

# From Slowdown to Recovery. Fluctuations of Consumer and Producer Prices. A Case of Poland (1997 - 2004)

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## Abstract

Inflation usually appears when either aggregate demand exceeds aggregate supply or as a result of growing costs of production. There has been observed a strong dependence in Poland between two most common measures of inflation: CPI and PPI. A cointegration analysis shows vividly that there exists a long-run relationship between these two indices, which breaks in the half of 2002. However, according to the supply-demand interpretation, business cycles are a consequence of firms' profits fluctuations and higher values of PPI than CPI should be observed during the recovery period and the opposite should hold during the recession. It turns out that statistical data for Poland confirm this theory. The values of PPI and CPI have deviated from trend since April 2004 as a consequence of Poland integration into the European Union (so called "union effect").

## 1 Introduction

Inflation is defined as the rise in the average price of goods within a certain period of time. Some economists suggest that it is the change in the nominal supply of money, which brings about the offsetting changes in wages and prices.

There are several methods of measuring inflation and its changes. It is The Consumer Price Index (CPI) that is undoubtedly the most popular way of calculating inflation. It plays a major role in Poland as a benchmark according to which The Direct Inflation Targeting<sup>1</sup> is set. There are other indices that estimate inflation, like The Producer Price Index (PPI), the core inflation<sup>2</sup>, the GNP deflator<sup>3</sup>, etc.

Inflation is a macroeconomic phenomenon and is present and observed in almost all countries. There are two main reasons of an increase in the price level, namely: demand-pull inflation and cost-push inflation.

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<sup>1</sup> Direct Inflation Targeting (DIT) is the main target of a monetary policy in Poland. In 2003 MPC drew up "Monetary Policy Strategy Beyond 2003". It introduces a continuous inflation target, according to which the monetary policy is targeted to attain a stable inflation rate at 2.5% (yoy) after 2003 with a permissible volatility band of  $\pm 1$  percentage point.

<sup>2</sup> Core inflation is calculated by NBP. Currently, there are five measures: core inflation excluding controlled prices, "net inflation", trimmed mean, core inflation excluding most volatile prices, core inflation excluding most volatile and fuel prices.

<sup>3</sup> The GNP deflator is not based on any benchmark. It contains information about overall production and its prices.

First situation takes place when production cannot keep up with aggregate demand (for both goods and services). The equilibrium is then reached by an appropriate increase in prices that weakens the aggregate demand. The cost-push inflation goes together with a growth of production costs. In such a case firms tend to shift these effects on consumers, so prices go up.

Another type of inflation has its roots in external trade balance. It appears when a domestic currency becomes cheaper with respect to foreign currencies (so called depreciation), which makes import goods, both production and consumption, more expensive automatically. Its indirect effect is observed by an increase in costs of production. A specific situation occurs when a domestic currency does not deviate from the parity, but foreign currencies increase or decrease their value between each other. Nevertheless, inflation finally goes together with an increase in money supply that exceeds economic growth.

Although an inflation rate is mainly measured with CPI, observing and calculating PPI is also fundamental. The theory of economics states that both indices are positively correlated, i.e. an increase (decrease) in one of them should lead to the growth (decline) of (in) the other index. There are also links in the theory of economics between these two measures and the GDP growth. When we analyse the firms' profits it turns out that they should increase in the recovery period and decline during recession. That is why PPI index should be higher than CPI in the former case and the opposite should hold in the latter situation.

## 2 Theoretical Issues

All price changes stem from processes that take place between supply and demand. In this terms inflation may be considered a "derivative" phenomenon, being a consequence of fluctuations of market mechanisms shown above. Although inflation is classified with respect to its sources, economic models often do not associate it with any particular index.

At the beginning it is useful to quote one example, referring to the Keynes theory and relying on a model description together with conclusions towards PPI. Although this theory does not specify precisely what measure is used in the model, one can easily come to a conclusion that it must be PPI. Factors that stimulate a price growth already appear in a production process, which affects CPI with a lag, whose length is dependent on duration of a production process.

Tapping into the Keynes model leads to discovering relationships between such variables as: product, production size and price. This tendency is shown in the model of aggregate supply<sup>4</sup> [Romer]. According to it, while in the short-run all aggregate demand (AD) shocks may result in real values' changes (product and real wages), in the long run they solely cause an increase in price level. Production prices grow in the first step.

Another economist who analysed the impact of an increase in demand on production prices was Robert Lucas. According to his findings a considerable growth of prices comes from sold production (supply-side) even if there are demand-side stimuli. The Lucas model, extended by the assumption regarding a rate of overall demand<sup>5</sup> growth, shows that product and inflation are positively correlated. Intuitively, a high and unexpected increase in the money supply which makes aggregate demand grow, results in an increase in not only prices, but product as well. This tendency is reflected by the Lucas supply curve.

The Lucas model additionally implies that if the government intends to bring about shocks in real terms (concerning product at a first place), it has to somewhat astonish private agents so that they did not

<sup>4</sup>  $W_t = AP_{t-1}$ ;  $Y_t = f(L_t)$ ;  $F'(\cdot) > 0$ ;  $F''(\cdot) < 0$ ;  $F'(L_t) = W_t/P_t$ ;  $(t-1)$  and  $t$  - consecutive periods; where:  $W$  - nominal wage;  $P$  - price level;  $A > 0$  - constant;  $Y$  - production;  $L$  - labour force;  $F$  - macroeconomic production function.

<sup>5</sup>  $m_t = m_{t-1} + c + u_t$  (small letters denote logarithms of the variables); where:  $M$  - overall aggregate demand;  $C$  - constant;  $U$  - error.

make allowances for the shocks in their expectations. Any portion of policy that is a response to publicly available information - such as interest rates, the unemployment rate, or the index of leading indicators - is irrelevant to the real economy.

Let aggregate demand,  $m$ , be equal  $m^* + v$ <sup>6</sup>. If the government does not pursue activist policy but keeps  $m^*$  constant (or at a steady state), the unobserved shock to aggregate demand in some period is the realisation of  $v$  less the expectation of  $v$  given the available information to private agents. If  $m^*$  is instead a function of public information, individuals can deduce  $m^*$ , and so the situation is unchanged. Thus, systematic policy rules cannot stabilise output [Romer].

One of the economic theories, namely the supply-demand interpretation of business cycles, has also focused on the interactions between producer prices, consumer prices and gross domestic product when analysing business cycles. It states that it is mainly the firm's profit fluctuations that generate cycles [Hubner]. The recovery takes place when profits grow and the recession happens when profits decline. Changes in the profit level stem from both supply and demand factors. If wages increase, it automatically makes the costs of production go up and, moreover, it creates the inflation pressure on the consumer side (it is reflected in CPI)<sup>7</sup>. On the other hand, the revenues rise if, for example, market conditions allow for raising prices of the goods produced by the firms (which is reflected in PPI). In most expansion periods real wages grow more slowly than profits, so CPI should be then greater than PPI one and in most recessions real wages decrease<sup>8</sup> at a lower rate than profits, so the opposite inequality holds. Hence, the relationship between PPI and CPI changes once the recession period ceases and the recovery begins.

### 3 Inflation and GDP Growth in Poland

Intensive research over inflation processes in Poland has been carried out since the beginning of the systematic transformation. In the first step they focused on a high volatility of inflation processes before and after releasing prices in 1989. Next, more attention was drawn to research methods that should succeed in lowering inflation and stabilising prices.

It is demand-pull inflation that has been present in the Polish economy for the last decade. At the beginning, when market economy only arose, it stemmed from equating deficits in various markets, representing a legacy of a command economy. Excluding the year 1999 and the first half of 2000<sup>9</sup>, CPI (yoy) fell gradually until April 2003, when it reached its bottom of 0.3% (yoy). A considerable increase in CPI was observed in May 2004 as a consequence of Poland membership in The European Union<sup>10</sup>. Prices of consumer goods became to grow in response to the excessive demand for them by EU15 members (especially agricultural products, e.g. milk and meat) and because of imposing higher taxes on some goods and services (e.g. construction materials). The "union effect" was clearly observable in case of producer prices. PPI (yoy) grew from 4.9% in March until 7.6% in April due to the fact that firms started to anticipate higher revenues as new markets became open for them.

In years 1997 - 2001 the smoothed real GDP (yoy) index became falling. The index<sup>11</sup> declined from 7.9% in the fourth quarter of 1996 until 0.3% in the fourth quarter of 2001. Although neither nominal nor real GDP faced a decline in absolute terms, the values of (yoy) index show that those five years could be considered the period of recession in Poland. It turns out, that the above period coincides with the time when CPI (yoy) surpassed PPI (yoy). However, starting from July 2002 this tendency was

<sup>6</sup>  $m$  - logarithm of aggregate demand;  $m^*$  - policy variable;  $v$  - disturbance outside the government's control.

<sup>7</sup>  $C=f(W/Y)$ ,  $R/K=g(W/Y)$ ;  $f'(\cdot)>0$ ,  $g'(\cdot)<0$ ; where  $C$  - consumption,  $W$  - wages,  $Y$  - national income,  $R$  - firms' profit,  $K$  - capital; all variables in nominal terms.

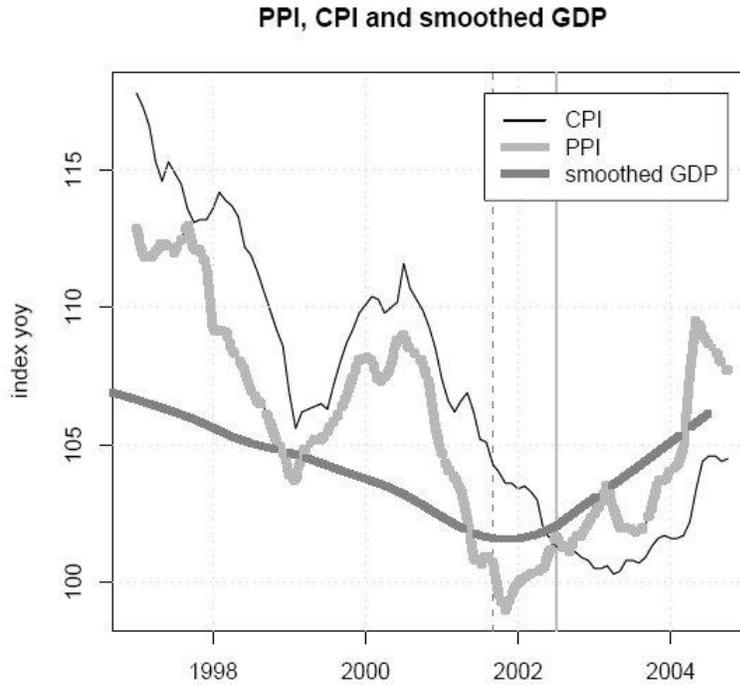
<sup>8</sup> Or increase, depending on the depth of the recession.

<sup>9</sup> At that time CPI went up as a consequence of both the Russian crisis in August 1998 and increase in oil prices.

<sup>10</sup> So called "union effect".

<sup>11</sup> Before smoothing.

reversed and PPI has been greater than CPI until October 2004, which is reflected on chart 1. Thus, simple computations show that during the recession period the consumption demand rose at a higher rate than the firms' profits and this relationship was ceased together with the advent of the recovery. The so called "transition period" last approximately<sup>12</sup> six months. This is consistent with the supply-side interpretation of business cycles.



*Figure 1. The beginning of recovery period coincides with a change of relationship between CPI and PPI.*

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<sup>12</sup> While PPI and CPI are published monthly, GDP data are published quarterly.

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## 4 Modelling CPI vs. PPI

The purpose of modelling is to show that there exists a long-run relationship between PPI and CPI, which is linked with GDP growth. The most appropriate tool here is the cointegration analysis.

Three time series have been chosen: monthly data for PPI (yoy) ranging January 1997 through October 2004 (94 observations), monthly data for CPI (yoy) ranging January 1997 through October 2004 (94 observations) and quarterly data for real GDP growth (yoy) from the first quarter of 1997 until the second quarter of 2004 (30 observations).

### 4.1 Whole Sample

In order to check the levels of integration of both PPI and CPI for the whole sample, the ADF test has been applied:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \gamma_0 Y_{t-1} + \gamma_1 \Delta Y_{t-1}$$

where Y stands for PPI or CPI. Results of the stationarity analysis are summarised in Table 1.

Table 1: *ADF test results for PPI and CPI (whole sample)*

	<i>t-value</i>	<i>critical value 5%</i>	<i>critical value 5%</i>	<i>stationarity</i>
PPI	-1.791	-2.893	-3.502	non-stationary
CPI	-2.107	-2.893	-3.502	non-stationary
$\Delta$ PPI*	-6.169	-3.459	-4.061	stationary
$\Delta$ CPI*	-5.454	-1.944	-2.588	stationary

\* *DW statistics are close to 2 and CIDW statistics are over 1*

As both PPI and CPI turn out to be non-stationary, a cointegration analysis has been done:

$$CPI_t = \alpha_0 + \alpha_1 PPI_t$$

However, although  $\alpha_1$  is statistically significant, the residuals of the model are non-stationary. The ADF statistics is equal -1.722 and at the same time the critical value at 5% significant level amounts to -1.944. The conclusion is that there does not exist a long-run relationship between PPI and CPI from January 1997 until October 2004.

### 4.2 Truncated Sample

The nonexistence of the long-run relationship in the whole sample does not exclude the possibility of such a relationship in a shorter period of time. Chart 2 shows that since July 2002 the relationship between PPI and CPI has been different which is reflected by the change of the slope of a regression line in the cross plot. The value of PPI index has contributed to lower dynamics of consumer prices ever since, so a new long-run relationship has been constituted.

An application of the ADF test once again shows that both PPI and CPI are integrated of degree 1 and the results are presented in Table 2.

Table 2: ADF test results for PPI and CPI (truncated sample)

	<i>t-value</i>	<i>critical value 5%</i>	<i>critical value 5%</i>	<i>stationarity</i>
PPI	-1.163	-1.946	-2.599	non-stationary
CPI	-2.009	-3.480	-4.106	non-stationary
$\Delta$ PPI*	-4.837	-1.946	-2.599	stationary
$\Delta$ CPI*	-5.096	-2.907	-3.534	stationary

\* DW statistics are close to 2 and CIDW statistics are over 1

Contrary to the previous analysis, the residuals of the model:  $CPI_t = \alpha_0 + \alpha_1 PPI_t$  are stationary. The ADF statistics is equal -3.059 and at the same time the critical value at 1% significant level amounts to -2.599. The CIDW is equal 0.278, but this value can be explained with a short time series (less than 100 observations). The cointegration vector is thus equal [1; -1.028].

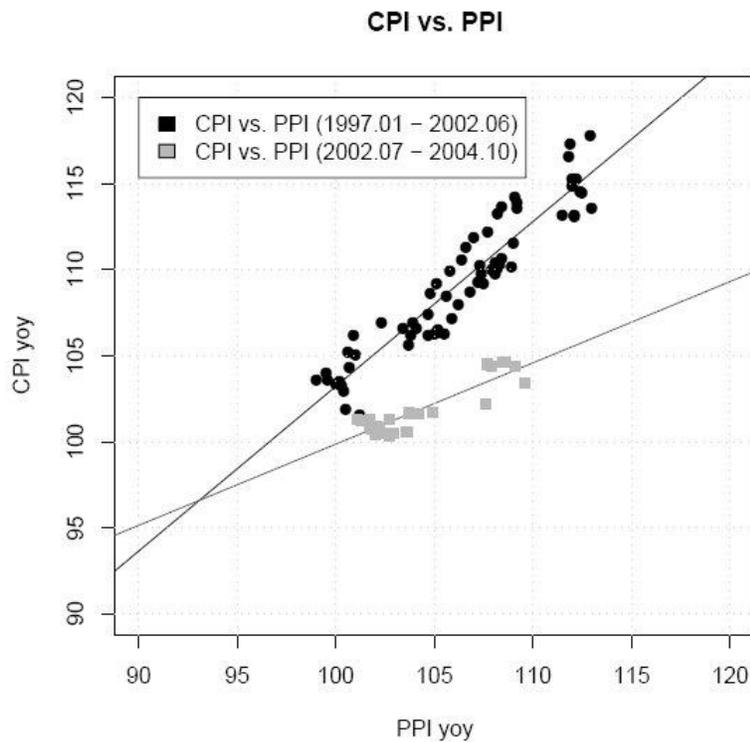


Figure 2. Structural change of relationship between PPI and CPI.

The second period (July 2002 - October 2004) has not been examined in detail for two reasons: a too small sample and the “union effect” that caused deviations from trend in case of both PPI and CPI indices.

## 5 Concluding Remarks

The results of the above cointegration analysis together with statistical data concerning GDP growth in Poland are consistent with the theory of supply-demand interpretation of business cycles. The 6 months' lag that is observed between the beginning of the recovery in Poland (2001/2002) and the time when the relationship between PPI and CPI changes (half of 2002) is a "transition period", when PPI value started to grow in order to exceed CPI value. Further research, aiming at specifying a new long-run equilibrium between PPI and CPI should be carried out in the second half of 2005 when it is possible to estimate the deviations from trend caused by "union effect".

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