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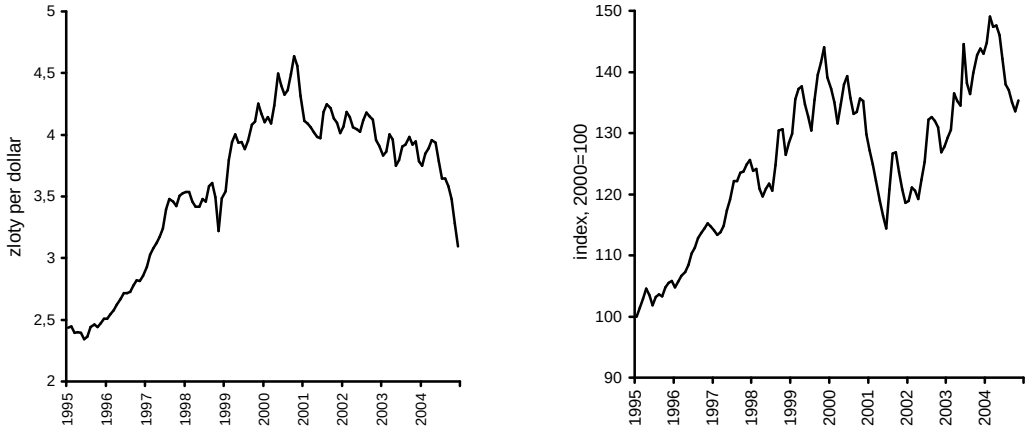
MACROECONOMIC EFFECTS OF THE STRONG ZLOTY

Introduction. A steep appreciation of the Polish *zloty* in 2003—04 raises concerns about its possible macroeconomic effects, such as economic slowdown, speculative capital flows, or worsening of the trade balance, leading to an abrupt downward exchange rate adjustment. On the other hand, strengthening of the *zloty* may reflect sustainable convergence towards the purchasing power parity (PPP), intertemporal optimization of private and public consumption, portfolio adjustment, or the Balassa—Samuelson effect[1]. The exchange rate effects are dependent upon the aggregate supply and demand mechanisms, as well as upon market expectations about a contemporaneous trend — permanent or transitory. Based on the Poland's data, this paper examines how macroeconomic dynamics is affected by different exchange rate components. First, permanent and transitory changes in the exchange rate are analyzed within the framework of a simple AD—AS model with rational expectations. Second, effects of the permanent and transitory components in the Polish exchange rate upon industrial output growth and producer price inflation (PPI), as well as upon exports and imports, are empirically studied with the use of the Kalman filter.

Effects of the strong zloty. Between mid-2001 and end-2004, the *zloty* appreciated by 28 percent in respect to the U.S. dollar and above 20 percent in respect to the basket of world currencies (Figure 1). The general wisdom is that the appreciation of Polish *zloty* may hamper exports and economic growth (Rachtan 2004, s. 24; Stasik 2004, s. 40; World Outlook 2004, p. 41). However, pessimistic assessments of the strong *zloty* as a factor behind slower growth and higher unemployment in 2001—03 may be misleading (Płowiec 2004, s. 151). The IMF experts agree that the export sector has served as engine of Poland's economic growth in

[1] According to the Balassa—Samuelson theory, relative prices of non-traded and traded goods in each country are inversely related to the relative productivity in the two sectors. Higher inflation in the non-traded goods sector and/or the exchange rate appreciation are the instrumental factors behind the Balassa—Samuelson effect.

2003—04, but cast doubt at the loss of competitiveness claims on the ground that stronger *zloty* may reflect the Balassa—Samuelson effect (Murgasowa 2004, p. 4—31). However, there are arguments in favor of the reversed Balassa—Samuelson effect, assuming higher productivity growth in the non-traded goods sector as a result of substantial foreign direct investments (Gots-Kozierkiewicz 2004, s. 317). Capital inflows used to be a substantial source of exchange rate appreciation (Sławinski 2004, s. 178). Inflationary pass-through appears to be weak. Contemporaneous changes in the exchange rate determine about 22 percent of inflation over a year period, and this relationship is weakening comparing with the mid-1990s (Choueiri 2004, p. 39—53).



a) a nominal exchange rate; b) a nominal effective exchange rate (NEER);

Figure 1. Exchange rate in Poland, 1995—2004

Source: IMF's International Financial Statistics

The lack of inflationary pass-through can be interpreted as the sign of actual exchange rate being close to the equilibrium trend. As of the end of 2001 the *zloty* was assumed to be slightly undervalued, with 10 to 12 percent of undervaluation in 2002 (Gots-Kozierkiewicz 2004, s. 328), which is not difficult to be explained by a local depreciation of a NEER (Figure 1b). Subsequent appreciation of the *zloty* in 2003—04 is not likely to bring about the exchange rate misalignment. Based on such fundamental factors, as the current account and foreign debt, empirical calculations point to the equilibrium exchange rate in the range between 4,20 and 4,38 zloty per euro. Calculations by the National Bank of Poland (NBP) assume the threshold profitable exchange rate for exporters at 4,2 zloty per euro (Stasik 2004,

s. 40). It is much telling that at the beginning of 2004 no one of the Polish experts predicted appreciation of the local currency above 3,8 zloty per dollar (Misiak 2004, s. 12). Despite substantial undervaluation in order of 1,8 times in respect to the PPP in 2000—04, speculative factors may cause a sudden reverse in the exchange rate trend, as it had happened recently in Hungary (Sławinski 2004, s. 178).

Widespread 'fear' about the strong *zloty* and pessimistic assessment of the PPP convergence set ground for the assessment of present appreciation of the *zloty* as a transitory phenomenon, which may be easily overturn because of a decrease in the net capital inflows or discreet NBP policies aimed at the support of exporters. Study of the permanent and transitory components of the exchange rate is interesting for the policy implications of strong *zloty*.

Theoretical framework. In order to illustrate effects of transitory and permanent components of the exchange rate, an open economy extension of the familiar AD—AS model with rational expectations is used:

$$y = s_1(m_t - E_{t-1}p_t) - s_2E_{t-1}(e_t + p_t^* - p_t) + u_t, \quad (1)$$

$$y = a_1(m_t - E_t i_{t+1}) + a_2E_t(e_{t+1} + p_{t+1}^* - p_{t+1}) - a_3r_t + v_t, \quad (2)$$

$$i_t = \gamma p_t + (1-\gamma)(e_t + p_t^*), \quad (3)$$

$$r_t = r_t^* + E_t e_{t+1} - e_t - (E_t i_{t+1} - i_t), \quad (4)$$

$$e_t = \rho e_{t-1} + \varepsilon_t, \quad (5)$$

where y_t is domestic real output (income), m_t is the money supply, e_t is the exchange rate (i.e., the domestic currency price of foreign currency), ε_t is the transitory component of the exchange rate, p_t and p_t^* are domestic and foreign prices, r_t and r_t^* are domestic and foreign interest rates, i_t is the aggregate price level, u_t is a term reflecting productivity changes in period t, with $u_t \approx N(0, \sigma_u^2)$, v_t is a stochastic demand disturbance, $v_t \approx N(0, \sigma_v^2)$. All variables, except of r and r^*, are expressed in logarithms. E_t and E_{t-1} are the expectation operators, denoting expectations made in the periods t and t-1, respectively.

The assumption that exchange rate expectations are determined rationally had become standard as early as in the beginning of 1990s (Papell 1992, p. 382).The model is kept deliberately small to easy the computational burden. Despite its size, the model (1)—(5)

embodies the key features of the transmission mechanism. Equation (1) describes the aggregate supply function, assuming the financial constraint in the real sector. Output is responsive positively on the amount of real credit (*the financial effect*), and it is negatively related to the relative price (*the price effect*), which can be explained by the dependence on the so-called critical imports. Decisions by producers are based on last period's expectations of relative prices. The productivity term u_t is assumed to affect positively the aggregate supply.

Equation (2) describes aggregate demand for the domestic good as a function of the real money supply (*the wealth effect*), expectations about the relative price (*the price effect*), and the real interest rate. A rise in the foreign price relative to the domestic price increases aggregate demand, as do the real value of money supply and a decline in the real interest rate. An increase in v_t represents a change in preferences that increases current expenditure relative to future expenditure.

Equation (3) defines the aggregate price index as a weighted average of the price of domestic goods and the domestic price of foreign goods, where γ represents the share of domestic goods in the aggregate price index. In equation (4) the interest rate is specified in real terms as the nominal foreign interest rate plus the expected depreciation of the domestic currency, subtracting the expected rate of inflation of the general price index. Finally, in equation (5) the exchange rate is modeled as a composite of permanent and transitory components, i.e. as the sum of an autoregressive component, ρe_{t-1}, in addition to the innovation in period t, ε_t. If the changes in exchange rate are transitory, ρ=0; if they are permanent, ρ=1.

The reduced-form solutions to the system (1)—(5) for the values of output and domestic price level are as follows:

$$y = \bar{y} + \frac{s_1 a_2 + s_2 a_1}{\Delta} m_t - \left[1 - \frac{a_1(1-\gamma)(s_1 - s_2)}{\Delta}\right] p_t^* + \frac{a_3(s_1 - s_2)}{\Delta} r_t^* - \\ - \frac{\rho s_1(a_2 - (1-\gamma)a_1) + s_2((1-\rho)a_2 + (1+(1-\gamma)\rho)a_1)}{\Delta} e_{t-1} + u_t; \quad (6)$$

$$p = \bar{p} + \frac{a_1 - s_1}{\Delta_1} m_t + \frac{s_2 + a_2 - (1-\gamma)a_1}{\Delta} p_t^* - \frac{a_3}{\Delta} r_t^* + \\ + \frac{s_2 + \rho(a_2 - (1-\gamma)a_1)}{\Delta} e_{t-1} + \frac{(1-\gamma)a_1 - \gamma a_3}{a_1 + \gamma a_3} \varepsilon_t - u_t + v_t, \quad (7)$$

where $\Delta = a_1 + a_2 - s_1 + s_2$, $\bar{y}$ and $\bar{p}$ are the equilibrium values of output and domestic price level, respectively.

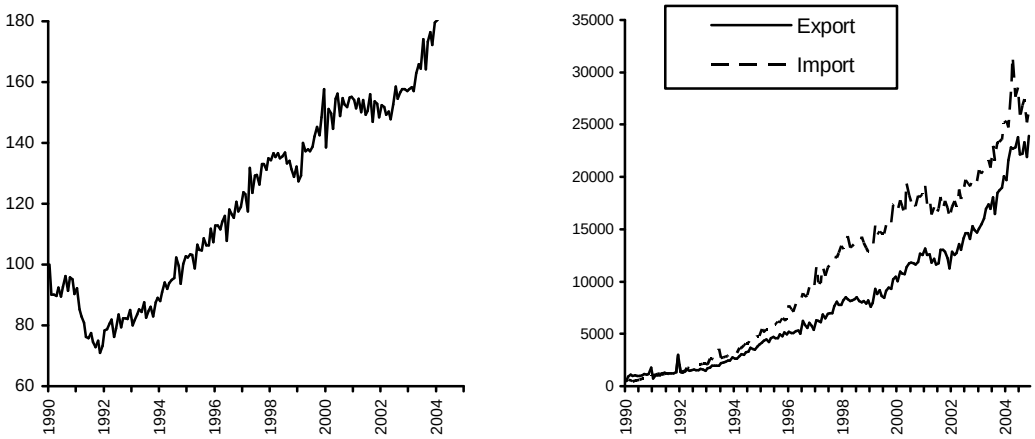
A temporary depreciation of the exchange rate, ε_t, has no effect on output, but causes changes in the domestic price level. Anti-inflationary impact of ε_t is likely to happen under condition of strong interest rate elasticity of the aggregate demand combined with a weak wealth effect, especially if the aggregate price level is determined mainly by the price of domestic goods. An inflationary impact of a permanent change in the exchange rate, e_{t-1}, depends upon the relative strength of the wealth and price effects in the aggregate demand, with the aggregate supply price effect working into a direction of higher domestic price level. Important difference between two components of the exchange rate refers to their effect upon output. Regardless of the impact upon the price level — inflationary or anti-inflationary, a permanent depreciation of the exchange rate brings about a decline in economic growth.

Among other results, the expansionary change in the money supply leads to output growth, while its effect upon the domestic price level is dependent on relative supply and demand effects; if $s_1 > a_1$, a decrease in prices is likely. The effects of the foreign price level are dependent upon structural features. An increase in the foreign interest rate is anti-inflationary, but its effect upon output is determined by the relative strength of finance and price effects in the aggregate supply. Intuitively appealing are pro-growth and anti-inflationary effects of the positive productivity shock. A higher domestic price level is the only consequence of a stochastic demand shock.

Empirical results. Data used in the study are monthly series covering the period of January 1990 to March 2004, and are obtained from the IMF's International Financial Statistics. As it is common in the empirical work, the exchange rate, e_t, is proxied by a nominal effective exchange rate, $neer_t$, as a more general measure of the exchange rate. With respect to y_t and p_t, these variables are proxied with Poland's industrial output, ind_t, and producer price index, ppi_t. The foreign price level and interest rate, p_t^* and r^* respectively, are proxied with the German's consumer price index, $gcpi_t$, and the 6-month London Inter-Bank Offer Rate, $libor_t$. Two other variables used in the estimation are Poland's exports and imports, $export_t$ and $import_t$, respectively. All variables are in log differences. Except for

$neer_t$, $libor_t$, ppi_t and $gcpi_t$, the monthly data are seasonally adjusted by Census X-11. The money supply has net been counted for because of multi-collinearity concerns.

Following a deep slump in 1990—91, Poland's industrial output had been on a steady rise during the 1992—97 period (Figure 2a). World financial turmoil of 1998 had been marked by a local decline in output, but in 1999—2000 upward trend had been restored. Industrial output stagnated in 2001—02, but since the beginning of 2003 a remarkable growth is being observed. Exports and imports follow the shape of industrial output trend, accelerating markedly since 2002 (Figure 2b). However, in the second half of 2004 Poland's exports has been stagnating, while the imports has decreased (in dollar terms).



a) industrial output (index, 1990=100); b) exports and imports (USD mn);

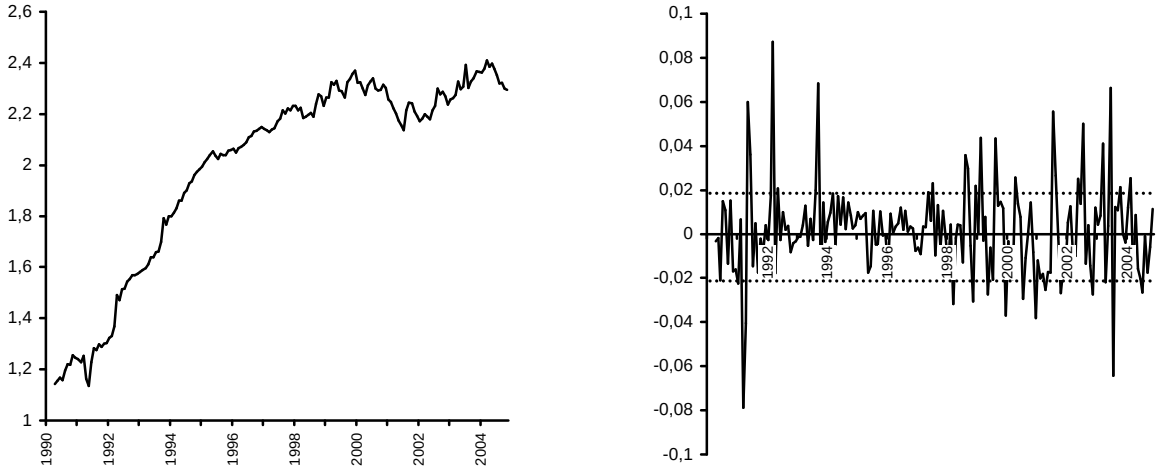
Figure 2. Poland: selected macroeconomic indicators, 1990—2004

Source: IMF's *International Financial Statistics*

The empirical analysis has two components. First, a nominal exchange rate index is decomposed into permanent and transitory components. Second, the effects of permanent and transitory exchange rate shocks are analyzed using the Kalman filter. Attractive feature about the Kalman filtering estimation of the time-varying parameters (TVP) model is that it provides insight into how a rational economic agent would revise his estimates of the coefficients of the model when new information is available, especially under a changing policy regime (Kim and Nelson 1999, p. 433). It is reasonable to assume that the TVP approach is appropriate for the 1990—2004 period, characterized by the transition process and numerous real and nominal shocks.

The decomposition of the time series of $neer_t$ into a permanent component, $neerp_t$, and a temporary component, $neers_t$, was done following the Beveridge—Nelson methodology. The transitory component is calculated as residuals from the ARIMA (1,1,1) model, with the lagged LIBOR as an independent variable, while the permanent component is obtained as a difference between $neer_t$ and $neers_t$. Stochastic properties of $neers_t$ have been tested with two unit root tests. Using augmented Dickey—Fuller and Phillip—Perron tests, the null hypothesis of a unit root can be rejected at the 1 percent level. The ADF statistics is −6,416 (the 1 percent critical value is −3,471) and the PP test statistics is −13,245 (the 1 percent critical value is −3,470). Four lags were used for both tests.

The decomposed exchange rate series are presented in Figure 3. Note that the *neers* series show higher volatility since the beginning of 1998 (Figure 3b). Similar period of the exchange rate instability, but less persistent one, is observed in the 1991—94 period. It is highly plausible that the volatility in exchange rate is attributable to either introduction of a floating exchange rate system in 2000, or real and nominal shocks which are more frequent since 1997. There is little doubt that the Poland's experience supports an international view that exchange rate volatility — either nominal, or real — is dramatically higher under floating rates (Obstfeld and Rogoff 1996, p. 606).



a) the permanent component; b) the transitory component;

Figure 3. Decompositon of the NEER into permanent and transitory components (in logarithms)

Source: IMF's *International Financial Statistics*

The TVP models for joint estimation of industrial output growth and PPI, capturing the main implications of the theoretical analysis, consist of the observation and transition equations:

$$\begin{aligned} ind_t = {} & c_0 + \alpha_{1t} ind_{t-1} + \alpha_{2t} ind_{t-2} + \alpha_{3t} ppi_{t-1} \\ & + \alpha_{4t} neerp_t + \alpha_{5t} neers_t + \alpha_{6t} libor_{t-1} + \omega_{1t} \end{aligned} \tag{8a}$$

$$\begin{aligned} ppi_t = {} & b_0 + \beta_{1t} ppi_{t-1} + \beta_{2t} ind_{t-2} + \beta_{3t} libor_{t-2} \\ & + \beta_{4t} neerp_t + \beta_{5t} neers_t + \omega_{2t} \end{aligned} \tag{8b}$$

and

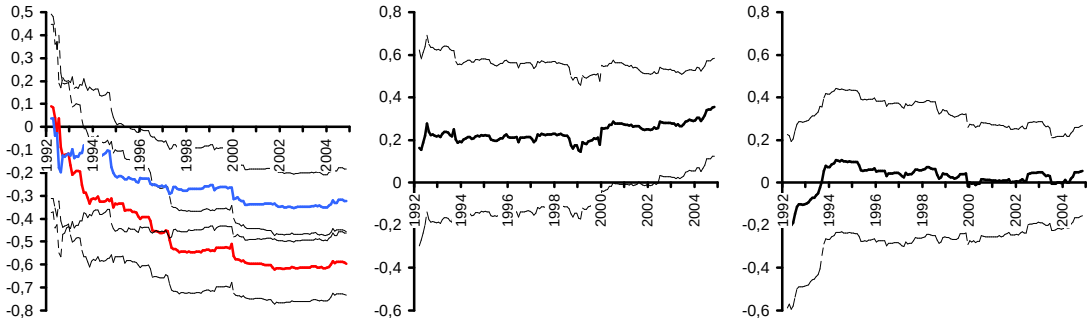
$$\alpha_{it} = \alpha_{it-1} \qquad i = 1,\ldots,6 \tag{9a}$$

$$\beta_{1t} = \beta_{1t-1} + \theta_{1t} \tag{9b}$$

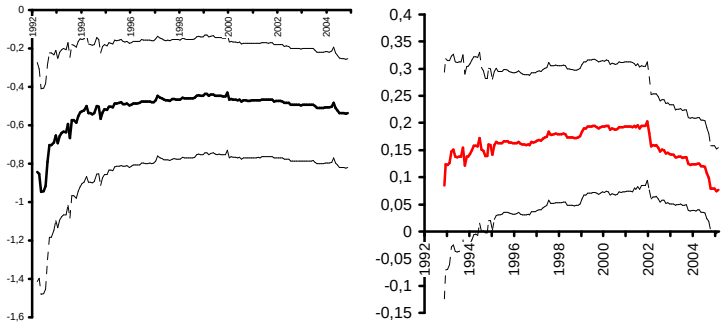
$$\beta_{it} = \beta_{it-1} \qquad i = 2,\ldots,5 \tag{9c}$$

where ω_{1t} and ω_{1t} are the measurement errors, θ_{1t} is the error term. Except of ppi_{t-1}, all time-varying coefficients are modeled as recursive ones. The parameter vector for the PPI autoregressive term is allowed to evolve along a random-walk. TVP experiments had not revealed any impact of the German's CPI or industrial output upon Poland's industrial output, or PPI.

The recursive TVP estimates of the industrial output growth determinants are presented in Figure 4. Coefficients on ind_{t-1} and ind_{t-2} are significantly different from zero with a downward trend to be expected from the autoregressive term in the way of achieving an equilibrium growth rate during the transition process. All coefficients on $neerp_t$ are positive, but they become statistically significant only since the second half of 2002. There appears to be a slight weakening of the expansionary effect in the second half of 1998, hinting on the likely association of this break with the Russian financial crisis, following by an opposite outcome since the beginning of 1999. This result not rules out that during the 1999—2000 period the appreciation of the *zloty* had contributed to the decline in output brought about by a restrictive monetary stance, as argued in Slawinski (2004, p. 178). While the permanent changes in the exchange rate are associated with strong output effects, the transitory depreciation of the exchange rate leaves output unaffected through the whole 1992—2004 period. Both empirical results are consistent with the theoretical analysis, implicating real effects only of permanent exchange rate shocks. Expansionary impact of a permanent depreciation of the *zloty* can be attributed to weak price effects combined with strong wealth and financial effects, as well as a low share of domestic goods in the aggregate price index, $(1-\gamma)a_1 > a_2$.



a) ind_{t-1} and ind_{t-2}; b) $neerp_t$; c) $neers_t$;



d) ppi_{t-1}; e) $libor_{t-1}$;

Figure 4. TVP estimates of the determinants of industrial output growth

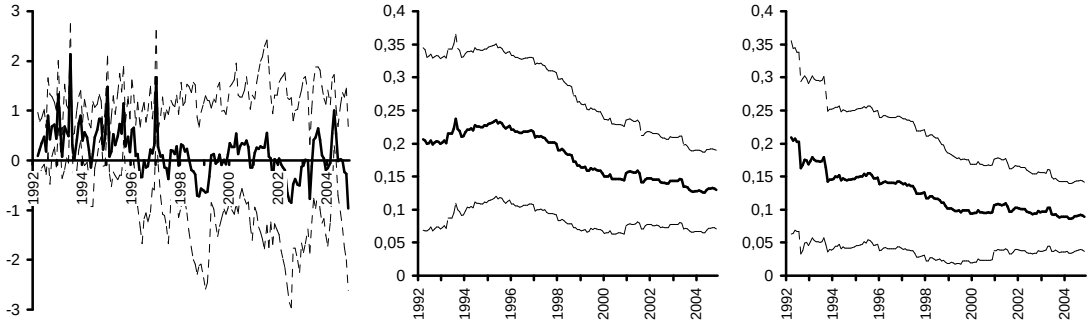
Note: the solid line is the point estimate, while the dotted lines represent a one-standard error confidence band around this point estimate.

Source: personal calculations

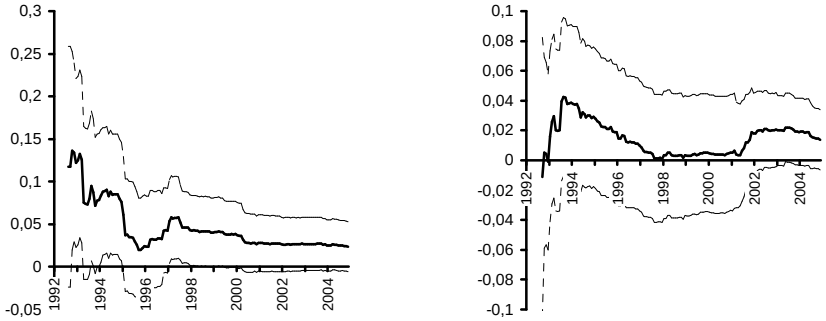
Among other results, industrial output growth is stimulated by a decrease in the PPI and an increase of the lagged LIBOR. Considering the former outcome, the recursive estimates of the coefficients on ppi_{t-1} vary very little, both numerically and statistically, pointing to the relative stability of the lagged price effects. The latter outcome is theoretically consistent under stronger financial effect comparing to the price effect in the aggregate supply, $s_1 > s_2$. The estimates of the coefficient on $libor_{t-1}$ sequence may be indicative of a structural break after November 2001. Since there were not any domestic event specific to the *zloty* around this period, this indication of a change in the trend can be regarded as reflecting external events (for example, the policy shift following the September 11 terrorist act).

Figure 5 shows that either permanent, or transitory depreciations of the exchange rate have a distinct inflationary impact. Although high value of $(1-\gamma)a_1$, as a condition for a

positive impact upon output, at the same time creates anti-inflationary pressure, an increase in the domestic prices may be brought about by a stronger price elasticity of the aggregate supply s_2. A closer examination of expression (6) reveals that a contractionary impact of relative prices upon output is weakened by higher values γ and ρ. Also, a strong financial effect s_1 contributes to an expansionary stance, assuming $(1-\gamma)a_1 > a_2$.



a) ppi_{t-1}; b) $neerp_t$; c) $neers_t$;



d) ind_{t-3}; e) $libor_{t-2}$;

Figure 5. TVP estimates of the determinants of the PPI

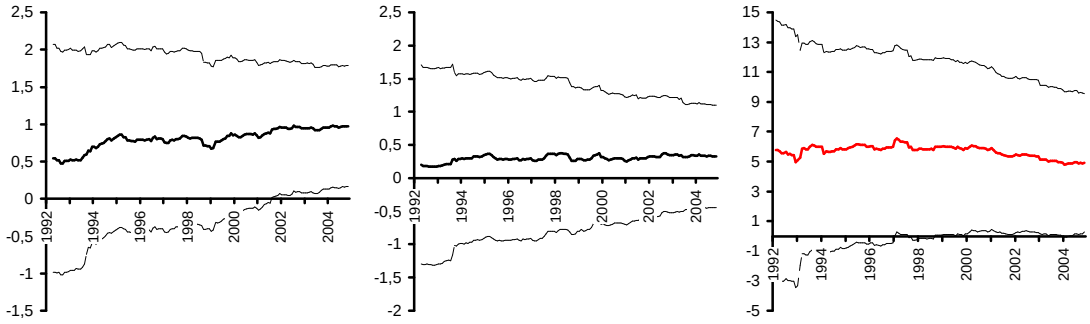
Source: personal calculations

As can be seen from Figure 5a, the estimates of autoregressive PPI term are very close to what should be expected from a random walk process. The results suggest that unstable autoregressive relationship is the primary source of PPI variation. An increase in the values of LIBOR has no any dampening effects upon the PPI, as predicted by our simple AS—AD model. Surely, such an outcome argues in favor of a more complicated interest rate pass-through, demonstrating the need for a richer theoretical framework.

Important extra insights are provided by the effects of exchange rate components in question upon the external sector. Figures 6 and 7 plot the TVP estimates of the individual

coefficients for exports and imports, respectively. In both cases there is a clear upward trend in the absolute value of the coefficients on $neerp_t$, meaning strengthening of a pro-export stance and weakening of an anti-import one. A permanent depreciation of the zloty gains a statistically significant positive impact on exports since the beginning of 2002. However, an ability of a weak zloty to decrease imports had been a case for the 1992—96 period only; since then a permanent depreciation is ineffective as a tool to curb imports. While there is no indication of any export effects caused by a transitory component of the exchange rate, $neers_t$, its impact upon imports follows the pattern of a permanent depreciation.

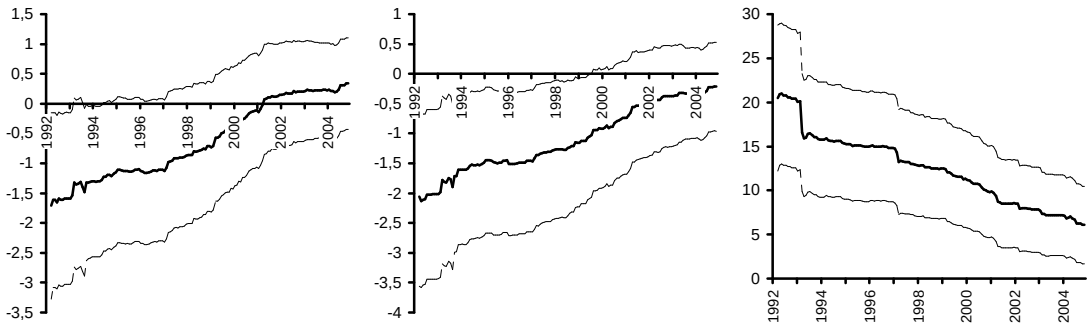
Both outcomes expand the picture of the permanent and transitory exchange rate effects upon industrial output. It is highly plausible to assume that since 2001 the permanent depreciation of the *zloty* promotes industrial output and thus contributes to export growth, while somewhat weakening its inflationary effects. All said, a recent gradual appreciation of the *zloty* should be viewed as a cause of slower industrial output and export growth, while bringing about a decrease in producer prices. However, any benefits of a weak *zloty* in respect to output and exports disappear, if the exchange rate depreciation is perceived temporary. If so, acceleration in inflation becomes the only outcome.



a) $neerp_t$; b) $neers_t$; c) $gcpi_{t-1}$;

Figure 6. TVP estimates of the determinants of exports

Source: personal calculations



a) $neerp_t$; b) $neers_t$; c) $gcpi_{t-2}$;

Figure 7. TVP estimates of the determinants of imports

Source: personal calculations

No surprises as to the effects of German's CPI on both foreign trade indicators. An increase in $gcpi_t$ is to raise either exports, or imports, thus providing with a textbook illustration of contradicting foreign price effects in aggregate demand and supply. While Poland's exports are stimulated by higher prices abroad, the same outcome leads to a higher price tag for imports.

Conclusions. The TVP estimates indicate a positive relationship between a permanent depreciation of the *zloty* and industrial output and export growth rates, both outcomes being a relatively recent phenomenon. Expansionary impact is combined with an increase in the producer price inflation. A transitory depreciation of the *zloty* is neutral in respect to industrial output growth, but retains inflationary impact. Until 2000, a transitory depreciation was quite effective in constraining imports, but since then its impact has become neutral. Our results suggest that producers tend to ignore exchange rate movements that are perceived to be temporary, and respond to permanent changes only. All outcomes are consistent with the predictions of a stochastic open economy AS—AD model. Overall, this theoretical framework can be seen to have performed well when confronted with the data on Poland's economy.

Empirical results confirm popular fears of the strong *zloty* as an outcome behind deceleration of industrial output and export growth rates. Fortunately, any negative effects of the strong *zloty* are being materialized only under a condition that the upward tendency in the exchange rate is credible for the public. If it is perceived as a transitory one, a decrease in the inflation will be the only macroeconomic consequence of the strong *zloty*.

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Prof. dr hab. Viktor Shevchuk. MACROECONOMIC EFFECTS OF THE STRONG ZLOTY

The effects of the permanent and transitory depreciation of the Polish *zloty* upon the dynamics of industrial output and domestic producer price inflation, as well as upon exports and imports, are studied with the use of the Kalman filter. The empirical estimation is based upon the monthly series for the January 1990 — March 2004 period, obtained from the IMF's International Financial Statistics, with the exchange rate proxied by a nominal effective exchange rate. The decomposition of the exchange rate into a permanent component and a temporary component was performed by the ARIMA (1,1,1) model, following a standard Beveridge—Nelson methodology. Empirical results reveal that the permanent depreciation of the *zloty* contributes to either industrial output growth, or an increase in exports, with the transitory depreciation of the *zloty* being neutral to either output, or exports. Positive macroeconomic impact of the weak *zloty* is attributed to its aggregate demand effects, illustrated within a simple AS—AD theoretical model.

Prof. dr hab. Viktor Shevchuk. EFEKTY MAKROEKONOMICZNE SILNEGO ZŁOTEGO

Wpływ permanentnej i przejściowej deprecjacji polskiego *złotego* na temp wzrostu produkcji przemysłowej i inflacje cen producentów, a także na eksport i import, jest studiowany za pomocą filtracji Kalmana. Empiryczne estymacje są przeprowadzone na podstawie miesięcznych danych w okresie od stycznia 1990 r. do marca 2004 r., otrzymanych z IMF's International Financial Statistics. Kurs walutowy był proksymowany za pomocą nominalnego efektywnego kursu walutowego. Dekompozycję kursu walutowego na permanentną i przejściową komponentę przeprowadzona za pomocą modeli ARIMA (1,1,1), jak to proponuje standardowa metodologija Beveridga i Nelsona. Rezultaty empiryczne ujawniają, że permanentna deprecjacja *zlotego* prowadzi do wzrostu tempa produkcji przemysłowej i eksportu, ale żadnego wpływu niema w przypadku deprecjacji *zlotego*, uważanej za przejściową. Pozytywny makroekonomiczny wpływ słabkiego *zlotego* jest związany z jego oddziaływaniem na podaż globalną, jak to przewiduje model teoretyczny AS—AD.