively lower income share of capital.**

By contrast, results **for the US** (not reported here) show quite the opposite development. **The IT revolution** there **took the more standard labour-augmenting form (with an attendant net acceleration in TFP growth), reflecting that, in the medium run, US labour availability has remained a constraining factor for growth**, indicated by the fact that the unemployment rate has fluctuated around a roughly constant long-run level. Moreover, factor income shares were essentially stable, suggesting that the profitability of capital-augmenting progress has not increased over time.

To conclude, our research highlights the importance of using generalised functions to capture movements in production and to reveal the factor content of TFP. In particular, our estimates offer an explanation for the deceleration of TFP growth in euro from the late 1990s until recently in terms of directed technical change.

1 *It should be noted that these discrete shifts in growth rates do not imply similar shifts in levels, but rather kinks in the slopes of capital and labour-augmenting technical progress levels.*

4th ECB Central Banking Conference: "The role of money: Money and monetary policy in the twenty-first century"

By Andreas Beyer, ECB

In November 2006, the ECB hosted the 4th Central Banking Conference to allow an open exchange on monetary policy issues between high-profile academics and policymakers. The conference comprised three academic sessions on theory, monetary analysis in practice and history; an honorary speech by former board member Otmar Issing; a keynote speech by the Vice-President of the ECB; and two panel discussions, one academic and one on policy.

In the first session on theory, Larry Christiano (*Northwestern University*) first presented two arguments for a central role for money in monetary policy: to keep expectations anchored; and to mitigate the negative macroeconomic consequences of boom-bust cycles. Michael Woodford (*Columbia University*) then defended the thesis that, to be successful in achieving its goals, a central bank does not need to assign a prominent role to money.

In the second session on monetary analysis in practice, Lucrezia Reichlin *(ECB)* presented a historical description of monetary analysis at the ECB since its creation, followed by a quantitative evaluation of the models that have played a prominent role in the inflation forecast based on money.

In the third session on history, Mark Flandreau (*Institute d'Etudes Politique, Paris*) discussed the long-run evolution of institutions governing monetary policy and the motivation for the different strategies they have pursued at different times.

Former Executive Board member Otmar Issing reviewed the historical decision process at the ECB that led to the choice of a two-pillar approach. He explained that in an environment of extreme uncertainty, the two-pillar strategy was chosen on the grounds that money should be given a "prominent" role in an all-encompassing strategy. ECB Vice-President Lucas Papademos explained in his keynote speech that in the ECB's experience, monetary analysis is helpful in extracting information about the inflation outlook and the associated risks to price stability, particularly in an environment of macroeconomic and financial uncertainty.

The conference concluded with two panel discussions. The academic panel broadened the discussion from money to financial variables in general, more specifically examining their impact on macroeconomic performance. In the policy panel, comprising the President of the ECB, the Chairman of the Board of Governors of the Federal Reserve System, the Governor of the People's Bank of China and the Vice-Governor of the Bank of Japan, the participants discussed their experiences using money as an input for monetary policy, and the role of money in their current monetary policy strategies.

The contributions to this conference can be downloaded from the ECB's website at http://www.ecb.int/events/conferences/html/cbc4.en.html.

Next Steps of the ECB-CFS Research Network on "Capital Markets and Financial Integration in Europe"

By Philipp Hartmann and José Luis Peydró-Alcalde, ECB

Since the spring of 2002 the ECB and the Center for Financial Studies (CFS) have been running a research network on "Capital Markets and Financial Integration in Europe". This network brings together researchers, policymakers and market participants with the aim of discussing recent research and policy issues related to the integration and development of the European financial system and its linkages to the financial systems of major other economies. Previous results of the network have been summarised in the April 2005 edition of this Research Bulletin (No 2, p. 10), which is available at http://www.ecb.int/pub/pdf/other/researchbulletin02en.pdf.

In the remainder of 2007 the network will hold a conference on "Asset management, private equity firms and international capital flows: Their role for financial integration and efficiency" hosted by the Central Bank and Financial Services Authority of Ireland in Dublin on 8-9 October. Further details about this conference can be found in the public call for papers at http://www.ecb.int/events/conferences/html/ecbcfs_conf9.en.html. In early 2008 a symposium concluding the three years of the second phase of the network will take place in Frankfurt am Main. The symposium will cover all areas of the network.

The Steering Committee proposes to extend the work of the ECB-CFS research network, with a third phase starting after the symposium. Three broad priority areas for this phase are envisaged:

1) Financial systems as risk managers and risk distributors

This first priority area would focus on the efficiency and financial stability implications of the increasingly complex risk allocations undertaken through modern financial systems. It would discuss the related financial innovations, and address the effects on the real economy. The results would be expected to have a bearing on monetary and financial policies.

2) Integration and development of retail financial services and the promotion of innovative firms

The second priority area would examine ways of improving the functioning of the markets for retail financial services, with the aim of drawing potential conclusions for the transmission of monetary policy. These markets remain diverse and fragmented in Europe, and are characterised by differing service levels and prices as well as varying degrees of competitiveness. These include for example the financing of innovative firms, asset management, insurance, mortgages, credit cards and retail payments.

3) Financial modernisation, governance and the integration of the European financial system in global capital markets

The third priority area would further analyse ways of modernising the European financial system, examining how these efforts are internationally interdependent. This concerns for example reforms of legal systems, regulations, various market standards and corporate governance. This priority area would also address the emergence and role of international financial centres and the linkages between them.

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