CATCHING-UP AND CREDIT BOOMS IN CENTRAL AND EASTERN EUROPEAN EU MEMBER STATES AND ACCEDING COUNTRIES: AN INTERPRETATION WITHIN THE NEW NEOCLASSICAL SYNTHESIS FRAMEWORK

PETER BACKÉ
CEZARY WÓJCIK

CESIFO WORKING PAPER NO. 1836
CATEGORY 6: MONETARY POLICY AND INTERNATIONAL FINANCE
OCTOBER 2006

An electronic version of the paper may be downloaded
- *from the SSRN website: www.SSRN.com*
- *from the RePEc website: www.RePEc.org*
- *from the CESifo website: www.CESifo-group.de*

CESifo *Working Paper No. 1836*

CATCHING-UP AND CREDIT BOOMS IN CENTRAL AND EASTERN EUROPEAN EU MEMBER STATES AND ACCEDING COUNTRIES: AN INTERPRETATION WITHIN THE NEW NEOCLASSICAL SYNTHESIS FRAMEWORK

Abstract

Credit to the private sector has risen rapidly in many Central and Eastern European EU Member States (MS) and acceding countries (AC) in recent years. The lending boom has recently been particularly strong in the segment of loans to households, primarily mortgage-based housing loans, and in those countries that operate currency boards or other forms of hard pegs. The main aim of this paper is to propose a conceptual framework to analyze the observed developments with a view to exploring some policy implications at a stage in which these countries are preparing for their prospective integration with the euro area. To achieve this, we first use a stylized New Neoclassical Synthesis (NNS) framework, which has recently been advanced by Goodfriend (2002) and Goodfriend and King (2000). We then discuss the implications of the NNS model for credit dynamics and ensuing monetary policy challenges. Specifically, we emphasize consumption smoothing as an important channel of the observed credit expansion and we show how it is related to and how it affects the monetary policy making in MS and AC. In doing so, we place our discussion in the context of the monetary integration process in general and the nominal convergence process in particular.

JEL Code: E5, F3.

Keywords: credit booms, new neoclassical synthesis, currency boards, euro area, convergence process.

Peter Backé
Foreign Research Division
Austrian Nationalbank
Austria
peter.backe@oenb.at

Cezary Wójcik
Warsaw School of Economics
Department of International Finance
Al. Niepodleglosci 164
Poland – 02-554 Warsaw
cezary.wojcik@sgh.waw.pl

The research was conducted while I was a visiting researcher at the European University in Florence in a framework of a fellowship scheme funded by the EUI Research Laboratory at the European Centre Natolin. I would like to thank the European Centre Natolin for the generous support and help. The idea and inspiration for the project came from discussions and joint work with my friends and colleagues from the Polish Ministry of Finance as well as from my earlier work with professor Ronald MacDonald. They were subsequently developed further during my stay as a visiting researcher at Glasgow University. The research has been supported by the Polish Ministry of Science and Higher Education through a research grant N113 005 31/0929.

1. Introduction

Credit to the private sector has risen rapidly in many Central and Eastern European EU Member States (MS) and acceding countries (AC) in recent years. Recently the lending boom appears to be particularly strong in the segment of loans to households, primarily mortgage-based housing loans, and in those countries that operate currency boards or other forms of hard pegs. This development attracted considerable attention from policy makers and spurred new research aimed at better understanding the phenomenon.

A number of potential explanations of credit expansions have been put forward in the literature (for reviews of the literature see e.g. Terrones and Mendoza (2004), Gourinchas, Valdes and Landerretche (2001) or Backé and Zumer (2005)). For example, some authors emphasize the role of real business cycles caused by technological or terms-of-trade shocks. Others see financial liberalization of an initially repressed financial system as an important force fueling credit dynamics. Still others focus on the role of capital flows triggered by external factors or wealth shocks originating from comprehensive structural reforms. Also, less then fully credible polices, in particular exchange rate-based stabilizations, can play a role in stimulating credit booms by setting off a consumption boom. Finally, credit expansion can be viewed simply as a symptom of financial development, in particular financial deepening, as the literature on the finance-growth nexus points out (on this strand of the literature see e.g. Beck, Levine and Loayza (2000) and Rajan and Zingales (2001)).

Indeed, when looking at the experience of the MS and AC countries over the last decade or so most of these factors have been at play, while their relative importance has changes over time.[1] Lending growth in these countries has been promoted at different stages of their transition and catching-up process by a set of factors. Undoubtedly, credit expansion was stimulated by

[1] Studies on credit growth in MS and AC have mushroomed in the last few years. See Cottarelli, Dell'Ariccia and Vladkova-Hollar (2003), Kiss, Nagy and Vonnák (2006), Boissay, Calvo-Gonzalez and Kozluk (2006), Hilbers et al.

macroeconomic stabilization and a build-up of confidence in policy frameworks that provided lower inflation and, thus, declining interest rates. Privatization and restructuring of the banking sector together with regulatory reforms of financial markets have promoted private savings as a source of banks' financing the credit expansion. At the same time increased competition stimulated development of new products, such as for example mortgage loans. Continuous opening-up of these economies to international financial flows facilitated access to foreign funds as an additional source of refinancing banks' credit action. Also improvements of legal frameworks, by reducing risk of banks' activities, positively influenced supply of credit. Other government policies, such as interest rate subsidies or guarantee schemes, may have also contributed at times to lending booms.

While all these factors have certainly had a bearing on the credit development in MS and AC, the particularly strong surge in household loans in the recent years suggests that households in these countries has recently started to engage more intensively in consumption smoothing, i. e. borrowing against their expected future income. Looking ahead, it seems likely that continued development of the banking sector and financial markets in general along with the ongoing improvements of regulatory and legal frameworks will, by reducing liquidity and collateral constraints on MS and AC households, further support credit dynamics in this segment. While, the households' intertemporal substitution has been already suggested by some authors as potential driving force of credit expansion (see for example Coricelli, Mucci and Revoltella (2006)), there as been so far little attempt to expose this issue in the context of MS and AC in their run-up to the euro area in a more systematic manner.

The main purpose of this paper is to address this issue and to propose a conceptual framework to analyze the observed developments with a view to exploring some policy implications at a stage in which these countries are preparing for their prospective integration with the euro area.

(2005), Hilbers, Otker-Robe and Pazarbasioglu (2006), Duenwald, Gueorguiev and Schaechter (2005), Backé, Égert and Zumer (2006).

To achieve this, we first use a stylized New Neoclassical Synthesis (NNS) framework, which has been advanced by Goodfriend (2002) and Goodfriend and King (2001). We then discuss the implications of the NNS model for credit dynamics and ensuing monetary policy challenges. Specifically, we emphasize consumption smoothing as an important channel of the observed credit expansion and we show how it is related to and how it affects the monetary policy making in MS and AC. In doing so, we place our discussion in the context of the monetary integration process in general and the nominal convergence process in particular. Against this background, we address some pertinent policy questions regarding the effects of the credit expansion on macroeconomic policies and financial stability.

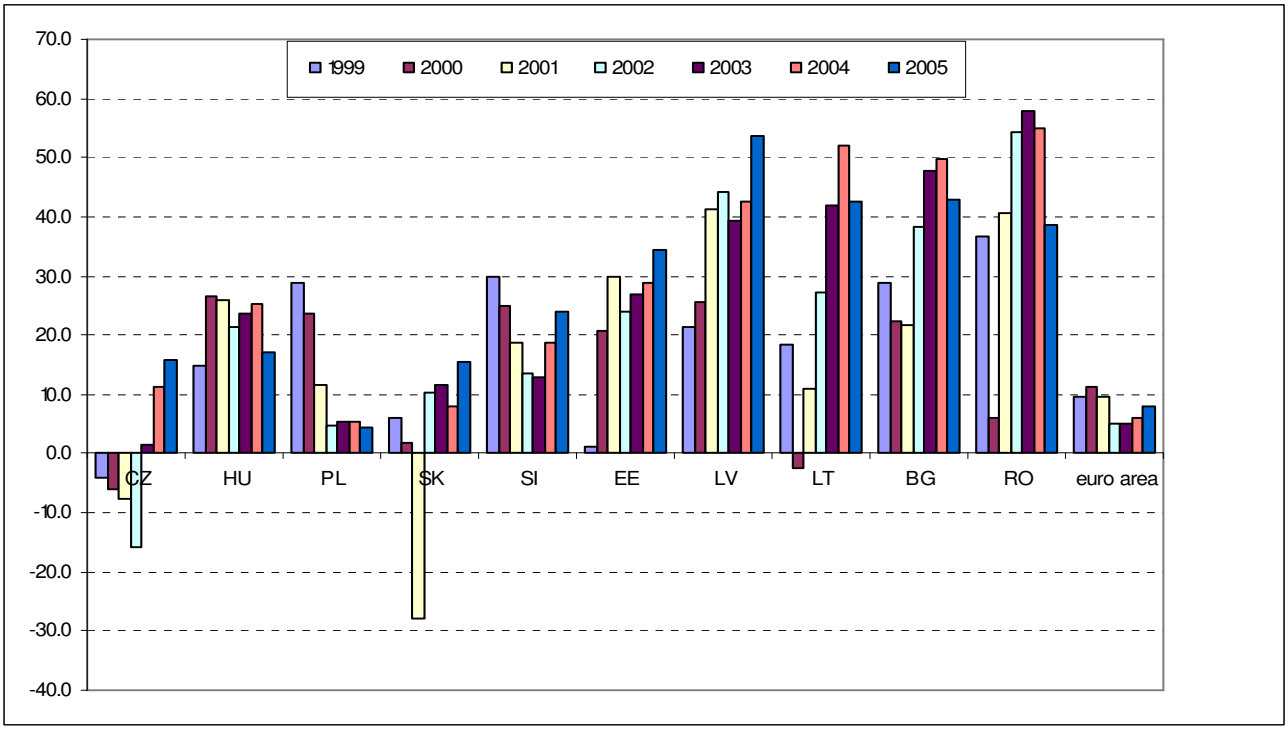
The outline of the reminder of the paper is as follows. The next section sets the scene by presenting the main stylized facts on credit growth in new MS and AC. Section 3 sketches the main features of the NNS framework. Section 4 presents the main insights from the NNS model for credit booms in new MS and AC in their run-up to the euro area. Section 5 contains our discussion of policy implications for MS and AC. Section 6 concludes and suggests avenues for further research.

2. Stylized facts

The key facts about the developments in credit to the private sector in the new MS and in the AC, which will be analyzed in more detail in subsequent sections, can be summarized in three main points. First, in most countries one can observe dynamic growth in credit to the private sector, well above the pace seen in the euro area (see charts 1a and 1b). Nominal growth rates of credit to the private sector (displayed in chart 1a) have been especially high in the Baltic countries, Hungary, Bulgaria and Romania, and to a somewhat lesser extent also in Slovenia. It is noteworthy that the Baltic countries and Bulgaria recorded very high nominal credit growth rates in an environment of low or relatively low inflation, while in Hungary, Slovenia and Romania credit dynamics have to be seen to some extent in the context of higher and only gradually falling inflation, implying less rapid

growth rates of credit in real terms (see chart 1b). In some other countries growth in credit to the private sector has picked up recently (Czech Republic and Slovakia). In Poland, on the other hand, overall growth in credit to the private sector has moderated in recent years from relatively high levels recorded previously. Although growth in credit to the private sector has varied across countries, lending to households, especially for home purchases, has been dynamic in all new MS as well as in the two AC.

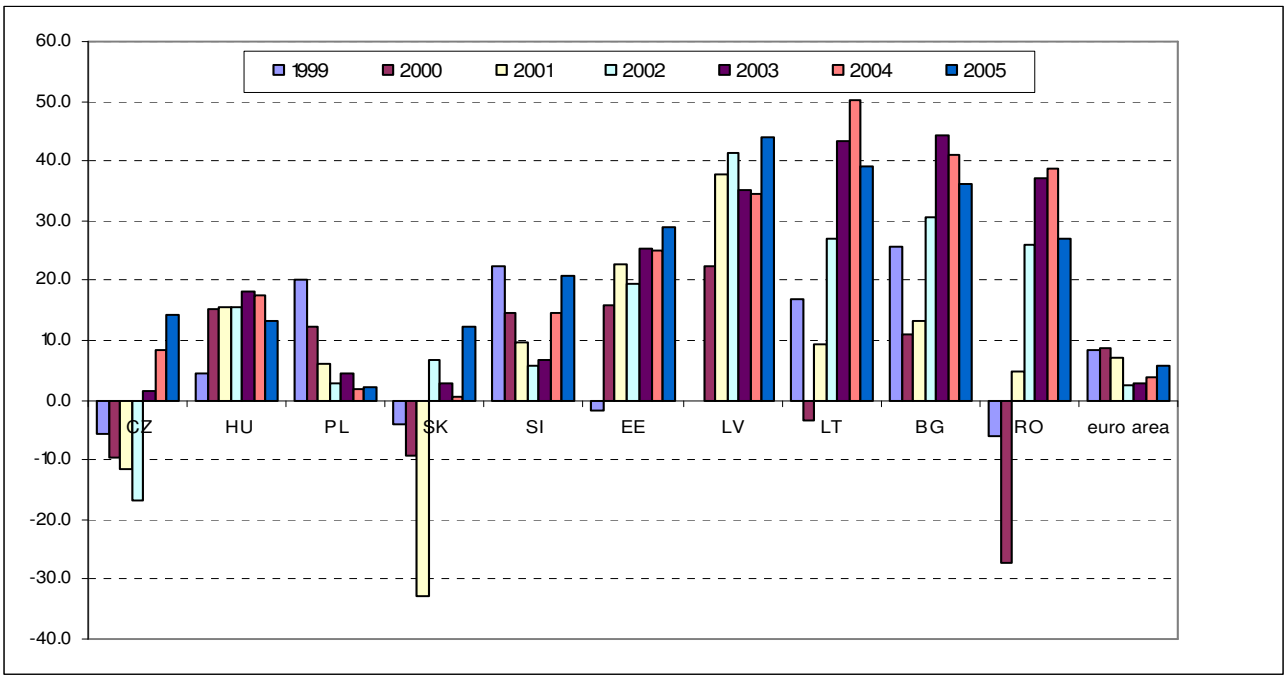
Chart 1a: Credit Growth to the Private Sector, 1999–2005, Average annual changes in nominal terms in %



Note: The contraction in 2001 and 2002 in the Czech Republic and in Slovakia is essentially due to bank rehabilitation measures.

Source: National central banks.

Chart 1b: Credit Growth to the Private Sector, 1999–2005, Average annual changes in real (CPI-deflated) terms in %

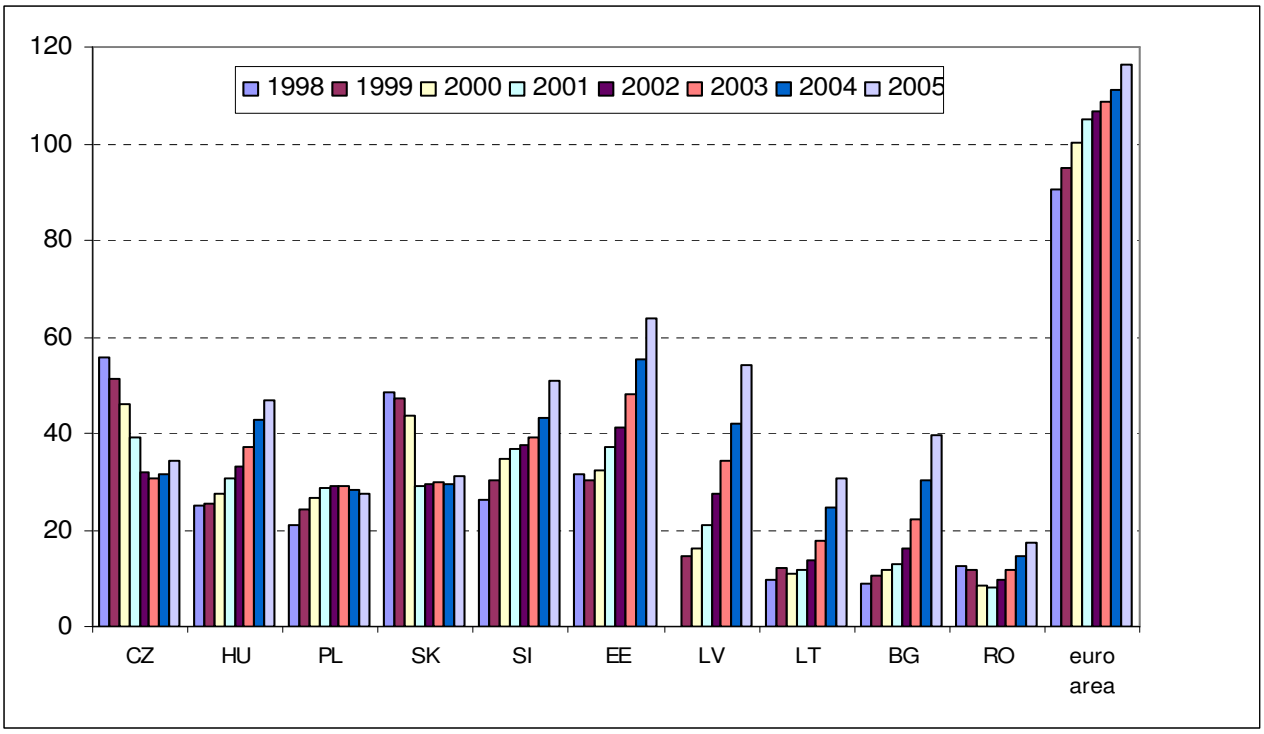


Note: The contraction in 2001 and 2002 in the Czech Republic and in Slovakia is essentially due to bank rehabilitation measures.

Source: National central banks.

Second, credit/GDP ratios have increased (or are beginning to increase) in most new MS and in the AC, while still remaining well below those of the euro area (chart 2). The rise was particularly pronounced in the Baltic countries and in Bulgaria. In Central Europe, the expansion of credit relative to GDP was noticeable in Hungary and Slovenia, while much more moderate in the Czech Republic and in Poland. Slovakia, in turn, has recorded broadly steady credit/GDP ratios, though starting from levels that were above those of the other countries under review.

Chart 2: Private Sector Credit/GDP Ratios, 1999–2005, %.

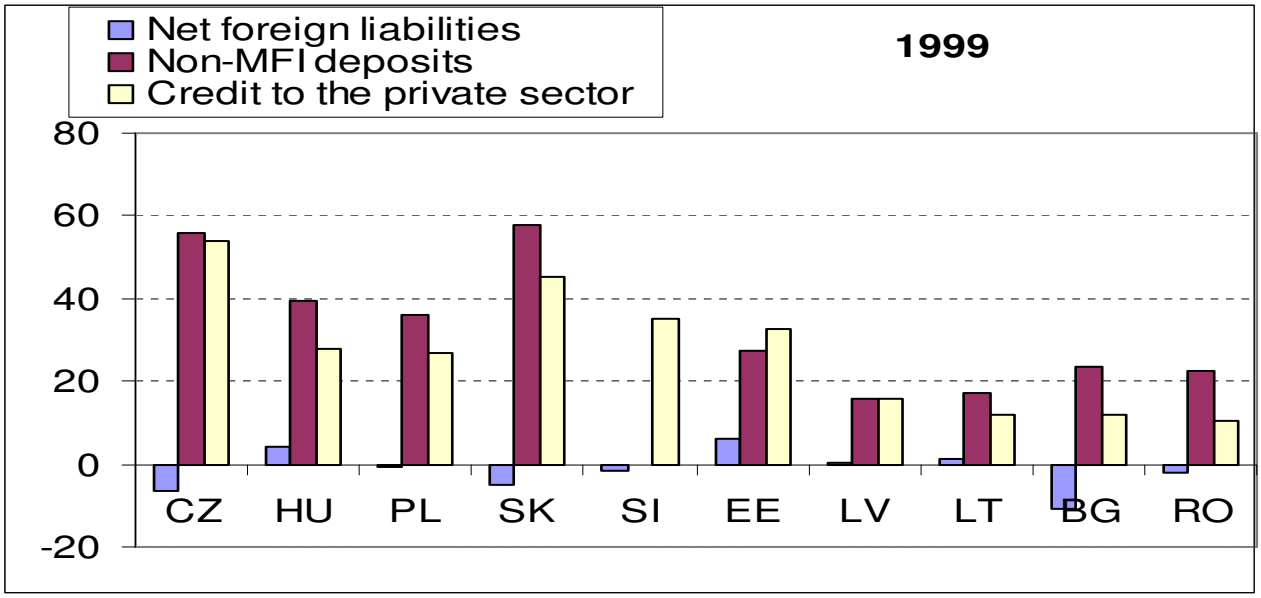


Source: National central banks.

Third, credit expansion in the most of the new MS and AC has been financed by both domestic and foreign sources (see chart 3). While deposits of domestic residents played the main role in funding credit growth until 2001/02 and are still the largest item on the liability side of banks, foreign borrowing has become an increasingly important source of financing the expansion of domestic credit in these countries, particularly in those new MS/AC which have recorded rapid credit dynamics. Whereas the banking systems of most new MS/AC were net lenders to the rest of the world at the beginning of this decade, the net foreign position of banks in those countries that have recorded high and rising credit growth has deteriorated noticeably more recently (as net foreign liabilities increased or net foreign assets turned into net foreign liabilities). Still, net foreign

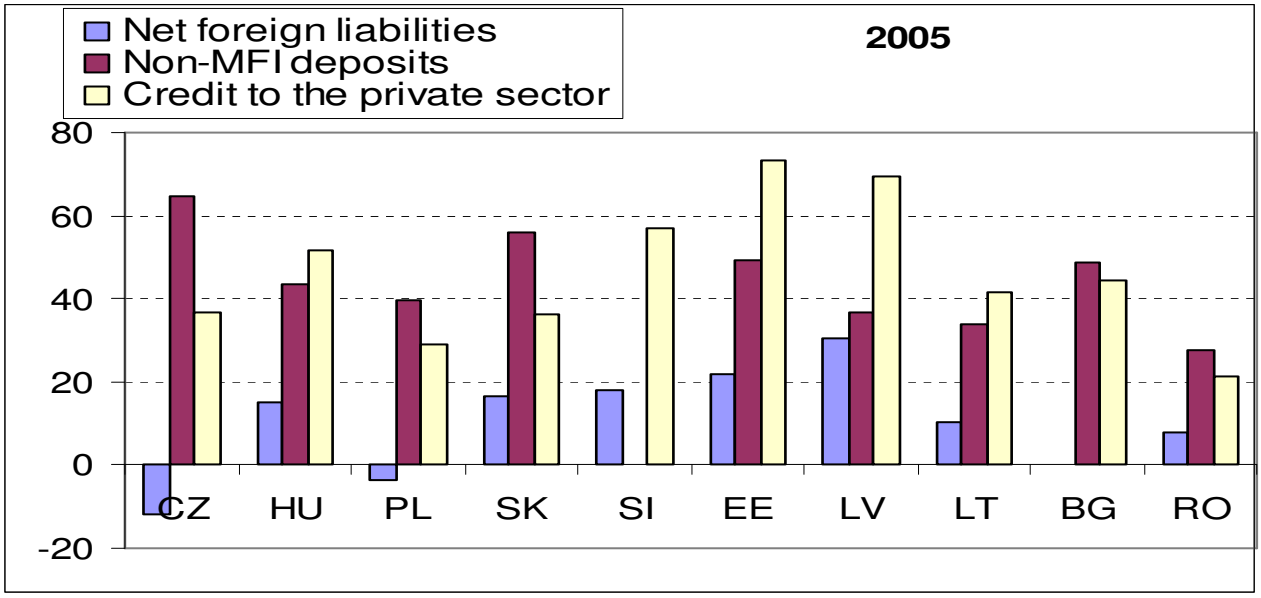
liability positions of CEE banking sectors continue to be moderate; only in Estonia and Latvia have they reached more sizeable levels (of about 22% and 30% of GDP, respectively, at the end of 2005), in part driven by borrowing from foreign parent banks. In Poland and the Czech Republic, where aggregate credit growth has remained moderate, banking systems continue to be net creditors to the rest of the world.

Chart 3a: Selected Banking Sector Assets and Liabilities, 1999, % of GDP.



Source: National central banks.

Chart 3b: Selected Banking Sector Assets and Liabilities, 2005, % of GDP.



Source: National central banks.

Moving now on to a more detailed stocktaking, it is useful to examine developments across countries, sectoral allocation and currency structure of credit to the private sector in the countries under review.

Since 1999, credit growth has been most dynamic in the Baltic countries, Hungary, Slovenia, Bulgaria and Romania. Whereas Estonia, Hungary and Slovenia displayed relatively steady annual average rates of credit expansion throughout the sample period, credit growth accelerated visibly in Latvia (until 2001 and again in 2005), Lithuania (until 2004), Bulgaria (in 2001 03) and Romania (until 2003), i.e. in the countries where credit growth started from the lowest base (relative to GDP),. It is notable that most recently, in 2005, credit growth decelerated in Bulgaria and Romania, while still being buoyant. The annual average growth rates of credit to the private sector differ substantially within these seven countries, ranging – in 2005 – from around 17% in Hungary to about 54% in Latvia.

In the Czech Republic and Slovakia, growth in credit to the private sector picked up more recently after a period of rather moderate or, at times, negative growth before 2004 (Czech Republic) and 2002 (Slovakia). In 2005, credit growth in these two countries amounted to around 10%, while accelerating further to around 15%, respectively, in 2005. It should be noted that in the Czech Republic and Slovakia the interpretation of credit data before 2002 is difficult due to the consolidation of the banking sector and the cleaning of the credit portfolios of selected banks at the time. In any case, banking sector "rehabilitation" facilitated the subsequent acceleration of banks' lending activity in these countries since 2002. In addition, the fact that more dynamic credit expansion took place only recently can be attributed to the cautiousness of banks to finance longer-term capital projects in the business sector and, in the Czech Republic, also to relatively moderate real GDP growth in past years. Moreover, FDI (which also includes credit transactions between affiliated enterprises) has been a particularly important source of financing in these two countries and has thus substituted for bank credit.

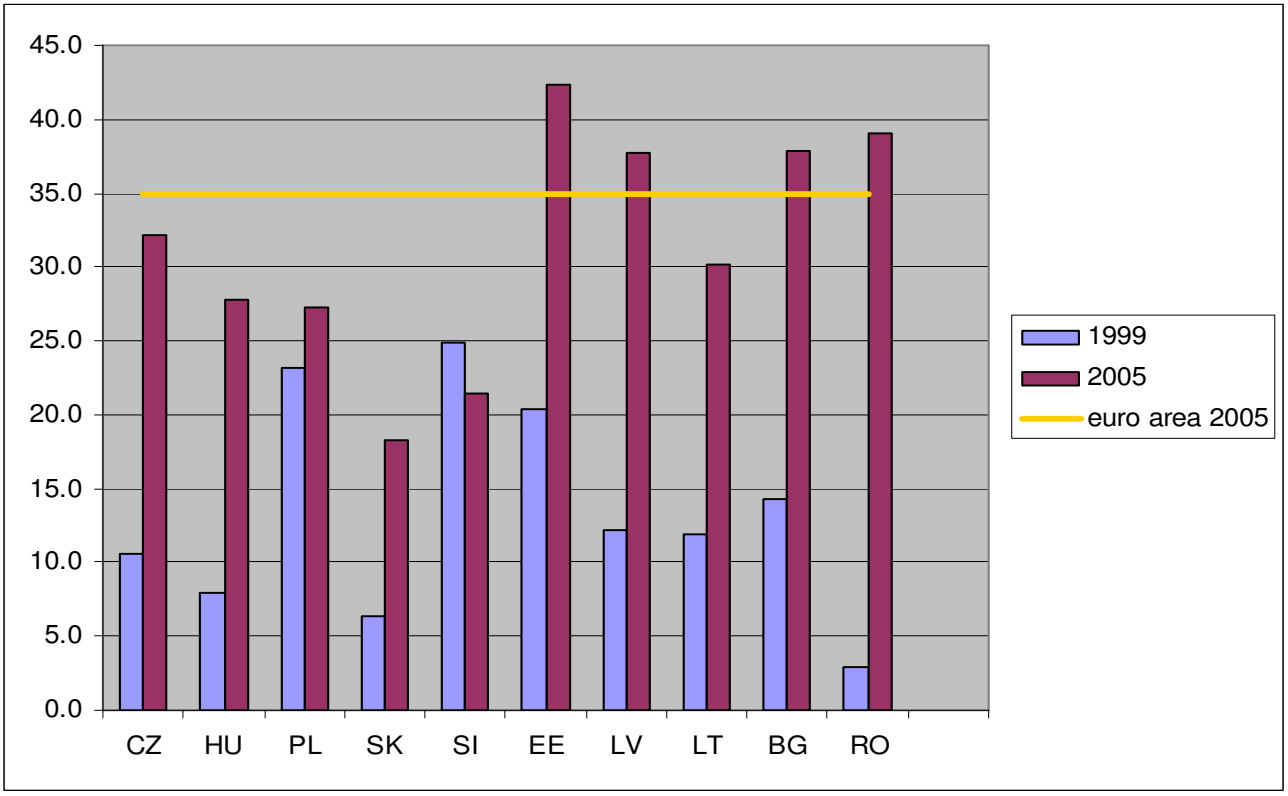
In Poland, lending to the private sector has decelerated from relatively high rates recorded in the period up to the end of 2000, to average annual growth rates of around 5% since 2002. This was related to the economic slowdown and, in particular, the severe contraction of gross fixed capital formation during the earlier years of this decade. In the more recent economic upswing since 2003, the ample profit situation of the enterprise sector has promoted internal financing of corporate sector activities and thus curbed overall credit demand in the economy. Household borrowing in contrast expanded dynamically.

With regard to sectoral allocation, the trend of strong growth of loans to households, primarily mortgage-based housing loans, in general continued in most of the countries throughout the period 1999 to 2005. However, housing loan dynamics have recently started to decelerate in a few countries, reflecting the tightening of mortgage scheme subsidies (Hungary) and base effects after prior spikes in lending (e.g. in Latvia). In Slovakia, on the contrary, commercial banks

adjusted their interest rate policies to offset lower subsidies, which led to a further strengthening of mortgage loans dynamics. In Slovenia, where the credit expansion to the private sector was not strongly based on housing loans, such loans have also begun to pick up considerably more recently. Furthermore, in some countries, consumer loans have also grown dynamically, underpinning buoyant private consumption.

Overall, loans to non-financial corporations have grown at a more measured pace than loans to households, so that the share of household lending in total domestic lending increased considerably in most countries during the period under review (see chart 4).

Chart 4: Share of Household Lending in Total Domestic Lending, 1999 and 2005, %.



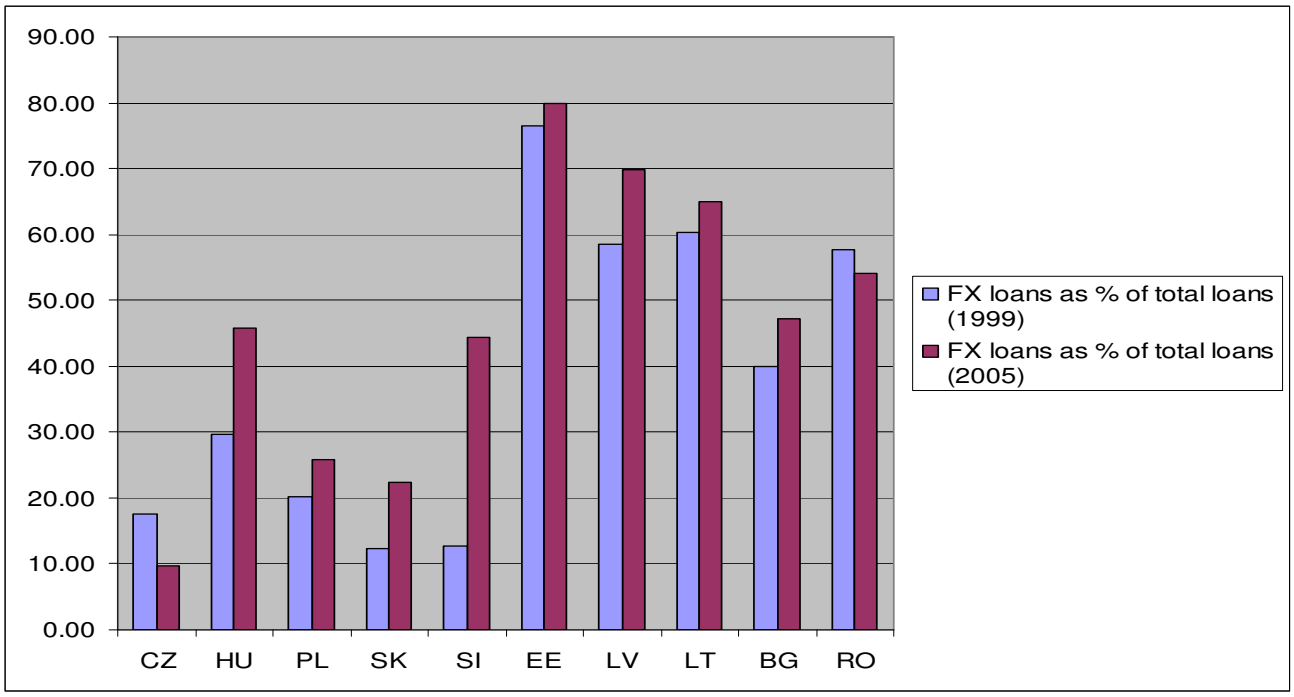
Note: The horizontal line refers to the share of household loans in the euro area.

Source: National central banks.

In terms of the currency structure of lending to the private sector, foreign currency-denominated or foreign currency-indexed loans have had an important share in total private sector

loans in most of the Central and Eastern European new Member States, with their shares ranging in 2005 from 10% in the Czech Republic to 80% in Estonia (see chart 5). It is worth noting that in three of these countries, namely in the Baltic countries, the share of foreign currency-denominated loans is at or above 60% of total loans to the private sector. Furthermore, the shares in these three countries have remained relatively steady between 1999 and 2005, which implies that foreign currency-denominated borrowing had already built up in the Baltics before 1999. Long-standing exchange rate stability and a high degree of foreign ownership in the banking sector may have played a role in these developments. The share of foreign currency-denominated loans is also high and fairly steady in the two acceding countries (around 50%). In the other countries, with the exception of the Czech Republic, the share of foreign currency-denominated borrowing increased over the same period, most notably in Slovenia and in Slovakia, where it tripled or almost doubled, respectively.

Chart 5: Share of Foreign Currency Loans in Total Loans to the Private Sector, 1999 and 2005, %.



Source: National central banks.

Foreign currency-denominated loans in new MS/AC are mainly granted to the non-financial corporate sector, and in some countries, in considerable magnitudes also to households. Such loans are mostly euro-denominated. In most countries under review, the euro and its legacy currencies have played a leading role in foreign currency lending from the outset. In the remaining countries, where the US dollar was preeminent, the euro has gained ground, to different degrees, with the reorientation of exchange rate policy to the single currency. However, in some countries, other currencies, in particular the Swiss franc, have begun to gain importance most recently, also in household borrowing. Foreign currency loans to non-financial corporations represent an important share in total loans outstanding to this sector in all EU countries in Central and Eastern Europe, ranging, at the end of 2005, from around 16% in the Czech Republic to 83% in Estonia, whereas for the household sector the respective shares range from 0.3% in the Czech Republic to 75% in Estonia.

Overall, borrowing in foreign currency has been more extensive in countries with fixed exchange rate regimes, particularly currency board arrangements, as the perceived exchange rate risk is smaller. In addition, in most of the countries borrowing in foreign currency has been associated with lower borrowing costs and supported by progressing financial liberalization. Besides that, a sizeable share of borrowing in foreign currency is generally undertaken by larger multinational firms, for which information asymmetries are lower. Furthermore, foreign-currency borrowing by the corporate sector is frequently used for hedging purposes. Large multinational firms play a prominent role in this respect as well, as the greater part of their revenues is in foreign currency. On the contrary, the rationale for household borrowing in foreign currency is much less clear cut, even where and as long as sizeable interest rate differentials to key currencies still prevail, as it substantially increases their exposure to exchange rate risk, especially for loans denominated in other foreign currencies than the euro.

3. A Sketch of the New Neoclassical Synthesis Model[2]

In this section we present a stylized, benchmark NNS model. In the next section we will discuss the main insights of the model for credit booms in MS and AC in their run-up to the euro area. The model incorporates classical features, such as a real business cycle (RBC) component, and Keynesian features, such as monopolistically competitive firms with sticky prices. In particular, as Goodfriend (2002) demonstrates, the NNS model behaves like the flexible price RBC model on average, but with some possibility for deviations of actual output from potential output in the short run, and thus some room for monetary policy to influence aggregate demand and stabilize employment and inflation. Since the basic structure of this class of models is by now well known, we focus on certain key relationships which are relevant to the key objectives of our paper, leaving a complete account of the model to the appendix.

3.1. Flexible prices: The RBC model

The model is set up for a single country, *i*, and the representative household maximizes consumption subject to a standard budget constraint. With a log utility consumption function, the households´ utility from lifetime consumption is maximized, when the marginal rate of substitution is equal to the marginal rate of transformation:

$$(1+\rho_i)\frac{c_2^i}{c_1^i} = (1+r_i), \qquad 1)$$

where c_1 and c_2 represent the marginal utility from consumption in periods 1 and 2, respectively, *r* is the real interest rate and ρ_i is the subjective discount or time-preference factor (see the appendix for a full discussion).

The household allocates time between leisure and work and the household gets direct utility from leisure and indirectly from earning a wage and using the wage to buy consumption goods[3].

[2] See Goodfriend (2002).

Assuming log utility functions for leisure and consumption it can be demonstrated that the household's willingness to supply labor is a function of household consumption and the real wage:

$$n_i^s = 1 - \frac{c_i}{w_i}, \qquad 2)$$

where n^s denotes labor supply and w is the real wage.

In each country there are assumed to be a large number of monopolistically competitive firms so that each firm can sustain a price above the marginal cost of production. Firms adjust their prices to maintain the profit maximizing markup of price over marginal cost, μ^*, at all times and the profit maximizing markup is invariant to shifts in demand or in the cost of production. With a Cobb Douglas production technology it can be demonstrated that the first order condition for the firm is:

$$\mu_i = \frac{a_i}{w_i}, \qquad 3)$$

where *(1/a)* is the hours of work needed to produce one unit of consumption, w is the real wage *(W/P)*. From expression 3), the equilibrium real wage, w^*, is determined as:

$$w_i^* = \frac{a_i}{\mu_i^*}. \qquad 4)$$

Furthermore, the equilibrium employment, n^*, and the equilibrium output, c^*, in each country can be shown to be determined as:

$$n_i^* = \frac{1}{1+\mu_i^*}, \qquad 5)$$

$$c_i^* = a\frac{1}{1+\mu^*}, \qquad 6)$$

[3] The hourly wage buys w units of consumption and the household values the additional w units of consumption at $u'(c)=1/c$. So, the household ears w/c units of utility by working an hour instead of taking leisure.

Thus, the equilibrium employment n^*, in the flexible price RBC model depends only on the profit maximizing markup μ^* and does not fluctuate with productivity, a[4], whereas output, c^*, grows and fluctuates proportionally with productivity a. By substituting the current and future supply of consumption goods (c_1^* c_2^*) into the optimal lifetime consumption plan 1) an expression for the equilibrium real interest rate may be obtained as:

$$1 + r_i^* = (1 + \rho_i) \frac{a_2^i \frac{1}{1+\mu_i^*}}{a_1^i \frac{1}{1+\mu_i^*}} = (1 + \rho_i) \frac{a_2^i}{a_1^i}. \qquad 7)$$

From expression 7) we see that the equilibrium real interest rate varies directly with the growth of labor productivity, as in standard neoclassical growth theory models. The driving force for this is the existence of the life time consumption plan and the consumption smoothing of a representative agent. For example, when future productivity is expected to be higher than current productivity $(a_1 < a_2)$, households will want to borrow against their brighter future income prospects to bring some consumption forward in time. As they engage in consumption smoothing, households drive up the real interest rate to the point where they are satisfied with the steeply sloped consumption plan that matches the expected growth of productivity. Hence, the real equilibrium interest rate clears the economy-wide goods market by inducing the representative household to spend exactly the amount of its current income; demand matches supply and the economy is in equilibrium with stable inflation.

3.2. Introducing sticky prices: The NNS model

Relaxing the assumption that firms constantly adjust prices to maintain the profit maximizing markup allows aggregate demand to generate short-term fluctuations in employment

[4] The reason is that productivity a affects consumption c and the real wage w proportionally given hours worked n.

and output. If prices are sticky in the short term, a firm decides to change the price of its product to restore the profit maximizing markup only when demand or cost conditions move the actual markup persistently away from the profit maximizing markup. If a firm expects the shock to the markup to be temporary it will not change its price to restore the profit maximizing markup. Given this behavior, one can write the following inflation function:

$$\pi = INF(\mu_1, E\mu_2) + E\pi \qquad 8)$$

where $E\pi$ is the expected rate of inflation, and $INF(\mu_1, E\mu_2)$ is a function indicating the effect of the current and expected future markup on inflation. When the current and expected future markup equal the profit maximizing markup firms adjust their prices in accordance with expected inflation, so $INF(\mu^*, \mu^*) = 0$. Markup compression $(\mu < \mu^*)$ moves actual inflation above expected inflation whereas markup expansion $(\mu > \mu^*)$ moves actual inflation below expected inflation.

Stickiness of prices implies that current employment and output are determined by the aggregate demand for goods. This outcome is central to the new neoclassical synthesis: although firms maintain the profit maximizing markup on average over time, so that the NNS model behaves like the flexible price RBC model on average, there is nonetheless some scope for monetary policy to influence aggregate demand and stabilize employment and inflation in the short-run, if prices are sticky.

3.3. The central bank reaction function

The central bank reaction function in this class of NNS models typically presupposes that there are no constraints to using the nominal interest rate in monetary policy-making. Accordingly, the central bank's policy actions may be described in the following way. The central bank implements monetary policy by steering the short-term nominal interest rate, $\overline{R}$. After making

some simplifying assumptions about expected inflation rate[5] the central bank's nominal interest rate target, $\overline{R}$, translates into a certain target for the real interest rate, $\bar{r}$. Furthermore, the public expects future markups to be at their profit maximizing level, $E(\mu_2) = \mu^*$, and current and future productivity (a_1, a_2) are given by technology and independently of interest policy, so that from 6) expected future household consumption $c_2^* = a_2 \frac{1}{1+\mu^*}$. Hence, using equation 1), one can write the effect of a change in the central bank's interest rate target $\overline{R} = \bar{r}$ on current consumption as:

$$c_1 = \frac{1+\rho}{1+\bar{r}} * a_2 \frac{1}{1+\mu^*} \qquad 9)$$

Expression 9) reveals the way interest rate policy influences aggregate demand: current consumption c_1 is inversely related to the targeted real interest rate, $\bar{r}$, when expected future consumption is anchored at $a_2 \frac{1}{1+\mu^*}$. An increase in the targeted real interest rate depresses current aggregate demand by raising the opportunity cost of current consumption in terms of future consumption. The contraction in aggregate demand is reflected, in turn, in reduced current employment, n_1, a low current real wage, w_1, and an expanded current markup μ_1. Conversely, a cut in the real interest rate target expands current aggregate demand, raises the real wage, and compresses the markup.

3.4. An example of catching-up and the role of central bank

In this section we consider an example of catching-up, in terms of an upward shift in trend productivity growth,[6] in the context of the NNS model and, in particular, consider the central banks reaction to this shock. With such a shock, current and future productivity are related by

[5] See Goodfriend (2002) for more details.

$a_2 = (1+g)a_1$, where g is the trend growth rate and current productivity, a_1, is taken as given. Assuming that the interest rate policy is expected to keep the actual markup at the profit maximizing markup in the future, $\mu_2 = \mu^*$, future income prospects will vary directly with the growth rate, g :

$$y_2 = (1+g)a_1 \frac{1}{1+\mu^*} \ . \qquad 10)$$

Using conditions A2) and A3) and setting $y_1 = c_1$ (current income is demand-determined when prices are sticky), we can solve for current aggregate consumption, c_1, in terms of future income y_2 and the central bank's real interest rate target, $\bar{r}$:

$$c_1 = \frac{1+\rho}{1+\bar{r}} \cdot y_2 \, . \qquad 11)$$

By substituting y_2 from 10) into 11) we see that - holding $\bar{r}$ constant - a household transmits higher future income induced by an increase in trend productivity growth to current consumption, employment and output. In other words, households smooth consumption by borrowing in the credit market as they allocate any expected increase in lifetime resources to both current and future consumption.

From this example we see that a positive shock to trend productivity growth is *inflationary*: an increase in current aggregate demand raises the real wage and compresses the markup due to an increased demand for labor. However, the central bank can stabilize the economy by moving its real interest rate target proportionately with the growth rate, g (and thus real equilibrium interest rate, r^*; substitute $(1+g)a_1$ for a_2 in 7). The higher real interest rate target gives households a disincentive to bring consumption of expected resources forward. In other words, in order to

[6] Although it is possible to use the NNS to analyze a variety of shocks, in this paper we focus only on productivity shocks, as they are the most relevant for our purposes. For more details see Goodfriend (2002).

stabilize the economy the central bank has to contain consumption smoothing by raising its real interest rate target, $\bar{r}$. This result will be central to our subsequent policy analysis.

4. Insights from the NNS model for credit booms in new MS and AC in their run-up to the euro area

In this section we present the main insights of the NNS model that we believe are relevant for the observed credit dynamics in MS and AC. In doing so, we first present the basic set-up. Having done so, we discuss some pertinent issues related to the link between the credit booms and the convergence process in the run-up to the euro area.

4.1. The basic set-up

The NNS model presented above is a one-country model. Therefore, in order to draw some implications of the model for MS and AC consider a simplified case where there are two economies operating along the lines of the NNS model[7]. For practical purposes, think of the euro area as the one, economy *i,* and an MS/AC as the other, economy *j*. Furthermore, suppose that both economies are heterogeneous in terms of two specific aspects (that we observe in practice): i) differences in the trend productivity growth rates and ii) differences in economic size. Specifically, think of the MS/AC as a relatively smaller and catching-up economy. In terms of the NNS modeling, catching-up means that the trend productivity growth rate, g, in the MS/AC, *j*, exceeds that of the euro area, *i*, so that $g_j > g_i$.

Now consider the case where economy *j*, decides to peg its currency to economy *i*. In this case, and assuming no capital controls, the rate of interest in country *j* is pinned down by the uncovered interest rate parity (UIP):

[7] Developing the NNS model into a two-country open economy model would allow making the point in a more rigorous manner and should be the subject of further research.

$$i_j - i_i = E(\Delta e_{t+1} | \Omega_t) + \sigma_t \qquad 12)$$

where i_j is the nominal interest rate in MS/AC (henceforth also referred to as domestic interest rate) and i_i is the nominal interest rate in the euro area (henceforth also refereed to as foreign interest rate), $E(\cdot)$ is the expectation operator, Ω_t is the information available up to period t, e_t is the log of the exchange rate and σ_t is the risk premium. In general, the UIP condition is a vehicle through which the monetary policy in country *i* is transmitted to country *j*: in absence of the risk premium[8], and if exchange rates are fixed for ever, i.e. $E(\Delta e_{t+1} | \Omega_t) = 0$, domestic interest rates are equal to foreign interest rates.

In this model, the euro area wide economy is stabilized as long as the euro area central bank's nominal interest rate target, $\overline{R}_i = i_i = \overline{r}_i$ is consistent with keeping the targeted real interest rate, $\overline{r}_i$, at the equilibrium level, r_i^*[9]. Furthermore, as long as trend growth rates were the same in economy *i* and in economy *j* (and as long as cyclical synchronization is high), UIP would not imply a deviation of interest rates in economy *j* from equilibrium interest rate levels. In this special case, therefore, monetary policy of country *i* would stabilize both economies. However, consider now a case, as we noted earlier, when the small economy, *j*, which has pegged its currency to that of economy *i*, starts to catch-up and households expect an increase of trend productivity growth rate, g, such that $g_j > g_i$. In this case, economy *j* faces a higher equilibrium interest rate that that in the *i* economy, $(1 + r_j^*) > (1 + r_i^*)$ and stabilization of the economy calls for raising the target rate, $\overline{r}_j$, point for point with the increased g, i.e. in proportion to the increase in the growth rate in order to set the real interest rate with the equilibrium rate $(1 + r_j^*) = (1 + \overline{r}_j)$. However, given the UIP

[8] In that stage of our discussion we will disregard the risk component. We will return to this in the next subsection.

[9] Here we treat the euro area economy *en bloc*. Obviously, there is also heterogeneity among members of the euro area that creates its own challenges for stabilization policies in the euro area. This is a specific problem that has been address by various papers, for example in the context of inflation differentials in the euro area (see for example, MacDonald and Wójcik (2006).

condition the actual rate is lower that the equilibrium rate that would be required to stabilize the economy, $\bar{r}_j = \bar{r} < r_J^*$. This gives households an incentive to consume expected future resources, thus fueling lending in economy *j*.

If not kept in check, households will borrow in the credit market in order to smooth consumption which will eventually raise current aggregate demand over current output. An increase in current aggregate demand, if not offset by other policies (in particular fiscal policy), raises the real wage and compresses the markup due to an increased demand for labor. After a sustained mark-up compression firms would decide to change the price of their products to restore the profit maximizing markup which would eventually lead to added inflation pressures (see eq. 8). The eventual price effect will depend on the degree of openness of the economy. With a high degree of openness, the price effect of the credit expansion maybe benign, while it may spill-over onto current account deficits or/and asset price inflation. We will return to this point in subsection 4.3 where we discuss the general consequences of credit expansions.

4.2. Credit booms and the convergence process

The above discussion shows how the constraint on monetary policy deriving from the exchange rate commitment can add extra momentum to lending dynamics in small, catching-up economies such as MS and AC. However, we have so far disregarded the risk premium in the UIP condition. In practice, the MS and AC assets need not be, and indeed typically are not, perfect substitutes with euro area assets: in terms of the UIP condition presented above this implies that $\sigma_t > 0$ and thus $i_j \neq i_i$. The positive risk premium in MS and AC would likely drive up the domestic interest rate somewhat relative to the foreign interest rate level thereby providing some cushion against (or mitigation of) the effects we described in the preceding section. Such a cushion is also likely to play a role in economies with flexible exchange regimes, while in these economies the flexibility of the nominal exchange rate will clearly provide additional leeway for monetary

policy: in this case $E(\Delta e_{t+1}|\Omega_t) \neq 0$ so that the domestic and foreign interest rate can be set more independently.

However, the monetary integration process that MS and AC are or are intended to engage in may in both cases render such cushion less effective, in particular as countries are getting closer to qualifying for euro area entry. Beside the obligation of the exchange rate stabilization within the ERM II system prior to the euro area entry, the process of nominal convergence and in particular the convergence play – i.e. foreign buying of MS and AC assets in the expectation of their revaluation (in foreign-currency terms) through the combination of interest rate convergence and, possibly, an appreciation of MS and AC currencies – may play an important role in this respect. To see this consider a deliberately very simple model of the convergence play that focuses on the aspect of interest rate convergence:

$$i_j^c = \alpha_t(i_i) + (1-\alpha_t)(i_j) \qquad 13)$$

such that,

$$\alpha = f(t)$$

$$\begin{cases} f'(t) > 0, \quad \forall \quad t \in (\bar{t}, T) \\ \alpha = 1, \quad \forall \quad t > T \end{cases} \qquad 14),$$

where, i_j^c is the convergence-play-induced interest rate, i.e. the domestic interest rate targeted by financial markets during the period of the convergence play, i_j denotes the non-convergence play interest rate, i.e. the (unobservable) interest rate that would prevail on the domestic market if there was no convergence play, and i_i denotes the euro area interest rate (the ECB rate), α is the weight assigned by investors to the euro area rate, $\bar{t}$ denotes the date at which the domestic authorities announce their target date for euro area entry, and T, is the euro area entry date.

This simple model implies that once the perspective of euro area entry arises and, in particular, once it becomes more concrete through the announcement of a credible entry target date,[10] forward looking investors will start calculating the domestic nominal interest rate, i_j^c, as a weighted average of i_j and the interest rate that will prevail after joining the euro area, i_i, i.e. the euro area or the ECB short-term nominal interest rate target. Moreover, the weight of the euro area rate assigned by investors in their calculations of the domestic rate will be increasing with the date of the euro adoption approaching, hence $\alpha = f(t)$ and $f'(t) > 0, \quad \forall \quad t \in (\bar{t}, T)$. At the time of the euro area entry, the ECB will take over the monetary policy conduct in new euro area member and hence $\alpha = 1, \quad t > T)$.

Notwithstanding the simplicity of the approach, the presented framework implies that a country striving to join the euro area may face an exogenous fall in the interest rate, i.e. the cost of credit that may add momentum to credit dynamics in that country. In fact, with forward looking investors the domestic interest rate will be converging close to the euro area level already before the final entry date, the T day. In the extreme case, a country may ultimately experience difficulties in fulfilling the entry requirements for the euro area, unless the effects of the nominal convergence (play) are counter-balanced by other policies.

4.3 Is there reason for concern?

Is such credit expansion an essentially benign process that reflects the shift to a new equilibrium or do we see an excessive increase of private sector debt that will eventually require some correction? If it is the former, should policy-makers let the adjustment to the new equilibrium

[10] Of course, the announcement of the target entry date per se is not a sufficient condition for the convergence play to kick in. Clearly, in order to produce the effects discussed above such announcement should be backed up by policies that are conducive to the future adoption of the euro. Otherwise, the announcement will not be credible enough to start the process of convergence play.

work itself through the system, or should they take policy measures to slow rapid credit growth so as to contain vulnerabilities, both as regards financial stability and macroeconomic balance?

On the one hand one can see the lending boom as a natural consequence of the increase in trend productivity growth rate. In terms of the model presented in section 3, it is an optimal response of the representative household. In this case the boom would not necessarily imply any future bust along the way. After all the country's productivity rises and the household can afford to borrow. Furthermore, rising indebtedness of the country can be simply a reflection of financial and goods market integration as the integration process unfolds. As Blanchard and Giavazzi (2002) show, this would lead to a higher equilibrium level of indebtedness. On the other hand, as is known from overlapping generation models, even if individual intertemporal decisions are privately optimal, they can lead to inefficient aggregate outcomes, in particular if an economy is not perfectly open[11]. Furthermore, the benchmark intertemporal models, including the NNS model, typically assume perfect foresight. However, if borrowing decisions are in practice based on overly bullish expectations about future income, lending expansions may eventually become unsustainable and would imply correction. This may be relevant especially in cases where a constrained monetary policy cannot respond to a credit boom and other polices fail to sufficiently do so either. In particular, if the credit boom is not properly kept in check by relevant policies and leads, through the increased aggregate demand, to added inflation pressures, asset prices inflation or unsustainable current account deficits, the situation may become problematic. For example, the excessive asset price inflation may lead to potential misallocation of resources and thus render the household's optimistic expectations about future income incorrect. Large external imbalances that exceed sustainable levels for a prolonged period of time may too pose risk to macroeconomic stability, especially if they contribute to changing market sentiment. A pick up in inflation may pose additional challenges for policy making.

[11] See for a discussion of this point in Blanchard and Giavazzi (2002).

Overall, while credit growth is in general a welcome development as it leads to financial deepening which may eventually support GDP growth in the long-run, there are a number of policy issues that arise in the process and authorities need to remain vigilant. In the next section we present supplementary discussion in this context.

5. Discussion of policy implications for MS and AC

The NNS model presented in section 3 and the more detailed discussion of the model in section 4 highlight the role of monetary policy and interest rates for the dynamics of credit in an economy. Recent studies on the factors driving credit growth in new MS and AC corroborate that falling interest rates certainly are a key factor that has spurred credit growth in Central and Eastern Europe (see e.g. Backé and Zumer (2005)). Declining interest rates in the region are a consequence of macroeconomic stabilization and of financial sector reforms. Banking sectors have been rehabilitated and privatized (mostly to financial institutions with headquarters in the old EU Member States), and competition has greatly increased. In fact, in many countries in the region, foreign banks have aimed at raising market shares, which has further compressed interest rates, in particular on the lending side. Overall, the provision of financial services and the access of the corporate and household sector to finance have greatly improved, while at the same time its costs have substantially fallen. Moreover, successful transformation and the increased integration of new MS and AC in the European Union and international division of labor has raised expectations of faster income growth in the future. Such a setting, in which countries emerge from financial repression and perceptions about future growth increase, is certainly conducive to dynamic financial deepening and, in particular, fast credit growth.

The framework presented in this paper takes the issue a step further. It shows that credible hard peg regimes may well add a further element of stimulus to credit growth, if potential output and productivity growth rates in the pegging country are higher than in the anchor country/area.

This extra stimulus will lead to higher output and inflation volatility and can, in the worst case, result in – potentially very costly – boom-bust cycles, unless other policy areas help offset the impact of low or negative real interest rates on aggregate demand developments. The policy implication for countries with hard peg regimes is to be particularly prudent as regards fiscal policy, banking sector supervision, as well as the smooth functioning of product and labor markets (see e.g. Lipschitz, Lane and Mourmouras (2005)).

Some first empirical findings support the proposition that credit growth in hard peg countries in Central and Eastern Europe has been more dynamic than in the other countries of the region, in the sense that private sector credit/GDP levels the former group of countries (with the exception of Lithuania) have been converging more quickly to their estimated equilibrium levels than this has been the case for countries with more flexible exchange rate policies (see Backé, Égert and Zumer (2006)).

In fact, the interpretation of the NNS model can be generalized to all cases in which a central bank is effectively constrained in using the interest rate as a policy tool. Such constraints may not only emanate from explicit exchange rate commitments. They may also result from a range of other factors, e.g. a limited effectiveness in the interest rate channel of monetary transmission, asymmetries in the exchange rate pass-through, global liquidity conditions and discontinuities in risk premiums and, as we argued in the previous section, the process of interest rate convergence.

The effectiveness of the interest rate channel, in turn, is related to financial depth (which is still comparatively low in some new MS and AC despite the recent credit boom), to the degree of currency substitution in the financial sector (which is high in a number of MS and AC), and to banks' business strategies (the quest for market share has apparently diluted the transmission from money market rates into lending rates in various new MS and AC).

Moreover, in countries with a high degree of currency substitution, monetary policy is more generally constrained, as sizeable changes in exchange rates could have large balance sheet and

wealth effects ("fear of floating"). On the other hand, a flexible exchange rate may reduce the incentives of economic agents to incur currency mismatches in the first place. However, this does not necessarily hold true if agents expect a nominal trend appreciation of their home currencies against foreign currencies (which does seem to be a relatively wide-spread expectation in new MS and AC with more flexible exchange rate policies).

Of course, once the credibility of a fixed exchange rate regime is shattered, financial stability is also at peril in pegging countries, in particular if domestic agents have built up sizeable amounts of unhedged foreign-currency debt in the expectation of a stable nominal exchange rate to the anchor currency.

The pass-through of exchange rate movements to inflation may be faster and more pronounced in case of depreciation than it is in the case of appreciation (see Popa 2006). This constrains interest rate policy, as the interest rate needed to ensure macroeconomic balance may lead to an overshooting of exchange rate appreciation. If the exchange rate pass-through is asymmetric, the subsequent exchange rate correction would have a ratcheting-up effect on inflation.

Global liquidity conditions and discontinuities in the pricing of risk can also infringe on the scope of monetary policy in small open economies. This is particularly so for periods of low interest rates in the world's large economies which are often paired with increases in risk appetite of international financial investors (search for higher yields). In such settings, large capital inflows would thwart any attempt by a central bank to keep interest rates at levels that would ensure macroeconomic balance in catching-up economies, no matter what monetary strategy it follows. Nevertheless, a more flexible exchange rate regime should allow at least provide for some additional margin of maneuver in affecting the monetary stance, given the currency risk premium such a regime involves, even if this risk is substantially under-priced at times.

Finally, it should be pointed out that the NNS model presented in this paper does not take into account the potential costs and effects of exchange rate regime changes. Shifting from a well-

established fixed peg to a more flexible regime may in itself impinge on the credibility of monetary policy and the preparations of a country for monetary integration. It is an open question whether the gains from a degree of monetary autonomy – more precisely, temporary monetary autonomy before the eventual joining of monetary union – would outweigh these potential costs.

5. 6. Conclusions

In this paper we have proposed a conceptual framework to understand the nature and consequences of the recent surge of credit lending, in particular household lending, in new Member States and Acceding Countries. We concentrated on the consumption smoothing as an important channel for the observed phenomenon and we analyzed its relation to and its effects on the monetary policy making. Based on our analysis we discussed some policy implications for MS and AS in the context of their prospective monetary integration with the euro area.

We have shown, in the context of an optimizing model, how productivity shocks may produce credit booms through their effects on the consumption smoothing behavior of economic agents. Furthermore, we have demonstrated how the constraint on monetary policy deriving from an exchange rate commitment can add extra momentum to lending dynamics in small, catching-up economies such as MS and AC, in particular as they are getting closer to qualifying for euro area entry. In doing so, we have emphasized the effects of the convergence play at the threshold of euro adoption.

Although we have not formally modeled them in our paper, our results highlight the importance of other policies, such as fiscal policies and financial market prudential regulation policies, in keeping credit growth in check. This seems particularly important for the new EU Member States and the Acceding Countries which are destined to participate in the euro area alongside with the prospect of a potentially fast catching-up process and a need for further financial deepening of their economies. The link between these policies and monetary policy in catching-up

countries would thus appear to be an important subject for further research possibly using the framework proposed in this paper.

References:

Backé, P., B. Égert and T. Zumer. (2006). Credit growth in Central and Eastern Europe: New (Over)Shooting Stars?, forthcoming in Focus on European Economic Integration, 11 (1).

Backé, P. and T. Zumer. (2005). Developments in Credit to the Private Sector in CEE EU Member States: Emerging from Financial Repression – A Comparative Overview, Focus on European Economic Integration, 10 (2).

Beck, T., R. Levine and N. Loayza. (2000). Finance and the source of growth. Journal of finance and economics 58. 261–300.

Boissay, F., O. Calvo-Gonzalez and T. Kozluk. (2006). Is Lending in Central and Eastern Europe Developing too Fast? Paper presented at the conference "Finance and Consumption Workshop: Consumption and Credit in Countries with Developing Credit Markets", Florence, 16-17 June 2006.

Cottarelli, C., G. Dell'Ariccia, and I. Vladkova-Hollar. (2003). Early Birds, Late Risers, and Sleeping Beauties: Bank Credit Growth to the Private Sector in Central and Eastern Europe and the Balkans, IMF Working Paper WP/03/213

Blanchard O., F. Giavazzi. (2002). "Current Account Deficits in the Euro Area: The End of the Feldstein-Harioca Puzzle", Brooking Papers on Economic Activity (September).

Coricelli, F., F. Mucci and D. Revoltella. (2006). Household Credit in the New Europe: Lending Boom or Sustainable Growth?, CEPR Discussion Papers No. 5520.

Duenwald, C., N. Gueorguiev and A. Schaechter. (2005), Too Much of a Good Thing? Credit Booms in Transition Economies: The Cases of Bulgaria, Romania, and Ukraine. IMF Working Paper No. 128.

Gaurichas, P., R. Valdes and O. Landerretche. (2001). Lending booms: Latin America and the world, Working Paper 8249. NBER, April.

Goodfriend, M. and R. King. (2001). "The Case for Price Stability", NBER Working Paper 8423.

Goodfriend, M. (2002). Monetary Policy in the New Neoclassical Synthesis: A Primer, Federal Reserve Bank of Richmond, July.

Gottfries, N. (2003). Boom and Busts in EMU, Uppsala University Economics Working Paper No. 2003-29.

Hilbers, P., I. Otker-Robe, C. Pazarbasioglu, and G. Johnsen. (2005). "Assessing and Managing Rapid Credit Growth and the Role of Supervisory and Prudential Policies," IMF Working Paper 05/151 (International Monetary Fund).

Hilbers, P., I. Otker-Robe and C. Pazarbasioglu. (2006). Going too Fast? Managing rapid credit growth in Central and Eastern Europe. Finance and Development. 43 (1). March.

IMF. (2004). "Are Credit Booms in Emerging Markets a Concern? In: World Economic Outlook: Advancing Structural Reforms, IMF, Washington D.C., April.

Kiss, G., M. Nagy and B. Vonnák. (2006). Credit Growth in Central and Eastern Europe: Trend, Cycle or Boom? Paper presented at the conference "Finance and Consumption Workshop: Consumption and Credit in Countries with Developing Credit Markets", Florence, 16-17 June.

Lipschitz, L., T. Lane and A. Mourmouras (2005). Real convergence, capital flows, and monetary policy: Notes on the European transition countries, 61-69, in: S. Schadler, ed. (2005). Euro adoption in Central and Eastern Europe: Opportunities and challenges. Washington D.C.: International Monetary Fund.

MacDonald, R. and C. Wójcik. (2006). "Catching-up, Inflation Differentials and Credit Booms in a Heterogeneous Monetary Union: Some Implications for EMU and new EU Member States, CESifo Working Paper 1761, Munich (July).

Popa, C. (2006). Monetary Policy in the Shadow of the Euro. Lecture at the Vienna Institute for Comparative Economic Studies, 31 March, Vienna.

Rajan, R.G. and Zingales L. (2001). Financial systems, industrial structure and growth. Oxford Review of Economic Policy. 17 (4). 461-482.

Terrones, M. and E. Mendoza (2004). Are credit booms in emerging markets a concern? World Economic Outlook, Chapter IV. Washington D.C.: International Monetary Fund. April. 147-166.

Appendix

The New Neoclassical Synthesis Approach: Household and Firm Behaviour.

In this appendix we present the derivation of the key household and firm equilibrium conditions contained in the text. Since the model is symmetric with respect to the home and foreign country we focus here only on the household and firm in country *i.*

Household consumption

Each country contains a representative household which maximizes lifetime utility, $U(C_1, C_2)$, which depends on period consumption levels, C :

$$U^i(C_1^i, C_2^i) = U(C_1^i) + \frac{1}{1+\rho_i} U^i(C_2^i), \qquad \text{A1)}$$

where $U(C_1^i)$ represent utility from consumption in the present period, $U(C_2^i)$ is utility from future consumption, ρ_i is a fixed preference parameter, the subjective discount or time-preference factors and $U^i(C_1^i, C_2^i)$ is therefore the present discounted values of lifetime utility from consumption. The parameters are positive, and measure consumers' impatience to consume. In other words, consumers favor current consumption over future consumption. As usual, we assume that the period utility function $U(C)$ is strictly increasing in consumption and strictly concave: $U`(C) > 0$ and $U``(C) < 0$.

The lifetime budget constraint of each household is given by:

$$C_2^i = -(1+r_i)C_1^i + (1+r_i)(y_1^i + \frac{y_2^i}{(1+r_i)}) \qquad \text{A2)}$$

where y is output (which is assumed perishable and cannot be stored for later consumption), $y_1^i + \frac{y_2^i}{(1+r_i)}$ is the present discounted value of lifetime income prospects of a representative household from the country i , and $(1+r_i)$ represents the "marginal rate of transformation" of future for current consumption. Equation (A2) says that the household's lifetime consumption cannot exceed their lifetime income.

Assuming the utility function has a log form, $U(C) = \log c$, so that $U'(C) = 1/c$, each household's marginal rate of substitution, is given by:

$$\frac{dC_2^i}{dC_1^i} = -(1+\rho_i)\frac{C_2^i}{C_1^i} \qquad \text{A3)}$$

Equation A3) says that the household values current consumption more highly relative to future consumption the more abundant is planned future consumption compared to planned current consumption.

The households´ utility from lifetime consumption is maximized, i.e. the optimal consumption plan is obtained, when the marginal rate of substitution is equal to the marginal rate of transformation:

$$(1+\rho_i)\frac{c_2^i}{c_1^i} = (1+r_i)\,. \qquad \text{A4)}$$

Household Labor supply

Each household's time budget supply is given by:

$$l_i + n_i = 1\,, \qquad \text{A5)}$$

where, l is time allocated to leisure and n is time allocated to work by each household; the amount of time per period is normalized to 1. A household gets direct utility from leisure and indirectly by earning a wage and using the wage to buy consumption goods[12].

Assuming log utility functions for leisure and consumption, the allocation of time in a given period which maximizes the household's utility is that where the marginal utility earned directly from leisure equals the marginal utility earned indirectly by working:

$$\frac{1}{l_i} = \frac{w_i}{c_i}\,. \qquad \text{A6)}$$

Given A5) and A6), household's willingness to supply labor is a function of household consumption and the real wage:

$$n_i^s = 1 - \frac{c_i}{w_i}\,. \qquad \text{A7)}$$

Firms, Employment and Output

In each country there are a large number of monopolistically competitive firms; i.e. each firm is large in its market but small with respect to the whole economy. Firms can sustain a price above the marginal cost of production and adjust their prices to maintain the profit maximizing markup of price over marginal cost, μ^*, at all times. The profit maximizing markup is invariant to shifts in demand or in the cost of production.

[12] The hourly wage buys w units of consumption and the household values the additional w units of consumption at $u'(c)=1/c$. So, the household earns w/c units of utility by working an hour instead of taking leisure.

The production function has a standard Cobb-Douglas form:

$$y = an^{\beta}k^{1-\beta}, \qquad \text{A8)}$$

where *y* denotes output, and *a*, *n* and *k* stand for productivity, labor and capital. For simplicity we assume constant returns to scale and constant capital stock. Furthermore, noting that total output is fully consumed, we can write production of consumption goods *c* in each country as being generated by using only labor input, *n,* according to the following, linear, production technology:

$$c_i = a_i n_i, \qquad \text{A9)}$$

where a_i denotes labor productivity in units of consumption goods produced per hour in each country. Labor productivity fluctuates and grows over time with technological progress.

In each country the firm's markup of price over its marginal cost of production is given by

$$\mu_i = \frac{P_i}{MC_i}, \qquad \text{A10)}$$

where P is the price of a unit of consumption goods, and MC is the marginal cost[13].

Given that *MC* is equal to the nominal wage, *W* times *(1/a)* hours of work needed to produce one unit of consumption, equation A10) can be rearranged as:

$$\mu_i = \frac{a_i}{w_i}, \qquad \text{A11)}$$

where *w* is the real wage *(W/P)*.

If we define the equilibrium real wage as *w** it follows from (A11) in each country is determined as:

$$w_i^* = \frac{a_i}{\mu_i^*}, \qquad \text{A12)}$$

where real wage grows and fluctuates directly with productivity

Equilibrium employment in each country, *n**, is determined by using A9) and A12) to substitute for *c* and *w* in the labor supply function A8). From this we obtain the desired labor supply n^s in each country as:

$$n_i^s = 1 - \frac{a_i n_i}{a \ / \mu_i^*}, \qquad \text{A13)}$$

and equate it to labor utilized by each country's firm *n*, ($n^s = n$),

[13] Note, although this is not crucial for the end results, that P_i and P_j may or may not be necessarily equal in participating countries.

$$n_i^* = \frac{1}{1+\mu_i^*}. \qquad \text{A14)}$$

Equilibrium output c^* in each country is determined from production technology A9) and equilibrium employment A14) as:

$$c_i^* = a\frac{1}{1+\mu^*}, \qquad \text{A15)}$$

where output c^* grows and fluctuates proportionally with productivity a.

CESifo Working Paper Series

(for full list see www.cesifo-group.de)

1772 Alessandro Cigno, Is there a Social Security Tax Wedge?, August 2006

1773 Peter Egger, Simon Loretz, Michael Pfaffermayr and Hannes Winner, Corporate Taxation and Multinational Activity, August 2006

1774 Jeremy S.S. Edwards, Wolfgang Eggert and Alfons J. Weichenrieder, The Measurement of Firm Ownership and its Effect on Managerial Pay, August 2006

1775 Scott Alan Carson and Thomas N. Maloney, Living Standards in Black and White: Evidence from the Heights of Ohio Prison Inmates, 1829 – 1913, August 2006

1776 Richard Schmidtke, Two-Sided Markets with Pecuniary and Participation Externalities, August 2006

1777 Ben J. Heijdra and Jenny E. Ligthart, The Transitional Dynamics of Fiscal Policy in Small Open Economies, August 2006

1778 Jay Pil Choi, How Reasonable is the 'Reasonable' Royalty Rate? Damage Rules and Probabilistic Intellectual Property Rights, August 2006

1779 Ludger Woessmann, Efficiency and Equity of European Education and Training Policies, August 2006

1780 Gregory Ponthiere, Growth, Longevity and Public Policy, August 2006

1781 Laszlo Goerke, Corporate and Personal Income Tax Declarations, August 2006

1782 Florian Englmaier, Pablo Guillén, Loreto Llorente, Sander Onderstal and Rupert Sausgruber, The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions, August 2006

1783 Adam S. Posen and Daniel Popov Gould, Has EMU had any Impact on the Degree of Wage Restraint?, August 2006

1784 Paolo M. Panteghini, A Simple Explanation for the Unfavorable Tax Treatment of Investment Costs, August 2006

1785 Alan J. Auerbach, Why have Corporate Tax Revenues Declined? Another Look, August 2006

1786 Hideshi Itoh and Hodaka Morita, Formal Contracts, Relational Contracts, and the Holdup Problem, August 2006

1787 Rafael Lalive and Alejandra Cattaneo, Social Interactions and Schooling Decisions, August 2006

1788 George Kapetanios, M. Hashem Pesaran and Takashi Yamagata, Panels with Nonstationary Multifactor Error Structures, August 2006

1789 Torben M. Andersen, Increasing Longevity and Social Security Reforms, August 2006

1790 John Whalley, Recent Regional Agreements: Why so many, why so much Variance in Form, why Coming so fast, and where are they Headed?, August 2006

1791 Sebastian G. Kessing and Kai A. Konrad, Time Consistency and Bureaucratic Budget Competition, August 2006

1792 Bertil Holmlund, Qian Liu and Oskar Nordström Skans, Mind the Gap? Estimating the Effects of Postponing Higher Education, August 2006

1793 Peter Birch Sørensen, Can Capital Income Taxes Survive? And Should They?, August 2006

1794 Michael Kosfeld, Akira Okada and Arno Riedl, Institution Formation in Public Goods Games, September 2006

1795 Marcel Gérard, Reforming the Taxation of Multijurisdictional Enterprises in Europe, a Tentative Appraisal, September 2006

1796 Louis Eeckhoudt, Béatrice Rey and Harris Schlesinger, A Good Sign for Multivariate Risk Taking, September 2006

1797 Dominique M. Gross and Nicolas Schmitt, Why do Low- and High-Skill Workers Migrate? Flow Evidence from France, September 2006

1798 Dan Bernhardt, Stefan Krasa and Mattias Polborn, Political Polarization and the Electoral Effects of Media Bias, September 2006

1799 Pierre Pestieau and Motohiro Sato, Estate Taxation with Both Accidental and Planned Bequests, September 2006

1800 Øystein Foros and Hans Jarle Kind, Do Slotting Allowances Harm Retail Competition?, September 2006

1801 Tobias Lindhe and Jan Södersten, The Equity Trap, the Cost of Capital and the Firm's Growth Path, September 2006

1802 Wolfgang Buchholz, Richard Cornes and Wolfgang Peters, Existence, Uniqueness and Some Comparative Statics for Ratio- and Lindahl Equilibria: New Wine in Old Bottles, September 2006

1803 Jan Schnellenbach, Lars P. Feld and Christoph Schaltegger, The Impact of Referendums on the Centralisation of Public Goods Provision: A Political Economy Approach, September 2006

1804 David-Jan Jansen and Jakob de Haan, Does ECB Communication Help in Predicting its Interest Rate Decisions?, September 2006

1805 Jerome L. Stein, United States Current Account Deficits: A Stochastic Optimal Control Analysis, September 2006

1806 Friedrich Schneider, Shadow Economies and Corruption all over the World: What do we really Know?, September 2006

1807 Joerg Lingens and Klaus Waelde, Pareto-Improving Unemployment Policies, September 2006

1808 Axel Dreher, Jan-Egbert Sturm and James Raymond Vreeland, Does Membership on the UN Security Council Influence IMF Decisions? Evidence from Panel Data, September 2006

1809 Prabir De, Regional Trade in Northeast Asia: Why do Trade Costs Matter?, September 2006

1810 Antonis Adam and Thomas Moutos, A Politico-Economic Analysis of Minimum Wages and Wage Subsidies, September 2006

1811 Guglielmo Maria Caporale and Christoph Hanck, Cointegration Tests of PPP: Do they also Exhibit Erratic Behaviour?, September 2006

1812 Robert S. Chirinko and Hisham Foad, Noise vs. News in Equity Returns, September 2006

1813 Oliver Huelsewig, Eric Mayer and Timo Wollmershaeuser, Bank Behavior and the Cost Channel of Monetary Transmission, September 2006

1814 Michael S. Michael, Are Migration Policies that Induce Skilled (Unskilled) Migration Beneficial (Harmful) for the Host Country?, September 2006

1815 Eytan Sheshinski, Optimum Commodity Taxation in Pooling Equilibria, October 2006

1816 Gottfried Haber and Reinhard Neck, Sustainability of Austrian Public Debt: A Political Economy Perspective, October 2006

1817 Thiess Buettner, Michael Overesch, Ulrich Schreiber and Georg Wamser, The Impact of Thin-Capitalization Rules on Multinationals' Financing and Investment Decisions, October 2006

1818 Eric O'N. Fisher and Sharon L. May, Relativity in Trade Theory: Towards a Solution to the Mystery of Missing Trade, October 2006

1819 Junichi Minagawa and Thorsten Upmann, Labor Supply and the Demand for Child Care: An Intertemporal Approach, October 2006

1820 Jan K. Brueckner and Raquel Girvin, Airport Noise Regulation, Airline Service Quality, and Social Welfare, October 2006

1821 Sijbren Cnossen, Alcohol Taxation and Regulation in the European Union, October 2006

1822 Frederick van der Ploeg, Sustainable Social Spending in a Greying Economy with Stagnant Public Services: Baumol's Cost Disease Revisited, October 2006

1823 Steven Brakman, Harry Garretsen and Charles van Marrewijk, Cross-Border Mergers & Acquisitions: The Facts as a Guide for International Economics, October 2006

1824 J. Atsu Amegashie, A Psychological Game with Interdependent Preference Types, October 2006

1825 Kurt R. Brekke, Ingrid Koenigbauer and Odd Rune Straume, Reference Pricing of Pharmaceuticals, October 2006

1826 Sean Holly, M. Hashem Pesaran and Takashi Yamagata, A Spatio-Temporal Model of House Prices in the US, October 2006

1827 Margarita Katsimi and Thomas Moutos, Inequality and the US Import Demand Function, October 2006

1828 Eytan Sheshinski, Longevity and Aggregate Savings, October 2006

1829 Momi Dahan and Udi Nisan, Low Take-up Rates: The Role of Information, October 2006

1830 Dieter Urban, Multilateral Investment Agreement in a Political Equilibrium, October 2006

1831 Jan Bouckaert and Hans Degryse, Opt In Versus Opt Out: A Free-Entry Analysis of Privacy Policies, October 2006

1832 Wolfram F. Richter, Taxing Human Capital Efficiently: The Double Dividend of Taxing Non-qualified Labour more Heavily than Qualified Labour, October 2006

1833 Alberto Chong and Mark Gradstein, Who's Afraid of Foreign Aid? The Donors' Perspective, October 2006

1834 Dirk Schindler, Optimal Income Taxation with a Risky Asset – The Triple Income Tax, October 2006

1835 Andy Snell and Jonathan P. Thomas, Labour Contracts, Equal Treatment and Wage-Unemployment Dynamics, October 2006

1836 Peter Backé and Cezary Wójcik, Catching-up and Credit Booms in Central and Eastern European EU Member States and Acceding Countries: An Interpretation within the New Neoclassical Synthesis Framework, October 2006