Non-accelerating wage inflation rate of unemployment in Poland

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Abstract

The model of wage bargaining constitutes a framework for calculations of NAWRU in Poland. The approach used in the paper let us trace changes of natural unemployment in Poland in the context of structural changes in the economy in the last decade. Moreover, we build the endogenous equilibrium rate into the macroeconomic model of the National Bank of Poland — ECMOD. It allows us to simulate NAWRU behavior after the introduction of economic shocks. Our simulation results shed some light on the channels and speed of adjustment of the modeled economy. Interestingly, we are able to generate certain degree of the unemployment persistence once we allow for the dependence of the level of equilibrium unemployment from the stock of capital, relative prices and fiscal variables.

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1 Introduction

This paper attempts to describe the concept and the evolution of the non-accelerating wage inflation rate of unemployment in Poland in the last ten years, partly for the clear interest of the results and partly to enhance forecasting performance of the macroeconomic model. The non-accelerating wage inflation rate of unemployment can be treated as some approximation of the equilibrium or natural unemployment rate. When unemployment is at its natural level, expectations are confirmed and wages should prevail on their medium or long run track, so that no acceleration or deceleration of wage dynamic takes place. We recognize the difference between two concepts but in the paper we use the term the equilibrium unemployment rate and NAWRU interchangeably.

There are three main approaches to pin down the natural unemployment rate. One of these approaches assumes that the equilibrium unemployment rate follows certain smooth stochastic process. Data on the current unemployment rate are filtered and movements of the variable at lower than cyclical frequency are interpreted as changes in the equilibrium rate thereupon. Second approach pertains to the Philips curve. The curve gives relation between the wage inflation and the unemployment gap (or price inflation and the unemployment gap). NAWRU (or NAIRU) is obtained by estimating the above relation with optional use of supply shift variables and calculating implied unemployment rate corresponding with stable inflation rate. Both methods were used for the determination of the natural unemployment rate in Poland ([11],[19],[23],[27]) leading to comparable results.

Third approach, which is exploited in the paper, concerns the wage curve concept. In contrast to the Philips curve, the wage curve gives the relation between unemployment and the level of wages. The negative relation between level of wages and the unemployment rate is a standard finding of efficiency wage or bargaining models. The unemployment rate in those models abates expected utility when out of job and via this channel the reservation wage. The wage curve was popularized by microeconomic studies of Blanchflower and Oswald ([9],[8],[10]). The authors conducted the analysis of individual wages and the regional unemployment rates for developed countries, confirming an existence of negative correlation between the variables. At the aggregate level, the wage curve is often referred to as a wage-setting relation but we will not distinguish between two concepts as both relate to wage level — unemployment rate negative link.

between the Philips curve and the wage curve specifications do not necessarily exists in economic theory. Additional constraints put on expectations of workers and firms or on the determinants of workers reservation wage let the authors derive the relation between inflation and unemployment gap from the wage curve specification. Further they claim that for the United States the Philips curve and at the same time for European countries the wage curve can give better description of the data because of lower flexibility of the labour market in the latter group of economies.

In the first step, we develop a model of wage bargaining which constitutes a framework for NAWRU calculations. The theoretical model we put forward is a version of McDonald and Solow [24] model. Firms which are price setters bargain with workers over wages and employment level. Following Chamberlin et al. [2] we specify two cointegrating relations describing firms-workers interactions. We interpret the first one as the „price curve” and the second as the „wage curve”. The equilibrium unemployment rate is an unemployment rate consistent with both wage setting and price setting behavior of the agents in the absence of inflation surprises. Therefore the natural unemployment is endogeneous in the described system and results from the interactions of the bargaining and the price and employment decisions of firms.

We distinguish between short run (or medium run) and steady-state NAWRU. Short run NAWRU corresponds with one-period Walrasian equilibrium and is dependant both on institutional and on state variables: labour force, stock of capital, level of total factor productivity, wedge between relative prices. Through those variables the natural rate of unemployment can be affected by the past evolution of unemployment or cyclical up and downturns. Proposed approach to modeling equilibrium unemployment rate accommodates the critique of dichotomy between factors affecting NAWRU und those triggering the current unemployment changes (Bean [3], Blanchard [5], Blanchard and Katz [7], Ball et al. [13]). In the long run, NAWRU converges to its steady-state level. Long run equilibrium unemployment rate alters in line with structural changes in the economy but is resistant to shocks reflected in the medium run in the adjustments of state variables.

The gap between the current unemployment rate and the short run NAWRU (further: NAWRU) takes centre stage in explaining changes in the wage inflation. Its evolution is, therefore, of key interest for monetary policy. Between 1995 and 2005 the natural rate of unemployment evolved in a range of 12%–16%. At the beginning of the period under consideration, NAWRU remained at high level which was noticeable reduced in successive years with an introduction of the reform of the unemployment benefit system in 1997. In 1999 further reforms of the social security system were undertaken. The
bunch of reforms had miscellaneous influence on the equilibrium unemployment rate. Division of social security contribution between employees and employers and strengthening of the link between contributions and benefits could have negatively affected labour cost and thus have favorable influence on NAWRU. But simultaneously introduced changes in the health insurance system which encourage maintaining unemployed status should have shifted the natural unemployment rate upward. Negative foreign demand shock, which decelerated capital accumulation, together with ensuing impact on the labour market of the reforms, raised NAWRU from historical low of around 12% in 1999, back to 16% in 2002. Additional upward pressure on the equilibrium unemployment rate in the period came from an increase of the price wedge: the difference of producer-worker price indexes, which in turn could originate in the apparent rise of the indirect taxation in the preceding years. From 2002 on, the equilibrium unemployment rate was falling, which was coupled mainly with investments acceleration and further restrain of the unemployment benefits system generosity.

Our second move, was to build endogenous NAWRU into core forecasting macroeconomic model of the National Bank of Poland — ECMOD. The model has been originally developed with exogenous equilibrium unemployment rate. Augmented with endogeneous NAWRU the model has been expected to deliver scenarios with more comprehensive supply-side responses to exogenous shocks like fiscal policy or oil price changes. Concurrently with NAWRU’s implementation some other adjustments of the model have been undertaken to assure coherency of different model’s modes with replaced labour market one.

In the next step, we tested how the model with the endogenous equilibrium unemployment rate reacts to different shocks. Introduction of the endogenous NAWRU proved, in point of fact, to enrich the system’s responses foremost to impulses which should affect the potential product of the economy. An interesting finding was material unemployment persistence which could be generated after inducing the modeled economy to adjust. Some channels of hysteretic development of labour market variables have been identified: capital accumulation, economic policy and net foreign assets position of the economy.

In the first part of the article we shortly describe ECMOD model and the rationales for endogenizing NAWRU in the model’s framework. Next we introduce the bargaining model which poses the basis for the specification of estimated relations. Third part includes sketchy characterization of factors which could affect the natural rate of unemployment in Poland throughout the last decade. In the consecutive chapter, we derive both short and long run NAWRU and detail their evolution. Last chapter sums up simulation results.
done with the use the macroeconomic model with the endogenous NAWRU.

2 NAWRU in ECMOD model

The ECMOD model is a forecasting and simulation tool of the National Bank of Poland. It is a hybrid, supply-demand model. Behavioral equations include cointegrating vectors which embody theoretical long run relationships between macroeconomic variables. For more detailed depiction of the model look in [17].

In former version of the model, NAWRU was given exogenously. It should have represented the level of unemployment rate which (by constant labour supply) which restricts potential product of the economy. The deviation of the current from the natural unemployment rate contributed to the output gap. Actually NAWRU affected the price level via two channels: by the presence of the output gap term in an inflation equation and presence of the unemployment gap in a wage equation.

In fact NAWRU was estimated beyond the model and constituted experts’ input for the forecast horizon. What followed, the interactions between the natural unemployment rate and the other macroeconomic variables were limited to one-way dependencies. This modeling approach has motivated apparent questions about integrity of the forecast of the equilibrium unemployment rate and the projections of the remaining economic categories. ECMOD includes all key macroeconomic variables and a relatively complex (in its model category) fiscal module. So, intuitively, changes of some variables present in the model would have an impact on the level of NAWRU, which outcome was neglected in the benchmark model. Not least important, cointegrating relations in ECMOD stand for the long run equilibrium of the economy. In such an equilibrium we should be able to identify some natural unemployment rate. Independent, external estimates of the NAWRU give no guarantee of cohesion between NAWRU and this implicit equilibrium.

These rationales have encouraged us to endogenize NAWRU in the forecasting model framework. It could be expected that the model augmented with the endogenous equilibrium unemployment rate would deliver more coherent scenarios — most of all more accurate scenarios of the economy’s responses to supply side shocks. As a result, it would represent better basis for conducting monetary policy in Poland. On the other hand, mapping out the natural unemployment rate in the ECMOD framework put some constraints on both estimation process and ways of NAWRU formulation. Two conditions have had to be fulfilled: original structure and logic of the model has had to be preserved and the natural unemployment rate be forecastable.
3 Bargaining model

Following Chamberlin, Hall and Hendry’s [15] paper on the wage modeling we refer to the wage bargaining model of McDonald and Solow [4]. McDonald and Solow consider bargaining process over both wages and employment between a union and a firm. The firm maximizes profit as the difference between revenues and labour cost, subject to level of wages and employment:

$$\pi(L) = R(L) - wL,$$

(1)

where $L$ stands for the level of employment, $w$ — wages and $R(L)$ revenues as a function of employment. The objective of the union is to maximize expected utility of its members. If the union has $N$ members and $L$ of them are employed then the expected utility of a representative union member is given by:

$$\frac{L}{N}(U(w) - D) + \left(1 - \frac{L}{N}\right)U(b)$$

(2)

where first part of the expression is the utility from receiving wage $w$ corrected for some fixed disutility of working $D$. $U(b)$ stands for utility from receiving income $b$ when unemployed (we can think of $b$ as unemployment benefits or different forms of support for the low-income households).

The outcome of bargaining will be efficient if one party cannot be better off without infringing the welfare of the other. Efficient combinations of wages and employment can be found in a wage-employment plane as points where slopes of a union indifference curve and a firm’s isoprofit curve are equal. So the efficiency condition for bargaining is:

$$\frac{(U(w) - U(w^*))}{U'(w)} = w - R'(L)$$

(3)

where $w^*$ is a reservation wage rate defined as $U(w^*) = D + U(b)$. Wage rates below $w^*$ does not compensate workers for disutility of holding a job and loosing income $b$ when employed. When wage rate stays close to $w^*$ union members remain indifferent between working and unemployment.

Chamberlin et al. argued that preferences of the union and the employer in the bargaining process should be represented by two separate cointegrating vectors. Namely:

$$w - R'(L) = H,$$

(4)
\[
\frac{(U(w) - U(w^*))}{U'(w)} = H. 
\]  

(5)

\( H \) is a variable which captures relative bargaining power of the firm and the union.

The authors interpret above relations as „labour demand” and „labour supply” equations. We have moved one step further. We treat the first cointegrating vector as a „price curve” constituting „warranted wage” condition. Second cointegrating vector should represent traditional „wage curve” binding wage level with the unemployment rate. Eventually, NAWRU will be laid out as a rate of unemployment for which both conditions (4) and (5) are satisfied.

Our perspective of workers-employers relations assumes that in equilibrium labour market does not clear because of the real wage rigidities on this market and, alternatively, due to frictions on the other markets.

Unemployment rate included into the second cointegrating vector should be a measure of labour market tightness and, at once, a discipline device for workers. The higher is the unemployment rate the stronger are fear (worse fallback position of workers after the job separation) and threat (higher probability that the firm will be able to replace fired workers with some new ones) effects which in turn lead to lower wage pressure of employees.

It is worth emphasizing that modeling wages and NAWRU we directly revoke to the wage curve specification — curve capturing the relation between level of wages and the unemployment rate — rather than to Philips curve specification — curve giving the relation between rate of growth of wages and the unemployment rate.

4 Labour market in Poland

The unemployment rate in Poland stayed between 10%–13% from 1995 until mid 1998. Following the negative foreign demand shock and later economic slowdown from 1999 on, the unemployment rate gradually rose to reach a peak of 20% in 2002. Adjustment of the production structure, linked to the sudden impairment of exports to the Eastern European countries and the growth deceleration, not only raised the current unemployment rate but also revealed institutional weaknesses of Polish labour market. Long-term unemployment sharply increased. Along with cyclical upturn the unemployment rate tumbled to lower levels to be around 17% at the end of the observation period with significantly higher long-term unemployment component than before the slowdown at the beginning of the current decade (Figure 1).
Decomposition of changes in the current unemployment rate into shifts of its cyclical component and of the natural unemployment rate is greatly hampered by the fact that data we have at disposal cover mainly the transformation period. Between 1995 and 2001 we witnessed nearly continuous disinflation — both in prices (Figure 2) and wages (Figure 3). Only beginning from 2002, the wage inflation stabilized at around 4% and started to reflect mostly cyclical changes: declining to below 1% in 2003, bobbing up to over 4% in the EU accession period and coming back to the target in 2005 after the accession growth acceleration faded out. Evolution of wages and unemployment can give us scant intuition about stability of the unemployment gap at the end of the period under consideration and, when we take into account the current unemployment rate correction, temperate fall in NAWRU.

To keep track of equilibrium unemployment rate’s development we take closer look at changes of labour market institutions. Quantitative measures of quality of institutions are scarce but some flagrant shifts in economic policy, which could have bearing on NAWRU, can be still identified.

The unemployment benefits system underwent a number of legislative changes in the first years of the transformation period. An economically relevant amendment to the act on employment and the unemployment prevention has been introduced in 1997. The amendment substantially reduced the generosity of the unemployment benefits system: benefits were differentiated in relation to work experience of individuals, unemployed had to substantiate longer employment period to be eligible for benefit, replacement rate was on average reduced (Figure 4). As a result only in one year the percentage of unemployed who collected unemployment benefits was reduced twofold (Figure 5). The amendment also singled out groups of individuals who lost their unemployed status.

Concurrently with the unemployment benefits system reform, the pre-retirement allowances and benefits program has been introduced. Pre-retirement transfers were targeted at elderly unemployed and together with an increase in the number of retirement pensions granted to people in pre-retirement age contributed to a decline of the activity rate of elderly (which could be observed since 1999). To some extent, those negative effects on the activity rate were compensated by higher restrictiveness of the disability benefits system after 1999, as compared with previous years in the sample period. Reduced pool of labour could transitally reduce both the actual unemployment rate and NAWRU. In 2004 some approach was taken to reduce the generosity of the pre-retirement benefits system (pre-retirement allowances were granted only till 2001), which would eventually lead to partial retreat of withdrawals from the labour market of the elderly.
Some premises exist to consider the social relief system as reinforcing changes in the natural unemployment rate not only through the labour supply channel. It appears that households with at least one unemployed are relatively strongly dependent on benefits from the social support system exclusive of unemployment, retirement and disability benefits (Figure 6). Under social benefits we understand survival benefits, pre-retirement benefits and allowances, child support, family, maternity, parenthood and nursing benefits, rent allowances (and some other benefits of similar character). Eligibility for social benefits is often conditional on the household per capita income and, what follows, transition between unemployment and employment can be coupled with losing the entitlement to that source of comings in. Relevance of social relief benefits for the level of shadow wage could have increased in the period under consideration both due to the effects of the introduction of the amendment to the act on employment and the unemployment prevention and increasing availability and generosity of different types of social support benefits (with representative example of child support benefits).

The third source of income of unemployed, beside unemployment benefits and social relief benefits, which should be considered, is unregistered income. In 1998 circa 25% of the formally unemployed were working in the shadow economy. As a result, income from unofficial activities could in substance affect the reservation wage of unemployed. However, the replacement rates for shadow income (income from the activity in the shadow economy related to the level of wages in official economy corrected for taxes and social contributions) were roughly stable (around 30%) in years for which the corresponding data are available (Figure 7). It indicates that even if the shadow economy income played an important role in determining the level of reservation wage, it was not the crucial source of the equilibrium unemployment changes.

Other factor which is often mentioned in the context of labour market outcomes is the burden of taxation. Leaving the discussion whether taxes or social security contributions can influence employment in the long run till the next chapter, we would like to describe main tendencies in the sample period. Tax wedge — both defined as the effective direct income tax rate plus the effective social security contribution rate only or with the effective indirect tax rates included — remained generally invariant between 1995 and 2005 (Figure 9). At least two important facts could be however overseen when one takes into account only changes in the level of the tax wedge. One of the outcomes of the social insurance system reform in 1999 was the strengthening of interrelation between social security contributions and benefits. Retirement, disability, sick, accident and healthcare contributions were singled out, each guaranteeing different benefits in the event of risk realization. Secondly, the
Onus of social contributions was divided between employers and employees. In the earlier years there was only one social contribution collected only on employers. Those changes could have led to material alternation in the subjective quasi-tax rates. Also launching of defined-contribution retirement system (partly capital funded), which replaced the pay-as-you-go defined benefit one, could get the ground off for greater internalization of the social contribution charges.

The other aspect of the social security system reform were restrictions put on the access of non working population to healthcare insurance. Since 1999 the pool of non working insured have been curtailed to registered unemployed. These changes increased the relative attractiveness of the status of unemployed as compared with the status of non active, which in turn, resulted in the adjustments in the form of higher flows from non active population to unemployment.

These effects: probable increase in the internalization of quasi-tax burden and constraints put on entitlement to public healthcare could be expected to have had contradictory influence on the natural unemployment rate.

Two other phenomena could have had considerable impact on the NAWRU development. In the period considered, the baby boom generation entered the labour market, which corresponded with relatively high unemployment of the young. Through compositional effects, it could have led to a transitional rise in the natural unemployment rate. Secondly, after the EU accession emigration impulses increased sharply leading to a marked outflow of working age population to the European countries. The parallel outcome of lowering the barriers for entering foreign labour markets can be higher expected utility of workers after job separation. Both mentioned labour supply factors were not taken into account in the empirical analysis. The first because of labour homogeneity assumed in the existing model. The second because of the lack of data and theoretical ambiguity of the net direction of influence on NAWRU of the better emigration opportunities.

5 Labour market mode in ECMOD

The cointegration relations corresponding with „price curve” and „wage curve” constitute foundation of the labour market mode in the model. „Price curve” relation enters wage and home prices (GDP deflator) equations. Further, „price curve” stays in correspondence with the long-run relationship describing core inflation and, through the assumed form of production function, with the employment equation. The role of the „price curve” cointegration relation
in the above mentioned behavioral equations reflects interrelation of pricing, employment and wage decisions of firms. All those are based on profit maximization. Estimated cointegration vector derived from first order condition for profit maximization has a form:

\[
\text{wage}_n + \text{glt}_\text{corp}_\text{tr} - \text{gdp} + \text{emp}_\text{na} - (1 + \theta_1)\text{pgdp} + \theta_1\text{imp}^* - \theta_2(1 - d99q1) - \theta_0.
\] (6)

Variables are in logarithms and their full description is given at the end of the article. The relation is corrected with dummy for grossing up of wages in 1999. The objective for including dummy into estimated long-run relation was twofold. Average wage time series was corrected for years 1995–1998 using theoretical rate of social contributions. In case the adjustment which was carried out infringed comparability of time series in two subsamples (before and after 1999) we wanted to control for the effect of possible shift in the relation. Secondly dummy was expected to capture any realized spillovers from introduction of the reform of social insurance system.

Rearranging (6) we get the relationship between home prices (GDP deflator), import prices and unit the labour cost:

\[
\text{pgdp} - \alpha_1\text{ulc}_\text{na} - (1 - \alpha_1)\text{imp}^* + \alpha_2(1 - d99q1) + \alpha_0.
\] (7)

The long run equation (7) is similar to the cointegration relation present in the model hitherto apart from other unit labour cost definition (which includes among others social insurance contribution effective rate) and presence of the dummy.

The „wage curve” cointegration vector is based on the relation between the aspiration real net wage of employees and their shadow wage. The real net wage is represented by average wage deflated with CPI, corrected for social security contributions and direct taxes. Among variables which affect bargaining position of workers we included: the unemployment rate, the unemployment benefit replacement rate, the social relief replacement rate and a dummy which controls for unemployment support reform in 1997. Some other variables were taken into consideration in the process of estimation: the minimum wage, demographic variables, variables controlling for the reform of the social insurance system. However performance of regressions including those variables was disappointing. Ultimately „wage curve” pecification has a form:
\[\text{wage}_n - \text{glt}_\text{emp}_\text{tr} - \text{glt}_\text{hc}_\text{tr} - \text{cpi} - 1.47\text{tfp} + \beta_1 \text{unemp} - \beta_2 \text{rp\_benefit} - \beta_3 \text{rp\_relief} - \beta_4 (1 - d97q1) - \beta_0. \] (8)

Both in (7) and (8) the unit direct elasticity of wages to social contribution rate and personal direct tax rate has been assumed. The calibration of tax and quasi-tax burden elasticities, which we conducted, was second-best solution. Clearly the best one would be estimation of respective parameters. That was however impeded by low variability of social insurance and tax rates. Supposedly pass-through of tax and social burden to wages is in the long run higher and as a result increasing fiscal charges on wages of the employed are less detriment for the labour market than we have accepted in the paper. Irrelevance theorem does not hold even if direct elasticities of wages are equal. Retirement, disability, sick and accident insurance contribution rates enter both replacement rates when direct tax rate and healthcare insurance contributions enter only social relief replacement rate. In the effect, responses of wages and employment to changes in various tax and social contributions rates are expected to be different.

Including TFP in the „wage curve” manifest the proposition that workers when negotiating wages take into account labour productivity changes. Although no consensus has been worked out yet, whether and how rising productivity enters shadow wage researchers usually include productivity term into wage curve mostly for practical reasons: it asserts absence of trend in the equilibrium unemployment rate. The parameter which precedes TFP has been calibrated on the basis of the elasticity of GDP to labour input \(\alpha\) in Cobb-Douglas production function and is equal to \(\alpha^{-1}\).

To estimate (7) and (8) we implemented cointegration techniques and imposed necessary restrictions on cointegrating vectors. One additional restriction on elasticity of wages to social relief replacement rate has been placed on second cointegration vector. Namely we assumed that the elasticity of wages to the social relief replacement rate is one third of the elasticity of wages to the unemployment benefit replacement rate. The restriction curtails the strength of the effect of the average relief changes on wages and NAWRU. The average social relief time series is calculated on the basis of the ministry’s of finance financial statements and includes all forms of public support for households apart from retirement, disability and unemployment benefits (total expenditures on social relief are divided by non-active working age population). In the previous chapter we indicated that social relief has been important source of income for households with at least one unemployed person. The empirical fact constituted the main rationale for including social relief replacement rate.
in the „wage curve”. Nevertheless, the average social relief time series we used does not need to closely correspond with the average social benefit granted to non-working recipients mostly because of its aggregate nature.\(^1\) The more so, it does not necessarily rightly reflect the actual level of the average social relief reaching households of unemployed which is of our interest. The other problem was inability to distinguish between benefits which influence either duration or occurrence of unemployment and those who deactivate the recipients. What follows we have expected stronger impulse from changes in the average social relief to the activity rate and labour supply than to wages (and through this channel to the unemployment rate). Both quality of the time series and economic role of social relief benefits have made it desirable to avoid too strong the responses of wages and the NAWRU to changes in the social relief replacement rate.

Short-run employment and wage equations are given below:

\[
\Delta emp_{na_t} = 0.74 \Delta aktyw_t - 0.06 (gdp_{t-1} - 0.68 emp_{t-1} - 32 k_{t-1} \\
- 1.48 + tfp_{hp_{t-1}}) + 0.26 \Delta emp_{t-1} + 0.02 alm_{p_{t-1}} + \\
+ 0.31 (\Delta gdp_{t-1} - \Delta tfp_{hp_{t-1}}/0.68) + dummies, \\
R^2 = 0.68, \quad DW = 2.00, \quad (9)
\]

\(^1\)In contrast to the average unemployment benefit time series for which we were able to contrast time series calculated on the basis of aggregate data with actual level of average unemployment benefit no such possibility persisted in the case of the average social relief time series.
\[
\Delta \text{wage}_{nt} = 0.29 \Delta \text{wage}_{n(t-1)} + 0.28 \Delta \text{wage}_{n(t-2)} + 0.43\Delta \text{cpi}_{t-1} - \\
0.10 \left( \text{wage}_{n(t-1)} + \text{glt}_{corp.tr}_{t-1} - \text{gdp}_{t-1} + \text{emp}_{nt-1} - 1.45\text{pgdp}_{t-1} + 0.45\text{imp}^*_{t-1} - \\
+ 0.07(1 - d97q1) - 4.87 \right) - 0.05 \left( \text{wage}_{n(t-1)} - \text{cpi}_{t-1} + \text{emp}_{nt-1} - 1.45\text{pgdp}_{t-1} + 0.45\text{imp}^*_{t-1} - \\
+ 0.07(1 - d97q1) - 4.87 \right) + \text{dummies},
\]

\[R^2 = 0.79, \quad DW = 2.34. \tag{10}\]

In both employment and wage equation dynamic homogeneity holds in the short run. Dynamics of employment in non agriculture sectors depends on changes in labour supply and positive demand shocks reflected in the deviation of GDP dynamics from its long run trend. As compared with previous specification of employment equation in ECMOD relation (9) has been augmented for positive effects of active labour market policy. Including active labour policy in the forecasting model has been done greatly in respect of increased role of these policies after joining the EU. Short run dynamics of wages depends, in turn, on past realizations of wage dynamics, inflation and labour productivity growth. Lower coefficients on the „wage curve” relationship in the wage equation suggests that pace of convergence to optimal level of wages on the side of employees was historically slower than accommodation of aberrations form optimal level of wages on the side of employers.

6 NAWRU

6.1 Short run NAWRU

With the estimated „price curve” and „wage curve” relations (7 and 8) at hand we calculated the unemployment rate which prevails on the labour market when the outcome of wage bargaining is efficient. If wage level satisfies both cointegration relations, wage dynamics evolves with consumer price inflation and labour productivity changes.

In the first step we compare both relations and rearrange the terms to get the unemployment rate in equilibrium as a function of structural and state
variables:

\[ \text{unemp} = \beta_1^{-1}(\text{tax\_wedge} + \text{price\_wedge} + \theta_1 \text{tot} + \text{benefits} + \text{reform99} + \text{const} - \text{gdp} + \text{emp\_na} + 1.47 \text{tfp}), \]  

(11)

where:

\[ \text{tax\_wedge} = \text{glt\_corp\_tr} + \text{glt\_emp\_tr} + \text{gpit\_tr} + \text{glt\_hc\_tr}, \]

\[ \text{price\_wedge} = \text{cpi} - \text{pgdp}, \]

\[ \text{tot} = \text{p\_imp}^* - \text{pgdp}, \]

\[ \text{benefits} = \beta_2 \text{rp\_benefit} + \beta_3 (1 - \text{d97q1}) + \beta_4 \text{rp\_relief}, \]

\[ \text{reform99} = -\theta_2 (1 - \text{d99q1}), \]

\[ \text{const} = \beta_0 - \theta_0. \]

Unemployment rate depends positively on the tax wedge, the difference between consumer and producer prices (which are represented by GDP deflator) and unemployment benefits other social relief systems generosity. To move further, we resorted to the production function:

\[ \text{gdp} = \alpha \text{emp} + (1 - \alpha) k + \text{tfp}. \]

(12)

The production function includes two factors of production: capital and labour. Labour input is represented by employment in the economy. On the other hand, the relation coupled with first order condition for profit maximization (9) involves employment in the non agricultural sectors. The presence of this discrepancy in the model is justified by structural changes in the agricultural sector in the last decade. These institutional changes have led to high variation in agricultural employment dynamics what in turn impaired the link between GDP, level of aggregate employment and level of wages. The empirical relationship between wage dynamics and labour productivity is, therefore, weak, which has encouraged constructing the relation leaving out employment in agriculture as exogenous variable. Subtracting from both sides of (12) the logarithm of employment in non-agricultural sectors and rearranging we get:

\[ \text{gdp} - \text{emp\_na} - \text{tfp} = (1 - \alpha) (k - \text{emp}) - (\text{emp\_na} - \text{emp}). \]

(13)

We can approximate the last term in the above equation by the ratio of employed in agricultural sector to economically active population \( \delta \). Next,
to remove employment term from the formula, we use the approximation \( \text{unemp} = \text{aktyw} - \text{emp} \).

Ultimately we get short run NAWRU as a function of cointegrating vectors’ parameters, variables present in „price curve” and „wage curve”, stock of capital and economically active population:

\[
\text{nawru} = (1 - \alpha + \beta_1)^{-1} \left( \text{tax \_ wedge} + \text{price \_ wedge} + \theta_1 \text{tot} + \text{benefits} + \text{reform99} + \text{const} + (1 - \alpha)(\text{aktyw} - k) + 0.47 \text{tfp} - \delta \right). \tag{14}
\]

Two parameters play important role for the changes in NAWRU: elasticity of GDP to labour \( \alpha \) and half-elasticity of wages to unemployment rate \( \beta_2 \). The higher the elasticity of product to labour input and the lower the half-elasticity of wages to unemployment rate the stronger is the pass-through of changes in taxes or in social benefits replacement rates into the equilibrium unemployment. The intuition behind these results is straightforward. The more flexible are wages in response to unemployment changes, the higher share of shifts in labour demand and labour supply determinants is reflected in the level of wages in a new equilibrium and the lower adjustment is needed in the level of employment.

The equilibrium unemployment rate depends on the relation of labour force to capital stock. Increase in labour supply leads to a surge in NAWRU as long as it is not meet by raising capacities of the economy to absorb the excess labour force. Presence of \( \delta \) in (14) positively relate natural unemployment rate to outflows of employed from agriculture. Also the raise in the level of TFP in the short run results in an increase of the unemployment rate in Walrasian equilibrium. Startling as it may seem, it is a direct consequence of the assumption of the lack of trend in the long run equilibrium unemployment rate and workers’ rational perceptions of the actual level of labour productivity.

On the strength of (14) the historical track of NAWRU has been calculated. High frequency fluctuations in NAWRU, which were mainly rooted in fiscal time series variability, have been removed with Hodrick-Prescott filter (Figure 10). The equilibrium unemployment rate in 1995 maintained at the level around 16% and actual unemployment rate at around 14% (Figure 11). Until 1999, both the natural and the actual unemployment rate were decreasing and negative unemployment gap was gradually narrowing. Drop in the equilibrium unemployment rate in this period can be greatly attributed to the reform of unemployed support system in 1997. The second important contributing factor was improvement of terms of trade following marked reduction.
of import tariffs.

In the aftermath of the negative foreign demand shock following the financial crises in Russia in 1998 the unemployment rate started to swell. NAWRU recaptured from all time low 12% in 1999 to come back to around 16% in 2003. The unemployment gap was widening until 2002 when the unemployment rate peaked at 20%. The increase in NAWRU at the end of ’99 was likely to be an unintentional outcome of the far-reaching reform of the social insurance system. On the one hand, division of social contribution between employees and employers and strengthening of the link between contributions and benefits could be expected to exert negative pressure on labour costs through greater internalization of quasi-tax burden by workers. On the other hand, the reform also encompassed changes in the health insurance system which restricted eligibility of the healthcare insurance to employed and unemployed (where the social insurance contribution of the latter is covered by the government), in distinction with common healthcare insurance in the earlier years. That notably upgraded the relative attractiveness of the unemployed as compared with the economically inactive status. The net effect of the bunch of reforms for the natural unemployment rate, approximated by the difference of adequate parameters estimated in (7) and (10), appeared to be positive. Beside the 1999 reform, in consecutive years restrictiveness of the unemployment benefit system partially loosened which was reflected in the rise of the unemployment benefit replacement rate. Last but not least, some upward pressure on the equilibrium unemployment rate was put by shifts in relative prices: between 2000 and 2001 by the price wedge (which could be induced by delayed pass-through of raised effective indirect taxes rates), between 2002 and 2003 by the terms-of-trade (tied to strong depreciation of the Zloty).

Following economic revival, at the end of the period under consideration, the unemployment rate began to fall and the unemployment gap to close. From the beginning of 2004 also NAWRU showed moderate downward correction what was bound to the acceleration of investments coupled with slowdown in the total factor productivity dynamics. In the same direction acted modest restrain of the unemployment benefits system generosity and strengthening of the Zloty.

6.2 Long run NAWRU

It is expected that NAWRU in the long run converges to a level which is dependent on institutional factors and not path dependent. Steady-state NAWRU can be calculated using the model framework. The long run relation between real user cost of capital and marginal product of capital in investments
equation has a form:

\[ \ln(1 - \alpha) + gdp - k - rucc \equiv 0. \quad (15) \]

Merging (15) with production function we get:

\[ \alpha(emp - k) + tfp = rucc - \ln(1 - \alpha). \quad (16) \]

Getting back to (11) we can replace \( gdp - emp_{na} \) in the equilibrium unemployment formula with:

\[ \left( \frac{\alpha - 1}{\alpha} \right) (rucc - \ln(1 - \alpha)) + \frac{1}{\alpha} tfp + \delta, \quad (17) \]

which leads to:

\[ nawru^* = \beta_1^{-1} \left( tax\_wedge + price\_wedge + \theta_1 tot + \right.
\]

\[ + benefits + reform99 + const + \left( \frac{1-\alpha}{\alpha} \right) (rucc - \ln(1 - \alpha)) - \delta \right) \quad (18) \]

The steady-state NAWRU depends on the user cost of capital and is autonomous to changes in both labour supply and capital stock. In the long run, capital stock is pinned down by the marginal cost of capital which in turn depends heavily on institutional factors (fiscal burden on companies, mark-ups in banking sector, monetary policy).

To go further we refer to the prices equations and replace the price wedge and the terms-of-trade with their postulated steady-state levels. In the long run we expect price wedge to converge to the level fixed upon by effective indirect taxes rates and mark-ups in the economy:

\[ price\_wedge^* = gvat\_tr + gext\_tr + ggam\_tr - gtr\_goods\_tr + \nu_0. \quad (19) \]

The steady-state terms-of-trade level pertains to import prices and exchange rate cointegration relations. In the long run imports deflator (excluding oil prices) fulfills the relation:

\[ p\_imp\_noil = pgdp + \eta_1 \left( pgdp\_ext + s\_neer - pgdp + \right.
\]

\[ + \psi(gdp\_pot - gdp\_pot\_ext) \right) + \eta_0. \quad (20) \]
From the exchange rate equation we extract factors which nail down the equilibrium exchange rate:

\[
p_{gdp\text{-}ext} + s\text{-}neer - pgdp = \psi (gd_{pot} - gd_{pot\text{-}ext}) - \gamma_1 nfa\text{-}gdp - \\
- \gamma_2 (i_{w3m} - i_{w3m\text{-}ext}) - \gamma_3 d04q2 + \gamma_0. \quad (21)
\]

The dummy in (21) stands for the positive shift in Polish trade competitiveness after joining the European Union. After joining (20) and (21) together we get terms-of-trade as a function of the net foreign assets position of the country, interest rates disparity, effective rate of tariffs and other structural factors implicitly present in constants and dummies.

\[
p_{\text{imp\-noil}}^* - pgdp = gtar\_tr - \eta_1 \left( \gamma_1 nfa\_gdp + \gamma_2 (i_{w3m} - i_{w3m\_ext}) + \\
+ \gamma_3 d04q2 - \gamma_0 \right) - \eta_0. \quad (22)
\]

The result above needs a short comment. The net foreign assets position of Poland measured by net foreign assets to GDP present in (22) is clearly state dependent variable. The fact can raise doubts whether it should enter the steady-state formula for terms-of-trade. The argument which supports leaving the net foreign position in the expression is that the net foreign assets in ECMOD implicitly depends both on fiscal (the general government debt) and monetary (interest rates) policies. It makes the variable strongly institution dependent and, as such, a good measure for the economic policy changes. Apart from that, the steady-state value of \textit{net\_gdp}, is not fully traceable on the basis of economic assumptions in the model only.

The mechanism introduced by the dependency of relative import and home production prices from net foreign asset position assures the balanced country net asset standing in the long run. The interest rates disparity in (22), in turn, can be thought as an approximate measure of changes in consumer preferences. The time or consumption smoothing preferences should be reflected in the level of the country natural interest rate to which real interest rate should converge. The channel reinforces the mechanism operating through the net foreign asset position described above. The moment the saving propensity of consumers drops the real interest rates should adjust upward. Thus the impact on the terms-of-trade is negative, import prices accrue in relation to home production prices. That partly counteracts the worsening of the current account balance and in consequence the net foreign assets position of the country after the shift in preferences.
For simplicity we assume that the long run level of import oil prices is the same as the level of non-oil import prices and incorporate (22) into (18) to get final expression for the steady-state NAWRU:

\[
\text{nawru}^* = \beta^{-1}_1 \left[ \text{tax\_wedge}^* - \theta_1 \left( \eta_1 \eta_{nfa\_gdp} + \gamma_2 (i_{w3m} - \delta) + \gamma_3 (d04q2 - \delta) \right) + \text{benefits} + \text{reform99} + \text{const} + \text{dummy} + \left( \frac{1-\alpha}{\alpha} \right) (rucc - \ln(1-\alpha)) \right],
\]

(23)

\[
\text{tax\_wedge}^* = \text{tax\_wedge} + \text{price\_wedge}^* + \theta_1 \text{ggat\_tr}.
\]

The steady-state natural unemployment rate hangs on mainly on fiscal variables and monetary policy stance as measured by the level of interest-rates. Tax and quasi-tax effective rates on labour and capital (through user cost of capital) increase the NAWRU in the long run. In the same direction act social transfers which discourage employment. What matters is also trade policy. Cutting tariffs rate or an exogenous positive shift in terms-of-trade lead to a drop of the long run equilibrium unemployment rate. Restrictive monetary policy raise the NAWRU\(^2\).

As compared with the short term NAWRU responsiveness of the long term equilibrium unemployment rate value to institutional changes does not hinge on the elasticity of GDP to labour input parameter. The disappearance of the parameter from the formula is connected with assumed full adjustment of capital to the shifts in policy. The strength with which structural shifts affect the long term NAWRU is constrained only by the quasi-elasticity of wages to the unemployment rate.

On the basis of formula above we were able to calculate the long-term equilibrium unemployment rate for Poland and stake out its evolution over the last decade. The first recognition is the strong correlation between the steady-state natural unemployment rate and the user cost of capital. There were strong swings in real interest rates in the period under consideration which clearly found its reflection in the equilibrium unemployment rate’s drifts. The second — the long term natural unemployment rate is characterized by strong variability. To proceed with description of its evolution we cut the sample for which we mapped out the long term NAWRU to the period between 1997 and 2005 to remove ostensible drop in real interest rate in 1996 connected with one-off GDP deflator dynamics growth (Figure 12). For further analysis we

\(^2\)The capital channel is stronger than the terms-of-trade channel.
also recalculate the NAWRU with the natural interest rate (4% for the whole period considered) in lieu of the actual real interest rate to separate fiscal and monetary policy impacts on the labour market\(^3\) (Figure 13). On account of the fact that both the level and variability of the long term NAWRU could be undermined by transformations of the model parameters and both quality approximating role of some institutional variables we had at disposal we concentrated only on trends discernible in the long term natural unemployment rate not on its level or absolute percentage point changes.

The main driver of the long term NAWRU shifts was the user cost of capital. Excessive user cost of capital tied mainly to the high level of real interest rates in a period after 1998 to 2000 raised the long run unemployment rate. Starting from 2001 monetary policy actually allowed the reduction of the steady-state NAWRU. Both capital taxation and depreciation rate amplified the impact of the user cost of capital — increasing in the earlier period and being reduced in the later years. In the effect NAWRU remained at considerable level till the mid 2001 to set forth for gradual decline since that date.

Among labour market policies the one which had the most pronounced impact on the track of the long run NAWRU was the unemployment benefits one. Stronger restrictiveness of the system depressed the long run unemployment between 1998 and 1999. In the next three years higher generosity of the system modestly lifted NAWRU. In the last period within the sample the unemployed support system had neutral or negative influence on the long run natural unemployment rate. Not less important was the social insurance system reform in 1999 which shifted NAWRU upward. To high level of long term equilibrium unemployment at the beginning of the period under consideration contributed marked outflow of labour force from agriculture before 1999.

Interestingly when we compare longer term trends in monetary and fiscal policy (Figure 13) that is the latter which seems to decrease elasticity of Polish labour market in the second half of the decade.

7 Impulses

Parallel to the introduction of the endogenous NAWRU some other model corrections have been implemented. The unit labour cost formula has been

\(^3\)We, however, left the actual real interest rate in the interest rates disparity and did not neutralize its influence on the net foreign assets to GDP ratio. As we argued earlier, the capital and the net foreign asset position channels tend to cancel out and the former outweighs the latter. The analysis we conducted should be treated as leading only to a very rough detach of monetary and fiscal policy impact on the labour market in the long run.
changed to take into account fiscal burden component of labour costs (mainly social security contribution). Core CPI long run equation has been explicitly augmented with the effective indirect taxes rate. Other changes of weaker influence on projections and simulations embrace the real capital cost definition, more detailed treatment of different tax revenues, subsidies and social transfers. Those changes have been compelled, first of all, by a pursuit to ensure possibly high cohesion between the new wage equation as well as the equilibrium unemployment and the rest of the model. Secondly, they were done to amend the model with new linkages between fiscal and real sector which were so far lacking.

Six different impulses has been presented. Short-term interest rate impulse has been defined roughly as in [17]. The main objective for outlining it in the article was to offer straightforward comparison between both models. No meaningful changes in the reaction of the modeled economy to the monetary shock has been grasped.

Next we have traced the responses of the system to different fiscal shocks and verified its correspondence with economic intuition. We have compared the influence of different fiscal policies on inflation, growth and labour market: raises of effective tax rates or social contribution rate, increase of generosity of unemployment benefits system and expansion of current government expenditures.

7.1 Monetary impulse

The monetary impulse displays the reaction of the modelled economy to a rise of the short-term interest rate by one percentage point over its level in the baseline scenario which is sustained for eight quarters. Impulse reaction functions are given in Figure 14.

The short-term interest rate hike triggers a rise of the long-term interest rates and appreciation of the Zloty through increase of home and foreign interest rates disparity. The initial impact on the real economy is a drop in investments due to the upsurge of both short- and long-term interest rates and a decline of individual consumption dynamic. The reduction of individual consumption growth is tied to the assumption that households are liquidity constrained. The GDP deceleration which follows presses down imports dynamics and at the same time the strengthening of the Zloty leads to a decrease of exports. In the result we witness the trade balance improvement.

Decline of the aggregate demand encourage firms to cut both wages and employment. The unemployment rate picks up reinforcing negative pressure
In line with the reduction of the unit labour cost and import prices.

When the actual unemployment rate moves up after the demand for labour decreases NAWRU actually goes down so that the unemployment gap widens. Lowering of the equilibrium unemployment rate is bound to the import prices moderation — the effect which allows firms to save on production cost by the given home price level.

After eight quarters short-term interest rates are allowed to follow the Taylor rule. Low level of both inflation and economic activity induces the easing of the monetary policy. Downward correction of short-term interest rates facilitates the economic revival and raises dynamics of prices so that they eventually converge to the baseline path.

7.2 Social contribution effective rate impulse

First fiscal impulse performed lets us trace the system’s response to a change in the effective rate of social contribution on average wage. The onus of the social contribution on wages in Poland is shared by employers and employees. The social contribution payable by the employer directly affects the unit labour cost. The social contribution burden falling on the gross wage influence the unit labour cost only indirectly. Changes in the effective social contribution rate of employees impinge upon the net wage and through this effect drive the increase of wage pressure. In conduct, we can expect that the effective social contribution rate’s shift leads to different outcomes depending on whether it concerns employer’s or employee’s social contribution tax rate.

We compared the reaction of the economy to the effective social contributions rate increase in two disparate cases: the raise of the employer’s social contribution burden by one percentage point and similar-scale upsurge of the social charges of employees for a period of two years. After contractionary fiscal impulse fades out the fiscal rule stabilizing the public finance sector balance sets about. Owing to the design of Polish pension system we placed the additional assumption on both simulations that in both simulations social contribution rate hikes concern other than retirement insurance contribution or only the pay-as-you-go share of the retirement insurance contribution. In other words we ascertain that the social contribution budgetary revenues increase proportionately to social contribution rate changes and the open pension funds revenues remain intact. Juxtaposition of impulse reaction functions is given in Figure 15 and Figure 16.

After the social tax rate change the unit labour cost goes up. The unit
labour cost dynamics acceleration is initially more pronounced in the case of the raise of social contribution burden of employer. In the alternative scenario, of increase of social contributions aggravating the after tax income of employees, a fall in a net wage and a concurrent increment of shadow wage (higher effective contribution rate has a bearing on relative attractiveness of social relief benefits as compared with market wage) trigger the wage demands of workers. The resulting wage pressure, in turn, amplifies the unit labour cost and prices dynamics. Firms save on labour reducing employment which leads to a surge in the unemployment rate.

Due to social relief replacement rate upping, NAWRU increases more sharply and employment drops more deeply when social contributions rate of employees goes up. The swell of quasi-tax burden exerts negative influence on the equilibrium unemployment rate in both scenarios. Unemployment adjustment to the new equilibrium rate is slack which in the effect induces unemployment and GDP gap opening.

In reaction to higher inflation figures than in the baseline scenario, monetary policy is tighter, reinforcing the negative impact of fiscal policy on the real economy. Because economic slowdown has a negative impact on the public finance sector, the fiscal policy aimed at balancing the deficit depress government expenditures and shifts up effective tax rates. That contributes to the restrictive economic policy. Deterioration of the public finance sector balance is more substantial in the response to the employee’s social contribution uplift, in the result in that scenario restrictive fiscal policy prevails for longer and have stronger influence on the real economy.

Eventually, the shock abates and the inflation is brought to the benchmark solution level. Though, two sources of relatively sluggish convergence can be identified. First of all, the speed of capital accumulation matters for the labour market even in the medium term. Slackening of investment dynamics tied to high interest rates levels at the beginning of the simulations period reduces the capital stock in successive years maintaining the high equilibrium unemployment rate level. Fiscal policy introduces other „hysteretic” effect to the model. Previous decisions of fiscal policy carry some weight for current ones and through this effect can alter transformation path after an economic shock.

7.3 Personal income effective tax rate impulse

Personal income tax rate impulse has been defined as a two years long lasting of PIT effective rate by one percentage point. After the impulse has faded out the fiscal rule has been introduced in the simulations. Corresponding impulse
reactions functions are pictured in Figure 17.

Following personal income tax rate upsurge two kinds of adjustments set about. On the demand side higher tax burden abates disposable income of households. Due to that effect individual consumption dynamics drops impairing the aggregate demand. This in turn induces fall of GDP and investments dynamics in the next periods. On the supply side NAWRU goes up. At the labour market the demand for labour lowers because of a general slowdown in the economic activity. At the same time wage pressure originating in a reduction of the net average wage swells. What goes next is a decrease of employment and a concurrent rise of wages. Finally, higher unit labour cost pushes up the inflation figures.

Monetary policy reacts to the uplifted inflation with short-term interest rate hikes which further dampens the economic growth. The natural and current unemployment rate converge to the baseline paths only inch-by-inch. The latter mainly due to creeping adjustment of relative prices. Immediate response of prices to the taxes policy change is deterioration of the level of consumer prices and import prices as compared with GDP deflator level. Shrinking price wedge and terms-of-trade originally restrict the growth of NAWRU. However, after income tax rate level is reduced the same mechanism delay the correction of the equilibrium unemployment rate downward. Ensuing home production price increases, exchange rate and consumer prices slowly adapt.

Clearly, transformation path after introduction of higher PIT rate resembles the one after temporary raise in the employee’s social contribution rate as both rates enter the wage equation in a similar way.

7.4 Value added effective tax rate impulse

Indirect taxes effective rates increases have similar effects on the long run growth as direct personal effective tax rate but the channels through which they affect the economy in the short and medium run differ. We have defined indirect tax rate impulse as a shift of the VAT effective tax rate by one percentage point which has been sustained for two years. Fiscal rule has been engaged from that time on. Impulse reaction functions are graphed in Figure 18.

An increment of one percentage point in the indirect effective tax rate inflate consumer prices and, at least in the short run, leaves production prices intact. As a result price wedge increases and NAWRU drifts up. However, price wedge upsurge follows only gradually and so does the raise in the equilibrium unemployment rate.
On the demand side, higher VAT charges impair net the operating surplus of companies and soaring consumer prices dynamics reduces real disposable income of households. It causes the decline of both investment and individual consumption. Lower GDP dynamics suppress the demand for labour which eventually leads to both employment and wages dynamics drop. Zloty appreciation tied to stronger public finance sector balance and a successive fall in exchange rate risk supported by contractionary monetary policy further hinder the GDP growth. In the response to GDP slowdown and withdrawal from the VAT tax rate increase inflation gradually converges towards the baseline solution.

Interestingly, significant reduction of the public finance sector debt as compared with the baseline scenario stemming from soaring tax revenues in the years when higher VAT tax rate are in force, let sustain lower NAWRU and real exchange rate than in benchmark simulation for over two decades. It pinpoints one more unemployment persistence channel in the modeled economy.

7.5 Unemployment benefits replacement rate impulse

Unemployment benefits replacement rate impulse has been settled as two years unemployment benefits increase which assures one percentage point higher replacement rate than in the baseline scenario. After the shock fiscal rule has been set off. Perspective impulse reaction functions are outlined in Figure 19.

Originally an increase in generosity of unemployment benefits system affects the economy through two channels. Firstly, disposable income of household swells on account of expansion of social transfers. Individual consumption drifts up triggering the rebound of GDP dynamics. Secondly, growth of the average unemployment benefit outpacing the wages dynamics pushes up the shadow wage of unemployed leading to rise of the natural unemployment rate.

In the short run positive demand effects outweigh negative impact of the policy change on supply side of the economy. GDP and employment growth accelerate and unemployment falls. Opening unemployment gap impels the average wage growth. Escalation of unit labour cost, which follows, encourage firms to save on labour and revise prices upward. Higher inflation curbs individual consumption dynamics through reduction of real disposable income of households. GDP and employment dynamics decelerate so as the consumer prices.

The raise in government expenditures leads to the deterioration of public finance sector balance which eventually result in the fiscal policy contraction. The raise of tax and quasi-tax rates causes both NAWRU and the actual
unemployment rate remain higher than in the reference scenario even in the medium run. In line with fiscal and capital adjustments the equilibrium and the actual unemployment rates come back to the levels conforming with the basis solution four decades after initial fiscal impulse has been imposed. Likewise real exchange rate which is coupled with the level of potential product.

7.6 Current government expenditure impulse

To compare the effects of the expansionary fiscal policy which has a direct bearing on labour market developments with the alternative policy which, in the first line, supports the aggregate demand recovery with moderate distorting influence on labour market institutions we have defined the government current expenditure impulse as eight quarters lasting raise in current general government expenditures by a total amount equal to the difference between unemployment benefits fund in the scenario with upheld unemployment benefits replacement rate from the previous subchapter and the unemployment benefits fund in the baseline solution (compare 20). After two years the current government expenditures to GDP ratio comes back to its initial level and the fiscal rule is introduced.

The increase of current government expenditure triggers the dynamics of government consumption and, as a result, of the GDP. Improvement in aggregate demand induces revival on the labour market. Employment grows with moderate upsurge in wages. In the result, the unit labour cost goes up boosting producer and consumer prices. In the same direction act widened GDP gap.

As monetary policy reacts the to inflation changes and to the overstimulated GDP growth with the interest rate hike both consumption and investment dynamics plunge and converge to the reference path. However, unemployment remains at higher lever than in the baseline solution. The direct reason of the persistent worsening on the labour market is the rise in the tax and quasi-tax burden which follows the shock. Extra expenditures in the first two years of the simulation and subsequent slowdown of the economic activity negatively affect both public finance sector balance and debt. Tightening of the fiscal policy with the uplift of tax charges exerts detrimental impact on the supply and demand for labour. In the consequence also real exchange rate depreciate. Eventually, after the public finance sector consolidation, NAWRU and real exchange rate reach their baseline levels.
8 Conclusions

The approach we used to describe the evolution of the natural unemployment rate in Poland as a category calculated on institutional and state dependant variables let us trace the development of the natural unemployment rate in Poland. With the application of a priori knowledge about the labour market development during the last decade and a formal model of bargaining we attempted to encapsulate the information available in the one labour market flexibility measure.

We built in the endogenous NAWRU into the macroeconomic model to check how interdependencies in the economy can shape the evolution of employment and wages. Simulation results shed some light on the speed of adjustment of the modeled economy after an economic shock. Even in the model in which in the long run neoclassical postulates should prevail we can generate certain degree of the unemployment persistence once we allow for the dependence of the level of unemployment from the stock of capital, relative prices and fiscal variables. The natural unemployment rate, in turn, constitutes an anchor not only for the actual level of unemployment but also for the real exchange rate, so it has an impact of the country trade competitiveness. One should not treat the results too rigorously. The rate of convergence is both model and country specific. However, the mechanisms which can lead to hysteretic development of the economy can be singled out: slack capital stock adjustment especially when monetary policy reacts to supply shocks with interest rates hikes, net foreign assets.

As compared with the original version of the ECMOD model, the model augmented with endogenous displays not only higher degree of hysteretic behavior but, as has been expected, delivers scenarios with stronger supply-side reactions to the impulses. Tax and quasi-tax rate increases not only slacken short run dynamics of the economy through the demand channel but also infringe on the potential product.

The analysis we conducted have certain imperfections. We do not take into account that shocks can affect the activity rate of population which seems to be binding constraint put on the scenarios of supply shocks accommodation. Apparent weakness is also calibration of the elasticities of wages to the fiscal charges which can lead to overreconing of negative impact of the raise in fiscal burden on the unemployment rate. These are the paths we shall take in the next future.
Bibliography


[27] Socha J., Wojciechowski W., „Koncepcja NAIRU, dezinflacja a druga fala bezrobocia w Polsce”, Bank i Kredyt, 2004

A1 Variables

aktyw – labour force, by BAEL (in logarithm)

almp – real active labour market policies expenditures divided by the number of unemployed as the deviation from the average in the sample period

avgbenefit_n – average quarterly amount of benefit from the Labour Fund per unemployed person eligible for unemployment benefits (in logarithm)

avgrelief_n – average quarterly amount of social benefits per non working person at working age (in logarithm)

cpi – consumer price level

depr – quarterly depreciation rate

emp – number of employees in the economy, by BAEL (in logarithm)

emp_na – number of employees outside the agricultural sector in thousands, by BAEL (in logarithm)

g_corp_tr – effective rate of taxes and quasi-taxes on corporate revenues excluding transfers

\[ g_{\text{corp}_tr} = gcit_{tr} + genv_{tr} + glt_{sb_{tr}} - gtr_{\text{corp}/\text{revenues}} \]

gcit_tr – effective CIT rate

gdp – Gross Domestic Product (in logarithm)

gdp_pot – potential GDP (in logarithm)

gdp_pot_ext – weighted potential GDP abroad (in logarithm)

genv_tr – effective rate of environmental charges

gext_tr – effective excise tax rate

ggam_tr – effective gaming tax rate

ggr5y – 5 year rates of return on bonds

glt_corp_tr – effective rate of revenues from social contributions paid by employers

glt_emp_tr – effective rate of revenues from social contributions paid by employees

glt_hc_tr – effective rate of revenues from health insurance contributions

\[ glt_{sb_{tr}} \] – effective rate of social contributions paid by farmers

gpit_tr – effective PIT rate

gtar_tr – custom duty and import taxes (in effect till mid ’90) effective rate
\( gtr\_corp\_tr \) – transfers to enterprises as a fraction of corporate revenues

\( gtr\_goods\_tr \) – effective transfers to products

\( gvat\_tr \) – VAT effective rate

\( i\_w3m \) – deflated quarterly nominal average value of WIBOR3M

\( i\_w3m\_ext \) – deflated real foreign 3M rate

\( k \) – average capital stock in the period

\( nfa\_gdp \) – net foreign assets to GDP ratio

\( p\_imp \) – import deflator (in logarithm)

\( p\_imp^* \) – import deflator adjusted for customs duties and import taxes: \( p\_imp^* = p\_imp(1 + gtar\_tr) \) (in logarithm)

\( p\_imp\_noil \) – import deflator adjusted for oil price movements

\( pgdp \) – GDP deflator (in logarithm)

\( pgdp\_ext \) – weighted GDP deflator abroad

\( r\_rate \) – real interest rates on loans to enterprises approximated by the weighted average of long and short term real interest rates \( r\_rate = 0.5(i\_w3m - pgdp/pgdp) + 0.5(ggr5y - target) \)

\( r\_rate \) – real interest rates on loans to enterprises approximated by the weighted average of long and short term real interest rates \( r\_rate = 0.5(i\_w3m - pgdp/pgdp) + 0.5(ggr5y - target) \)

\( rp\_benefit \) – unemployment benefit replacement rate: \( rp\_benefit = avgbenefit\_n - wage\_n - glt\_emp\_tr \) (in logarithm)

\( rp\_relief \) – social benefits replacement rate: \( rp\_relief = avgrelief\_n - wage\_n - glt\_emp\_tr - gpit\_tr \) (in logarithm)

\( rucc \) – real cost of capital \( rucc = (r\_rate + depr)/(1 - g\_corp\_tr) \) (in logarithm)

\( s\_neer \) – nominal effective PLN exchange rate (in logarithm)

\( target \) – inflation target

\( tfp \) – total factor productivity (in logarithm)

\( tfp\_hp \) – trend total factor productivity (in logarithm)

\( ulcna \) – unit labour costs outside agricultural sector: \( ulcna = wage\_n + emp\_na + glt\_corp\_tr - gdp \) (in logarithm)

\( unemp \) – BAEL unemployment rate

\( wage\_n \) – average monthly wage in nominal terms (adjusted for the transition to gross wages in 1999) (in logarithm)
A2 Model parameters

Table 1: Parameters

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A3 Figures

Figure 1: Unemployment rate

Figure 2: CPI inflation

Figure 3: Wage inflation
Figure 4: Unemployment benefit replacement rate

Figure 5: Percentage of registered unemployed who collect unemployment benefits

Figure 6: Social relief as percentage of household total income
Figure 7: Shadow income replacement rate

![Shadow income replacement rate chart]

Figure 8: Percentage of unemployed working in shadow economy

![Percentage of unemployed working in shadow economy chart]

Figure 9: Tax wedge

![Tax wedge chart]

- Tax wedge
- Tax wedge including indirect taxes
Figure 10: NAWRU

Figure 11: NAWRU vs. actual unemployment rate
Figure 12: Steady-state NAWRU

Figure 13: Steady-state NAWRU calculated on the basis of natural interest rate
Description: The monetary impulse is defined as a rise in the short-term interest rate by 1 percentage point for a period of 8 quarters. The simulation has been conducted with the monetary rule (Taylor’s rule) and the fiscal policy rule included.
Figure 15: Reaction of the economy to the employer’s social contribution rate impulse

Description: The employer’s social contribution rate impulse is defined as a rise in the employer’s social contribution effective rate by 1 percentage point for a period of 8 quarters. The simulation has been conducted with the monetary rule (Taylor’s rule) and the fiscal policy rule included.
Description: The employee’s social contribution rate impulse is defined as a rise in the employee’s social contribution effective rate by 1 percentage point for a period of 8 quarters. The simulation has been conducted with the monetary rule (Taylor’s rule) and the fiscal policy rule included.
Description: The personal income tax rate impulse is defined as a rise in the personal income tax effective rate by 1 percentage point for a period of 8 quarters. The simulation has been conducted with the monetary rule (Taylor’s rule) and the fiscal policy rule included.
Figure 18: Reaction of the economy to the value added tax rate impulse

Description: The value added tax rate impulse is defined as a rise in the value added tax effective rate by 1 percentage point for a period of 8 quarters. The simulation has been conducted with the monetary rule (Taylor’s rule) and the fiscal policy rule included.
Figure 19: Reaction of the unemployment benefit replacement rate impulse

Description: The unemployment benefit replacement rate impulse is defined as a rise in the unemployment benefit replacement rate by 1 percentage point for a period of 8 quarters. The simulation has been conducted with the monetary rule (Tylor’s rule) and the fiscal policy rule included.
Description: The current government expenditures impulse is defined as a rise in the current government expenditures by a total amount comparable to the difference between unemployment benefits fund in the scenario with the unemployment benefit replacement rate uprise by one percentage point for a period of eight quarters and the baseline scenario. The simulation has been conducted with the monetary rule (Taylor’s rule) and the fiscal policy rule included.