



Modelling Economies in Transition 2003

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THE STRUCTURE OF THE LONG-TERM W8D-2002 ECONOMETRIC MODEL OF THE POLISH ECONOMY

1. Introduction

Construction of the W8D model of the Polish economy within the years 1999–2001 led, in the Polish literature, to the emergence of the very first macroeconomic model regarding endogenous technical progress. This enabled an elaboration of preliminary policy scenarios within long horizons, up to the year 2025, in which were shown explicitly potential effects of total factor productivity resulting from absorption of both domestic and foreign R&D outlays as well as from increasing human capital accumulation. However, the option of stimulating endogenous growth would call for appropriate changes in macroeconomic policies, especially in the field of reallocation of budget expenditures to increase outlays on research and development activity (see W. Welfe (ed.) 2001).

The parameters of the W8D model were estimated, using a sample ending in the year 1998. Thus they were based only on a few observations concerning the transition period and as such could not be regarded as a pattern of behavior for the economic agents of the first quarter of the 21st century. To this end, the sample had to be extended, which was done by incorporating two more yearly data, 1999 and 2000 (at the moment the model was being re-estimated, data for the year 2001 were not available). The database for the W8 models was properly updated and extended, which is described in a separate paper (see W. Florczak 2002a).

Next, all the data – more than 300 time series – gathered in the database were subject to investigation into their integration order. It turned out – in line

with some previous research – that the majority of the analyzed series was stationary in their first differences (see W. Florczak 2002b). This is an invaluable hint for those running regressions with the use of those series.

The extended sample enabled then – in the process of running individual regressions – an examination of parameters' stability, and consequently resignation from calibration of some parameters (e.g. in the equation of investment outlays). This enabled also re-specification of some other equations, so as to include variables so far excluded from those equations. In particular, this referred to the functions of private consumption, in which an attempt was made to account for the welfare effect, of investment demand, in which FDI were explicitly introduced, and finally, of production to allow for the effects of imported technologies.

The new W8D-2002 model of the Polish economy is going to constitute a tool for elaborating *ex-ante* forecasts of long horizons, up to the year 2025, and for running alternative policy scenarios. The scenarios allow for various policy assumptions, including variable external economic environment and variants of a knowledge-based society.

2. The core and re-specified equations of the model

After having extended the sample to the year 2000, the re-estimation of all the initial equations followed. This enabled us to analyze the stability of individual relations. Adding two more observations from the transition period was of considerable importance for the accuracy of estimates, especially in the equations that previously had been estimated on short samples (e.g. in the sector of financial flows, whose data started in the 90-ies), and for piece-wise regressions. In the cases, in which data was abundant (such as in investment outlays or labor productivity) the changes in estimates were relatively minor. The estimates that previously used to be insignificant, frequently remained volatile even after extending the sample. This means that further updating is necessary in the future. Such a situation took place e.g. in the case of interest rates in the private consumption equation. Nevertheless, many times the extension enriched individual specifications through inclusion of additional variables. Below, most illustrative examples are given.

In analyses of consumer demand, especially those carried out in Great Britain, the increasing importance of the wealth factor has been accentuated. The wealth manifests itself in two forms: tangibles (mainly real estate) and financial goods, i.e. money stock (cash and deposits) and securities (bonds and shares). Tangibles are usually limited only to real estate, that, contrary to other tangibles, are valued and registered. So reduced tangibles used to enter equations of

consumer demand as an additional variable. Their increment stimulated households' expenditures on furnishings, household equipment, etc. and on repairs. As for the other tangibles some methods of an indirect assessment of their changes gained popularity (see e.g. J. R. N. Stone, D. A. Rowe 1957; L. D. Taylor, H. S. Houthakker 1970). However, the methods are rarely employed while constructing macroeconomic consumer demand functions (see I. Sujan et al. 1997, ch. 7).

The stock of financial assets also favorably affects the level of consumer expenditures – it enables purchases of luxurious goods, including tangibles. This hypothesis is confirmed by outcomes obtained in Great Britain, regarding the long-run elasticities, of order 0.3, of consumer expenditures with respect to tangibles. However, as far as the gross consumer demand is concerned, the elasticities with respect to real estate proved much lower, 0.07 (LBS), and only slightly higher with respect to financial stock, 0.14 (LBS) or 0.19 (NIESR). Those estimates come from investigations carried out in the early 90-ies (see J. Whitley 1994, p. 84).

All this made us to attempt at building a consumer demand function, C , allowing for the wealth effect. Unfortunately, we did not possess sufficiently long series concerning real estate. That is why we decided to rely on accumulated financial assets at constant prices, SAV . They include both cash stock and bank deposits, exclusive of securities.

The inclusion of the above-mentioned variable into the consumer demand function gave the expected sign, although its magnitude proved much lower than in the British models. The long-run elasticity of the consumer demand with respect to real financial assets equals only 0.012. On the other hand, the short-run elasticity is high but insignificant.

As a result of this novelty, we had to endogenize financial stocks, SAV , making them dependent upon accumulated households' savings, thus upon increment in real incomes, changes in interest rates on deposits, and finally, on inflation rate, whose increase discourages from keeping financial means at a hitherto level. The estimation outcomes are reported in Table 1.

Another important supplement to the specification of the W8D-2002 model's equations was introduction of foreign direct investment. However, this turned out not an easy task because of the duality of data sources. The level of FDI is computed either by means of balance of payments methodology or by means of surveys, comparing the volume of foreign capital invested in domestic enterprises at the beginning and at the end of a given year. Still, the estimates reported by those two sources differ very much both in levels and in dynamics. However, bearing in mind its higher comparability, we decided on adopting the balance of payments approach.

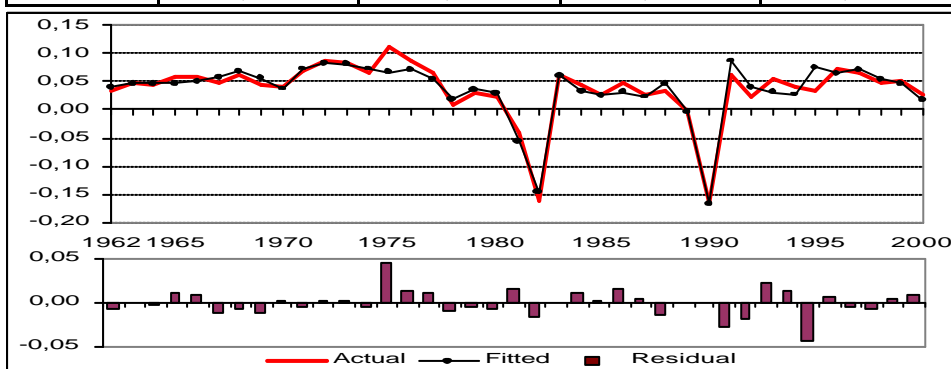
Table 1

Private consumption

$$\begin{aligned} \Delta \text{LOG}(C) = & A1 \\ & + (\text{LOG}(C\{1\}) - \text{LOG}(YDIS\{1\}) - \text{LOG}((\text{SAV}\{2\} + \text{SAV}\{1\})/2)) * (1 - U6092)) * A2 \\ & + \text{LOG}(YDIS\{1\}) * A3 + \text{LOG}(YDIS/YDIS\{1\}) * A4 \\ & + \text{LOG}((\text{SAV}\{2\} + \text{SAV}\{1\})/2) * (1 - U6092) * A5 \\ & + \text{LOG}(((\text{SAV}\{1\} + \text{SAV}\{2\})/2) / ((\text{SAV}\{2\} + \text{SAV}\{1\})/2)) * (1 - U6092) * A6 \\ & + \text{LOG}(I1) * A7 + \text{LOG}((1 + \text{RKFR}) / (\text{PC}/\text{PC}\{1})) * (1 - U6090) * A8 \\ & + U8182 * A9 + U83 * A10 + U89 * A11 + U90 * A12 \end{aligned}$$

| | | | |
|----------------------------------|-----------|----------------------|---------|
| Data | 1962–2000 | D–W | 2,0266 |
| Degrees of freedom | 28 | D–W – levels | 2,1152 |
| Adjusted R ² | 0,9051 | Lagrange Multiplier | 0,0697 |
| Adjusted R ² – levels | 0,9979 | Jarque-Bera test | 0,0522 |
| MAPE | 23,2657 | Goldfeld-Quandt test | 0,8377 |
| MAPE – level | 1,0104 | Harvey-Collier test | -0,6524 |
| Sum of squared residuals | 0,0078 | DF test of residuals | -6,2018 |

| Parameter | Estimate | Standard deviation | t-Statistic | Significance level |
|-----------|-----------|--------------------|-------------|--------------------|
| A1 | 0,380544 | 0,121601 | 3,129455 | 0,004068 |
| A2 | -0,132436 | 0,079035 | -1,675662 | 0,104938 |
| A3 | -0,029738 | 0,010420 | -2,853795 | 0,008038 |
| A4 | 0,401449 | 0,061990 | 6,476036 | 0,000001 |
| A5 | -0,129229 | 0,076034 | -1,699628 | 0,100286 |
| A6 | 0,379367 | 0,312016 | 1,215859 | 0,234190 |
| A7 | -0,002100 | 0,000841 | -2,497985 | 0,018637 |
| A8 | -0,200000 | – | – | – |
| A9 | -0,070754 | 0,017414 | -4,063088 | 0,000355 |
| A10 | 0,049043 | 0,018917 | 2,592488 | 0,014976 |
| A11 | -0,055948 | 0,017570 | -3,184226 | 0,003544 |
| A12 | -0,137404 | 0,021430 | -6,411706 | 0,000001 |



Source: W. Florczak (2002c).

In the initial version of the W8D model the FDI, expressed in USD, *SJBUSD*, were made dependent upon the expected economic growth as well as on the economy's stability (expressed by inflation rate). Changes in FDI affect capital account and reserve assets. Yet, the FDI is not present in the equation of the exchange rate, as it is portfolio investment that plays the balancing role. In that version of the model the effects of FDI on the production sector were not accounted for, either. Still, those are vast. Direct effects stem from investment on fixed assets or from greenfield investment. Indirect ones are associated with improvement in technology and management, e.g. via taking-over the existing enterprises by means of purchasing their shares (like in the case of Polish banks). However, because of the lack of proper data on their allocation, the FDI effects could not be empirically split into the direct and indirect ones.

In the new version of the model, FDI has been included in the list of variables explaining both investment outlays on machinery and equipment as well as on buildings and structures. The estimation results of these equations are reported in Tables 2 and 3.

Moreover, increment in FDI indirectly entails also increase in investment imports, *M7*, that in turn, depends on investment outlays on machinery and equipment, *JV*. Growth of *M7* in relation to *JV* induces the effects of foreign outlays on R&D, *BIRMS*. One can also analyze changes in the import structure, however only in the context of the increasing shares of investment imports (see also M. Przybylinski 2000). Finally, increase in investment outlays on machinery and equipment as well as increase in R&D outlays favorably influences GDP and labor productivity¹. The latter, however, reduces labor demand.

The effects of FDI might have been underestimated, especially that the hitherto specification did not allow for any improvement in managing the enterprise and bank sectors. This will call for another re-specification in the future. Besides, one should also account for new investment emerging due to the accession funds, that are supposed to be spent on public undertakings (infrastructure).

In the initial version of the model, the equation explaining fluctuations in the exchange rate PLN/USD, *WZLD*, was dependent – apart from relative prices – upon the ratio of exports over imports, such variable being responsible for fluctuations in demand and supply of foreign currencies. However, this proved insufficient to account for changes in the exchange rate, especially in the last years, when the exchange rate was mainly determined by inflows of foreign

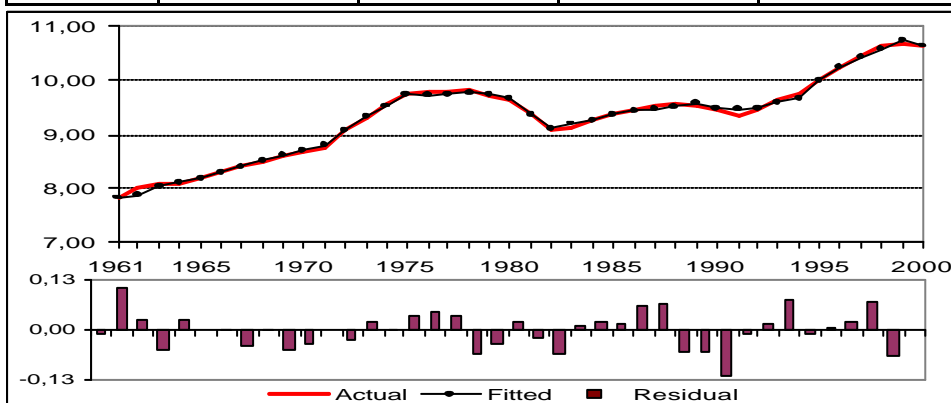
¹ An attempt to directly introduce FDI into the labor productivity function can be found in M. Przybylinski, I. Swieczewska (2002), in the IMPEC model. This approach was applied in all sectors of the economy. However, their results are incomparable with ours because of different definitions of FDI and different price bases.

Table 2
Investment outlays on machinery and equipment

$$\begin{aligned} \text{LOG(JV)} = & A1 + \text{LOG(JV}\{1\}) * A2 + \text{LOG(X)} * A3 \\ & + \text{LOG(WBP/8291/PJV)} * A4 + \text{LOG(WKZ)} * A5 \\ & + \text{LOG}(((1+\text{RKFR})/(\text{PJA/PJA}\{1\})) * (\text{PJV/PX})) * (1-\text{U6093}) * A6 \\ & + \text{LOG}((\text{SJBUSD} * \text{WZLD}) / \text{PJV}) * (1-\text{U6089}) * A7 \\ & + \text{U7275} * A8 + \text{U8182} * A9 + \text{U9596} * A10 + \text{U2000} * A11 \end{aligned}$$

| | | | |
|----------------------------------|-----------|-----------------------|---------|
| Data | 1961–2000 | D–W | 1,2275 |
| Degrees of freedom | 29 | D–W – levels | 2,2516 |
| Adjusted R ² | 0,9947 | Lagrange Multiplier | 1,4752 |
| Adjusted R ² – levels | 0,9934 | Jarque-Bera test | 12,3149 |
| MAPE | 0,3857 | Goldfeld-Quandt test | 0,2948 |
| MAPE – level | 3,5803 | Harveya-Colliera test | 3,0253 |
| Sum of squared residuals | 0,0862 | DF test of residuals | –5,2439 |

| Parameter | Estimate | Standard deviation | t-Statistic | Significance level |
|-----------|-----------|--------------------|-------------|--------------------|
| A1 | –3,100314 | 1,867275 | –1,660341 | 0,107622 |
| A2 | 0,556024 | 0,087332 | 6,366808 | 0,000001 |
| A3 | 0,606140 | 0,198823 | 3,048637 | 0,004869 |
| A4 | 0,185680 | 0,090536 | 2,050908 | 0,049408 |
| A5 | 0,896502 | 0,283157 | 3,166091 | 0,003618 |
| A6 | –0,260144 | 0,114100 | –2,279961 | 0,030147 |
| A7 | 0,026446 | 0,010613 | 2,491798 | 0,018676 |
| A8 | 0,155468 | 0,037343 | 4,163229 | 0,000256 |
| A9 | –0,236834 | 0,056378 | –4,200822 | 0,000231 |
| A10 | 0,173814 | 0,048989 | 3,548039 | 0,001343 |
| A11 | –0,143488 | 0,064492 | –2,224882 | 0,034030 |



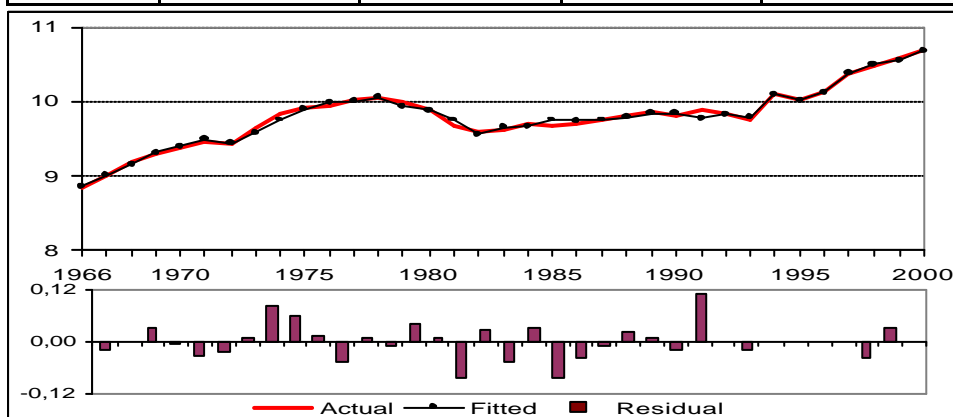
Source: W. Florczak (2002c).

Table 3
Investment outlays on buildings and structures

$$\begin{aligned} & \text{LOG}(\text{JJTF}) = \text{A1} \\ & + \text{LOG}(\text{JJTF}\{1\}) * \text{A2} \\ & + \text{LOG}(\text{X}) * \text{A3} \\ & + \text{LOG}(\text{WKZ}) * \text{A4} \\ & + \text{LOG}(((1+\text{RKFR})/(\text{PJA}/\text{PJA}\{1\})) * (\text{PJJT}/\text{PX})) * (1-\text{U6093}) * \text{A5} \\ & + \text{LOG}((\text{SJBUSD} * \text{WZLD})/\text{PJJT}) * (1-\text{U6093}) * \text{A6} \\ & + (\text{U72} + \text{U7981} + \text{U82}) * \text{A7} + \text{U95} * \text{A8} + \text{U96} * \text{A9} \end{aligned}$$

| | | | |
|----------------------------------|-----------|----------------------|---------|
| Data | 1966–2000 | D–W | –0,3210 |
| Degrees of freedom | 26 | D–W – levels | 2,2770 |
| Adjusted R ² | 0,9866 | Lagrange Multiplier | 0,3090 |
| Adjusted R ² – levels | 0,9916 | Jarque-Bera test | 5,1234 |
| MAPE | 0,2868 | Goldfeld-Quandt test | 2,8338 |
| MAPE – level | 2,7936 | Harvey-Collier test | 2,4199 |
| Sum of squared residuals | 0,0545 | DF test of residuals | –6,0675 |

| Parameter | Estimate | Standard deviation | t-Statistic | Significance level |
|-----------|-----------|--------------------|-------------|--------------------|
| A1 | –0,468409 | 0,766412 | –0,611171 | 0,546393 |
| A2 | 0,779582 | 0,074582 | 10,452756 | 0,000000 |
| A3 | 0,218104 | 0,110861 | 1,967365 | 0,059896 |
| A4 | 0,395493 | 0,101252 | 3,906044 | 0,000597 |
| A5 | –0,602809 | 0,191899 | –3,141292 | 0,004165 |
| A6 | 0,060079 | 0,009274 | 6,478240 | 0,000001 |
| A7 | –0,141587 | 0,025777 | –5,492793 | 0,000009 |
| A8 | –0,444033 | 0,081148 | –5,471869 | 0,000010 |
| A9 | –0,305362 | 0,078285 | –3,900630 | 0,000605 |



Source: W. Florczak (2002c).

currencies resulting from the increasing portfolio investment from abroad (see J. Brzeszczynski, R. Kelm 2002). The decisive role is played here by foreign portfolio investment. Still, we failed to account for changes in the portfolio investment even in the latest version of the model. However, we managed to incorporate a new variable into the exchange rate equation. The variable is a ratio of real domestic and foreign interest rates, the latter being represented by Germany's interest rate. Unfortunately, all the attempts to directly estimate the effects of that variable fell flat. As a result, a calibration process followed. The final estimate is -0.2 , which differs from the long-term elasticity obtained in R. Kelm's model (-0.6). The latter result, however, was obtained on the basis of quarterly data, with a specification excluding the export-import ratio and with currency reserves instead (see J. Brzeszczynski, R. Kelm, 2002, ch. 6). The outcomes of the estimation of the exchange rate equation are reported in Table 4.

3. The simulation model and its structure

The simulation W8D-2002 model was constructed in a similar manner to its predecessor, W8D, as a result of consolidating stochastic equations and adding proper accounting identities.

The simulation system consist of the following blocks of equations:

- a) final demand and foreign trade,
- b) productivity factors and technical progress,
- c) capacity output and employment,
- d) prices and financial flows.

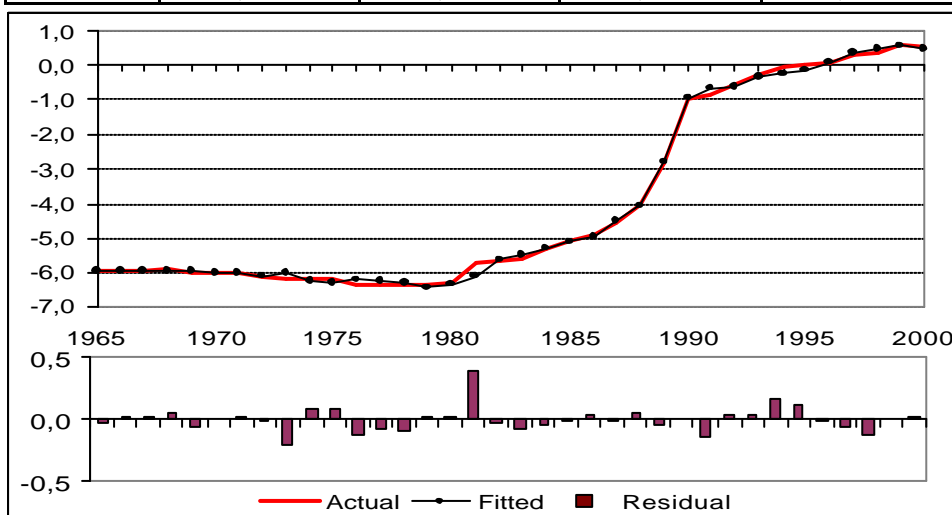
Basic equations of the simulation system stem from stochastic relationships, whose parameters were estimated on the sample ending in the year 2000. The starting observation for most of the series is the 60-ies. However, for some series, especially financial flows, the starting point is in the 90-ies. The majority of equations entered the simulation system with no changes, whereas some others, such as realizations, had to be transformed and modified, to get proper estimates of demand or potential variables. Those transformations, described in other papers, call for introducing additional identities. Thus, the simulation model contains also, apart from stochastic equations, a lot of bridge equations and identities, defining outlays of production factors both in constant and current prices. A small group of identities constitute auxiliary identities expressing the state of fixed assets and capital-labor ratio.

Table 4
Exchange rate PLN/USD

$$\begin{aligned} \text{LOG(WZLDR)} = & A1 \\ & + \text{LOG(PX/PH)} * A2 \\ & + \text{LOG(PX/PH)} * (1-U6089) * A3 \\ & + \text{LOG(E/M)} * (1-U6079) * A4 \\ & + (1-U6091) * ((\text{RKFR} - (\text{PX/PX}\{1\} - 1)) / (\text{RKFNIEM} - \text{INFNIEM})) * -0.02 \\ & + U6072 * A5 \\ & + U8790 * A6 \end{aligned}$$

| | | | |
|----------------------------------|-----------|----------------------|---------|
| Data | 1965–2000 | D–W | 1,8213 |
| Degrees of freedom | 30 | D–W – levels | 1,0935 |
| Adjusted R ² | 0,9984 | Lagrange Multiplier | 0,2964 |
| Adjusted R ² – levels | 0,9917 | Jarque-Bera test | 26,1759 |
| MAPE | 11,2242 | Goldfeld-Quandt test | 0,7707 |
| MAPE – level | 6,3855 | Harvey-Collier test | 1,5591 |
| Sum of squared residuals | 0,3471 | DF test of residuals | -5,3412 |

| Parameter | Estimate | Standard deviation | t-Statistic | Significance level |
|-----------|-----------|--------------------|-------------|--------------------|
| A1 | -0,060755 | 0,033654 | -1,805258 | 0,081080 |
| A2 | 0,933399 | 0,007668 | 121,725031 | 0,000000 |
| A3 | -0,364537 | 0,062247 | -5,856268 | 0,000002 |
| A4 | -1,201611 | 0,224734 | -5,346828 | 0,000009 |
| A5 | -0,296037 | 0,049157 | -6,022289 | 0,000001 |
| A6 | 0,342192 | 0,067808 | 5,046468 | 0,000020 |



Source: W. Florczak (2002c).

The full list of variables of the W8D-2002 model and its equations are given in Appendices 1–2. W8D-2002, just like its predecessor, W8D, is a medium-size model. Its simulation version contains 216 equations, of which 80 are stochastic and 136 are identities. Some stochastic equations are bridge or switch equations. This refers mainly to the relationships linking total values (aggregates) with their components, of which some information is unavailable (e.g. budget revenues are dependent only on some major taxes).

The number of strictly exogenous variables, exclusive of time and dummy variables, is 24. Those are:

- a) 7 socio-demographic factors: total population, working-age population, people in respective school-age groups, share of elementary school graduates who continue their education, number of retirees and pensioners;
- b) 6 variables describing external conditions: world exports, world prices, inflation rate in Germany, interest rates in Germany, GDP of six OECD countries, being main trading partners of Poland;
- c) 4 disequilibrium indicators that for the 90-ies take the value of zero;
- d) 1 variable of aggregate banking system: other liabilities; 1 variable expressing foreign portfolio investment in the balance of payments accounts;
- e) 5 policy instruments: social mark-ups over wage costs, ratio of capital depreciation, average tax rate on wages, share of investment outlays from the state budget in the state budget expenditures, and effective customs tariff rate.

To allow for other policy instruments, such as changes in indirect taxes, ceiling prices or other financial instruments, one can change estimates in proper equations or exogenize some selected endogenous variables, such as the exchange rate or interest rate.

A considerable number of dummy variables (97) introduced into the model served mainly to account for specific sub-periods.

Both a general analysis of Poland's economic development and empirical verification of parameters' stability let us distinguish the following sub-periods:

- a) accelerated growth in the first half of the 70-ies,
- b) crisis at the turn of the 80-ies,
- c) economic slowdown of the 80-ies (excluding the crisis year 1982),
- d) beginning of transformation, covering – depending on a given phenomenon – the years 1989–1990 or 1990–1991,
- e) starting with the economic recovery (since 1994), emergence of new tendencies, typical of developed market economies (e.g. increasing share of funding consumer expenditures by means of bank loans or growing importance of financial instruments),

- f) economic slowdown resulting from tight money and fiscal policies, started in 1998 and since 2001 leading to a decrease in the rates of growth of GDP to 1% a year.

W8D-2002 is a highly simultaneous model and with a large number of dynamic feedbacks. It contains 24 prologue equations, 98 simultaneous equations, 94 epilogue equations and 8 feedback variables. The feedback variables are those in the production sphere: GDP, investment outlays on machinery and equipment, employment, as well as those in the inflationary nexus: GDP deflator, exchange rate, investment deflator, gross average nominal wages, and indirect taxes.

A relatively large number of epilogue equations results, amongst others, from the introduction of numerous identities that generate important macro characteristics in the form of relations (e.g. structural ratios or accounting identities). The formal structure of the simulation model is reported use where.

4. Further research recommendations

The updated version of the long-term W8D-2002 model of the Polish economy is going to be a starting point for elaboration of new forecasts of Poland's economic development up to the year 2025. The forecasts will constitute a benchmark for running alternative policy scenarios of medium-term horizons and of long-term strategies of socio-economic development of Poland.

Such analyses will be preceded by investigations aiming at the determination of the relationships existing in the Polish economy by means of *ex ante* multiplier analysis based on the W8D-2002 model. Their results will be compared with the outcomes obtained in previous versions of the W8 model.

While elaborating alternative scenarios of Poland's economic development we are going to take advantage of other official projections, including those by the Ministry of Finance, and the Ministry of Economy, as well as of the assumptions made by the Committee *Poland 2000+* PAN. Moreover, we are going to benefit from the suggestions formulated in the economic literature in the recent years.

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Appendix I

LIST OF VARIABLES OF THE W8D-2002 ECONOMETRIC MODEL OF THE POLISH ECONOMY

| | |
|--------|---|
| A | – Raw materials – gross output ratio |
| ABPO | – graduates from elementary schools |
| ABSR | – graduates from secondary schools |
| ABWY | – graduates from higher schools |
| AFFP | – Mark-up over wage costs |
| AFZSP | – Financial statement (profits) of non-financial enterprises |
| AMKKP | – Ratio of capital depreciation |
| AT | – Technical raw materials – gross output ratio |
| BBGOP | – Budget outlays on education, exclusive of higher education |
| BCBWP | – Budget outlays on higher education |
| BCC | – Real current expenditures of the state budget |
| BCCP | – Current expenditures of the state budget |
| BCJP | – Expenditures of the state budget on investments |
| BCP | – Expenditures of the state budget, total |
| BDP | – Budget balance, current |
| BDPR | – Share of budget balance in GDP (current), percentage points |
| BEDOP | – Total outlays on education, exclusive of higher education |
| BEDOPX | – Total outlays on education, exclusive of higher education; share in GDP |
| BEDWP | – Total outlays on higher education |
| BEDWPX | – Total outlays on higher education; share in GDP |

| | |
|----------------|---|
| <i>BIRK</i> | – Domestic outlays on R&D, total |
| <i>BIRKB</i> | – Domestic outlays on R&D from state budget |
| <i>BIRK BX</i> | – Domestic outlays on R&D from state budget, share in GDP |
| <i>BIRK Q</i> | – Domestic outlays on R&D from non-financial corporations |
| <i>BIRKS</i> | – Cumulated domestic outlays on R&D |
| <i>BIRKSI</i> | – Index of cumulated domestic outlays on R&D |
| <i>BIRKX</i> | – Domestic outlays on R&D, share in GDP |
| <i>BIRM</i> | – Foreign outlays on R&D, weighted by imports |
| <i>BIRMS</i> | – Cumulated foreign outlays on R&D, weighted by imports |
| <i>BIRMSI</i> | – Index of cumulated imported outlays on R&D |
| <i>BRP</i> | – Liabilities of the banking system |
| <i>BRZFP</i> | – Foreign liabilities of the banking system |
| <i>BYCCOEF</i> | – Effective customs tariff rate |
| <i>BYCP</i> | – Revenues of the state budget due to import duties |
| <i>BYIFP</i> | – Revenues of the state budget due to income taxes on legal persons (corporate taxes) |
| <i>BYP</i> | – Revenues of the state budget, total |
| <i>BYPFP</i> | – Revenues of the state budget due to personal income taxes |
| <i>BYVP</i> | – Revenues of the state budget due to VAT taxes |
| <i>BYVP_X</i> | – Revenues of the state budget due to VAT taxes, share in GDP |
| <i>BZAKP</i> | – Assets of the banking system, total |
| <i>BZNGP</i> | – Assets of the banking system due from non-financial corporate sector |
| <i>BZNPP</i> | – Assets of the banking system due from individuals |
| <i>BZPPP</i> | – Assets of the banking system due from securities |
| <i>BZRESP</i> | – The other assets of the banking system |
| <i>C</i> | – Private consumption, realisation, real |
| <i>CD</i> | – Private consumption, demand, real |
| <i>CEDOP</i> | – Outlays on education, exclusive of higher education, by households |
| <i>CEDWP</i> | – Outlays on higher education by households |
| <i>CP</i> | – Private consumption, realisation |
| <i>CX</i> | – Share of private consumption in GDP (real), percentage points |
| <i>CXP</i> | – Share of private consumption in GDP (current prices), percentage points |
| <i>CY</i> | – Share of personal incomes (total) in GDP (constant prices), percentage points |
| <i>CYP</i> | – Share of personal incomes (total) in GDP (current prices), percentage points |
| <i>DIFXVA</i> | – Difference between GDP and value added |
| <i>DKKBT</i> | – Increment in fixed assets excluding machinery |
| <i>DKKI</i> | – Increment in credit liabilities of non-financial enterprises |
| <i>DKKM</i> | – Increment in machinery and equipment |
| <i>DOP</i> | – Increment in money supply |
| <i>DR</i> | – Inventories, realisation, real |
| <i>DRD</i> | – Inventories, demand, real |
| <i>DRP</i> | – Inventories, realisation |
| <i>DRX</i> | – Share of inventories in GDP (real), percentage points |
| <i>DRXP</i> | – Share of inventories in GDP (current prices), percentage points |
| <i>DSRUSD</i> | – Changes in gross official reserves |
| <i>E</i> | – Exports, total – according to the SNA classification, realisation, real |
| <i>ED</i> | – Exports, total – according to the SNA classification, demand, real |
| <i>EP</i> | – Exports, realisation |
| <i>EPUSD</i> | – Exports, realisation, millions of current USD |
| <i>ETUUSD</i> | – Exports of commodities and services by balance of payments |
| <i>EX</i> | – Share of exports in GDP (real), percentage points |
| <i>EXPP</i> | – Share of inventories in GDP (current), percentage points |

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| <i>FBP</i> | – Wage funds |
| <i>G</i> | – Public expenditures, realisation, real |
| <i>GD</i> | – Public expenditures, demand, real |
| <i>GDP CAP</i> | – GDP in USD per capita |
| <i>GP</i> | – Public expenditures, realisation |
| <i>GX</i> | – Share of public expenditures in GDP (real), percentage points |
| <i>GXP</i> | – Share of public expenditures in GDP (current prices), percentage points |
| <i>H</i> | – World exports |
| <i>HKLZ</i> | – Human capital indicator |
| <i>I1</i> | – Indicator of disequilibrium in consumer goods market |
| <i>INFNIEM</i> | – Rate of inflation in Germany |
| <i>IZZ</i> | – Indicator of disequilibrium in labour market |
| <i>JA</i> | – Investment outlays, total, realisation, real |
| <i>JAD</i> | – Investment outlays, total, demand, real |
| <i>JAP</i> | – Investment outlays, total, realisation, current |
| <i>JAX</i> | – Share of investment outlays in GDP (real), percentage points |
| <i>JAXP</i> | – Share of investment outlays in GDP (current prices), percentage points |
| <i>JIT</i> | – Total investment outlays excluding investments on machinery, realisation, real |
| <i>JITD</i> | – Total investment outlays excluding investments on machinery, demand, real |
| <i>JITF</i> | – Total investment outlays excluding investments on machinery and investment outlays from the state budget, realisation, real |
| <i>JITFD</i> | – Total investment outlays excluding investments on machinery and investment outlays from the state budget, demand, real |
| <i>JITFP</i> | – Total investment outlays excluding investments on machinery and investment outlays from the state budget, realisation |
| <i>JITFX</i> | – Share of investment outlays excluding investments on machinery and investment outlays from the state budget in GDP (real), percentage points |
| <i>JITFXP</i> | – Share of investment outlays excluding investments on machinery and investments from the state budget in GDP (current prices), percentage points |
| <i>JPRIV</i> | – Investment outlays beyond budget |
| <i>JPUB</i> | – Budget investment outlays |
| <i>JV</i> | – Investment outlays on machinery, realisation, real |
| <i>JVD</i> | – Investment outlays on machinery, demand, real |
| <i>JVP</i> | – Investment outlays on machinery, realisation |
| <i>JVX</i> | – Share of investment outlays on machinery in GDP (real), percentage points |
| <i>JVXP</i> | – Share of investment outlays on machinery in GDP (current prices) |
| <i>KIP</i> | – Unit costs |
| <i>KJAW</i> | – Unit costs of education per student |
| <i>KK</i> | – Fixed assets, total, real, end of year |
| <i>KKBT</i> | – Fixed assets excluding machinery, end of year |
| <i>KKIP</i> | – Credit liabilities of non-financial enterprises, end of year |
| <i>KKM</i> | – Fixed assets in machinery, real, end of year |
| <i>KKO</i> | – Current credits |
| <i>KKOP</i> | – Current credits, current prices |
| <i>KKP</i> | – Fixed assets, total, end of year |
| <i>KM</i> | – Fixed assets in machinery, real, average |
| <i>KWNXP</i> | – Labour unit costs |
| <i>KZBP</i> | – Domestic debt of the state budget |
| <i>KZBPXP</i> | – Domestic debt of the state budget, share in GDP |
| <i>L</i> | – Population |
| <i>L1518</i> | – Population in the 15–18 age group |
| <i>L1924</i> | – Population in the 19–24 age group |

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| <i>L714</i> | – Population in the 7–17 age group |
| <i>LB</i> | – Job vacancies |
| <i>LP</i> | – Population in productive ages |
| <i>LZ</i> | – Job searchers |
| <i>M</i> | – Imports, total – by the SNA classification, realisation, real, in USD, current prices |
| <i>M7</i> | – Imports of the SITC 7 commodity group |
| <i>MD</i> | – Imports, total – by the SNA classification, demand, real |
| <i>MP</i> | – Imports, total – by the SNA classification, realisation, current prices |
| <i>MPUSD</i> | – Imports, total – by the SNA classification, realisation, millions of current USD |
| <i>MTUUSD</i> | – Imports of commodities and services by balance of payments |
| <i>MX</i> | – Share of imports in GDP (real), percentage points |
| <i>MXP</i> | – Share of imports in GDP (current), percentage points |
| <i>MZ</i> | – Imports of intermediate commodities, real |
| <i>N</i> | – Employment, realisation |
| <i>ND</i> | – Labour demand |
| <i>NDT</i> | – Labour demand under technological productivity of labour |
| <i>NER</i> | – Number of the retired and pensioners |
| <i>NK</i> | – Labour demand under potential GDP (technological productivity of machinery) |
| <i>NKLZ</i> | – Effective labour force |
| <i>NKLZS</i> | – Effective labour supply |
| <i>NPO</i> | – The employed with elementary education |
| <i>NPOB</i> | – The employed with elementary education subject to balancing condition |
| <i>NS</i> | – Labour force |
| <i>NSR</i> | – The employed with secondary education |
| <i>NSRB</i> | – The employed with secondary education subject to balancing condition |
| <i>NTECH</i> | – Technical variable equal to total employment |
| <i>NWY</i> | – The employed with higher education |
| <i>NWYB</i> | – The employed with higher education subject to balancing condition |
| <i>NZ</i> | – Employees |
| <i>OP</i> | – Money supply, total, end of the year |
| <i>OWXK</i> | – Absorption of assets |
| <i>OWXKM</i> | – Absorption of assets |
| <i>PC</i> | – Private consumption deflator |
| <i>PDR</i> | – Inventory change deflator |
| <i>PE</i> | – Exports deflator, transaction prices |
| <i>PED</i> | – Exports deflator |
| <i>PG</i> | – Public expenditures deflator |
| <i>PH</i> | – World exports deflator |
| <i>PH59</i> | – World exports deflator of the SITC 5–9 commodity groups |
| <i>PJA</i> | – Investment outlays deflator |
| <i>PJJT</i> | – JJJT deflator |
| <i>PJV</i> | – JV deflator |
| <i>PKK</i> | – Fixed assets deflator |
| <i>PM</i> | – Imports deflator, transaction prices |
| <i>PM7</i> | – Imports deflator of the 7 SITC commodity group, transaction prices |
| <i>PM7D</i> | – Imports deflator of the 7 SITC commodity group |
| <i>PMD</i> | – Imports deflator |
| <i>PQ</i> | – Deflator of gross production, total |
| <i>PX</i> | – GDP deflator |
| <i>PY</i> | – Personal incomes deflator |

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| <i>PYW</i> | – Wages deflator |
| <i>Q</i> | – Gross output, real |
| <i>QP</i> | – Gross output |
| <i>RELBCJP</i> | – Share of investment outlays from the state budget in the state budget expenditures (current prices) |
| <i>RKFNIEM</i> | – Nominal interest rate in Germany |
| <i>RKFR</i> | – Nominal interest rate |
| <i>RNPO</i> | – Share of individuals with elementary education |
| <i>RNSR</i> | – Share of individuals with secondary education |
| <i>RNWX</i> | – Share of individuals with higher education |
| <i>SAV</i> | – Measure of wealth |
| <i>SHZ</i> | – Trade balance, according to the SNA classification, real |
| <i>SHZP</i> | – Trade balance, according to the SNA classification, current prices |
| <i>SHZUSD</i> | – Net exports according to the SNA classification, millions of current USD |
| <i>SHZXP</i> | – Share of trade balance in GDP (current), percentage points |
| <i>SJBUSD</i> | – Foreign direct investment, net, balance of payments |
| <i>SJBUSDX</i> | – Foreign direct investment, share in GDP |
| <i>SJPUSD</i> | – Portfolio investment, net, balance of payments |
| <i>SOBKRES</i> | – Balance of payments, capital, financial and the other (except for current) specifications, net |
| <i>SOBUSD</i> | – Balance of payments, current account, net |
| <i>SOBUSDX</i> | – Balance of payments, share in GDP |
| <i>SRUSD</i> | – Balance of payments, gross official reserves |
| <i>SRUSDM</i> | – Share of official reserves in imports of commodities and services, by balance of payments |
| <i>STUDPO</i> | – Students in elementary schools |
| <i>STUDSR</i> | – Students in secondary schools |
| <i>STUDWX</i> | – Student in higher schools |
| <i>STUUSD</i> | – Balance of imports of commodities and services, by balance of payments |
| <i>STUUSDX</i> | – Balance of imports of commodities and services, by balance of payments, share in GDP |
| <i>TFP</i> | – Total factor productivity, dynamics |
| <i>TFPCOMP1</i> | – Total factor productivity due to human capital |
| <i>TFPCOMP2</i> | – Total factor productivity due to domestic R&D |
| <i>TFPCOMP3</i> | – Total factor productivity due to imported R&D |
| <i>TFPLEVEL</i> | – Total factor productivity |
| <i>TT</i> | – Linear trend |
| <i>TU</i> | – Equipment ratio, total |
| <i>TUM</i> | – Equipment ratio in machinery |
| <i>U</i> (two digits) | – Dummy for a given year (last two digits of the year) |
| <i>U</i> (four digits) | – Dummy for a period starting with the first two digits and ending in the last two digits |
| <i>U</i> (two digits)D | – Dummy (equal to 1) for a given year (last two digits of the year) and –1 for the next year |
| <i>UN</i> | – Unemployment |
| <i>UNR</i> | – Rate of unemployment |
| <i>UNRE</i> | – UNR, reciprocal |
| <i>W</i> | – Annual average wages after tax, real |
| <i>WAPOSR</i> | – Share of graduates from elementary schools that continue their education in secondary schools |
| <i>WASRWY</i> | – Share of graduates from secondary schools that continue their education in |

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| | higher schools |
| <i>WBP</i> | – Annual average wages before tax |
| <i>WBPUSD</i> | – Annual average wages before tax, current USD |
| <i>WERP</i> | – Average pension and retirement benefit |
| <i>WKM</i> | – Rate of capacity utilization |
| <i>WKZ</i> | – Rate of shift utilization |
| <i>WN</i> | – Ratio of effective to nominal men-hours of workers |
| <i>WNB</i> | – Average tax rate on wages |
| <i>WNP</i> | – Annual average after tax wages |
| <i>WNT</i> | – Ratio of potential to nominal men-hours of workers |
| <i>WSTPO</i> | – Scholarization ratio in the 7–14 age group |
| <i>WSTSR</i> | – Scholarization ratio in the 15–18 age group |
| <i>WSTWY</i> | – Scholarization ratio in the 19–24 age group |
| <i>WXK</i> | – Productivity of fixed assets |
| <i>WXKM</i> | – Productivity of machinery and equipment |
| <i>WXKMT</i> | – Technological productivity of machinery under full utilisation of shifts and working time |
| <i>WXNM</i> | – Labour productivity |
| <i>WXNML</i> | – Effective labour productivity (allowed for human capital) |
| <i>WXNMLT</i> | – Potential effective labour productivity |
| <i>WXVA</i> | – Labour productivity (value added) |
| <i>WZLD</i> | – Exchange rate (old ZL/USD) |
| <i>X</i> | – Gross Domestic Product, realisation, real |
| <i>XD</i> | – Gross Domestic Product, demand, real |
| <i>XF</i> | – Final domestic demand, realisation |
| <i>XFD</i> | – Final domestic demand |
| <i>XKMT</i> | – Potential GDP under technological productivity of machinery equipment |
| <i>XNMT</i> | – Potential GDP under technological labour productivity |
| <i>XNSMT</i> | – Potential GDP under technological labour productivity and full employment |
| <i>XP</i> | – Gross Domestic Product, realisation |
| <i>XUSD</i> | – GDP in millions of current dollars |
| <i>XVA</i> | – Value added, total |
| <i>XVAP</i> | – Value added, total, current prices |
| <i>XW</i> | – GDP in main trading partners of Poland |
| <i>XX</i> | – Labour productivity of employees for $X/NZ > 0$ |
| <i>Y</i> | – Personal income, total, real |
| <i>YBSP</i> | – Social benefits |
| <i>YDIS</i> | – Personal disposable income |
| <i>YP</i> | – Personal income |
| <i>YRPWOP</i> | – Personal income of business |

NOTES:

- (i) “P” at the end of a given symbol means: current prices
- (ii) Values in real terms are expressed in 1995 prices
- (iii) Base year for all the deflators is 1995

Appendix II

LIST OF EQUATIONS OF THE W8D-2002 ECONOMETRIC MODEL OF THE POLISH ECONOMY FINAL DOMESTIC DEMAND, GDP AND FOREIGN TRADE (BY SNA)

YDIS = (YP-BYPPFP)/PY
 CD = EXP(0.380544301
 + (LOG(C(-1))-LOG(YDIS(-1)) -LOG((SAV(-2)+SAV(-1))/2)
 * (1-U6092))*-0.132435631
 + LOG(YDIS(-1))* -0.029737670
 + LOG(YDIS/YDIS(-1))* 0.401448754
 + LOG((SAV(-2)+SAV(-1)/2)) * (1-U6092) * -0.129229218
 + LOG(((SAV(-1)+SAV)/2)/((SAV(-2)+SAV(-1))/2))
 * (1-U6092) * 0.379367198
 + LOG((1+RKFR)/(PC/PC(-1))) * (1-U6090) * -0.2
 + U83 * 0.049042530) * C(-1)
 C = CD*EXP(-0.002099590*I1+U8182*-0.070754105+U89*
 - 0.055948051 + U90*-0.137403905)
 CX = C/X*100
 CP = C*PC
 CXP = CP/XP*100
 CYP = CP/YP*100
 CY = (C/Y)*100
 GD = EXP(0.866118163+LOG(G(-1))*0.803895006+LOG(BCCP/PG)*
 * 0.109300616
 + LOG(BCCP/PG)*(1-U6090)*0.005735978+U7175*0.026571929)
 G = GD*EXP(-0.074562790*U8081+-0.044459081*U89)
 GP = G*PG
 GX = (G/X)*100
 GXP = (GP/XP)*100
 DRD = 2258.03779
 + DR(-1) * 0.85192
 + (X-X(-1)) * 0.48685
 + WKZ * (1-U6089) * -10774.27340
 + U82 * 14454.28919
 + U90 * 15746.17994
 DR = DRD
 DRX = DR/X*100
 DRP = XP-CP-GP-JAP-EP+MP
 DRXP = DRP/XP*100
 JVD = EXP(-3.100314003
 + LOG(JV(-1)) * 0.556024189
 + LOG(X) * 0.606139791
 + LOG(WBP/8291/PJV) * 0.185680103
 + LOG(WKZ) * 0.896501981
 + LOG(((1+RKFR)/(PJA/PJA(-1)))*(PJV/PX))*(1-U6093) *
 - 0.260143700
 + LOG((SJBUSD*WZLD)/PJV) * (1-U6089) * 0.026446090
 + U7275 * 0.155468378
 + U9596 * 0.173814382)
 JV = JVD*EXP(-0.236834405*U8182+-0.143487981 *U2000)
 JVX = JV/X*100
 JVP = JV*PJV
 JVXP = JVP/XP*100
 JJTFD = EXP(-0.468408546
 + LOG(JJTF(-1)) * 0.779582283
 + LOG(X) * 0.218103828
 + LOG(WKZ) * 0.395493325
 + LOG(((1+RKFR)/(PJA/PJA(-1)))*(PJJT/PX)) * (1-U6093) *
 - 0.602809232
 + LOG((SJBUSD*WZLD)/PJJT) * (1-U6093) * 0.060079064)

JTF = JTTFD*EXP((U72+U7981+U82)*-0.141587062+U95*-0.444033471+U96*-0.305361595)
 JJTFX = JJTF/X*100
 JJTFP = JJTF*PJJT
 JJTFXP = JJTFP/XP*100
 JPRIV = JV+JJTF
 JPUB = BCJP/PJJT
 JJTD = JJTFD+BCJP/PJJT
 JJT = JJTF+BCJP/PJJT
 JAD = JVD+JJTD
 JA = JV+JJT
 JAP = JA*PJA
 JAX = JA/X*100
 JAXP = JAP/XP*100
 ED = EXP(1.196021854
 + LOG(H) * 1.162777579
 + LOG(H) * U7579 * 0.016503602
 + LOG(H) * (1-U6094) * 0.029417099
 + LOG((PE/(WZLD/2.4244))/PH) * (1-U6080) * -0.110533111)
 E = ED*EXP(U81*-0.184631556+U95*-0.089504531)
 EP = E*PE
 EXPP = EP/XP*100
 EX = E/X*100
 EPUSD = EP/WZLD
 MD = EXP(-9.076695429
 + LOG(X) * 1.614130483
 + U8289 * LOG(X) * -0.017765120
 + U6090 * LOG(X) * -0.042415800
 + LOG(PM/PX) * -0.255974344
 + LOG(PM/PX) * (1-U6091) * -1.519717635)
 MZ = EXP(-4.959374637
 + LOG(MZ(-1)) * 0.368518170
 + LOG(Q) * 0.834130406
 + U78 * -0.329801511
 + U81 * -0.212415270
 + U92 * 0.215932038)
 M7 = EXP(LOG(JV/JV(-1)) * 0.964682836
 + LOG(C/C(-1)) * (1-U6090) * 0.986241019
 + LOG((PM7/PJV)/(PM7(-1)/PJV(-1))) * -0.520221943
 + LOG((PM7/PC)/(PM7(-1)/PC(-1))) * (1-U6091) * -0.559994505
 + U78D * -0.127390419
 + U91D * 0.366723448) * M7(-1)
 M = MD
 MP = M*PM
 MXP = (MP/XP)*100
 MX = (M/X)*100
 MPUSD = MP/WZLD
 SHZ = E-M
 SHZP = EP-MP
 SHZXP = SHZP/XP*100
 SHZUSD = EPUSD-MPUSD
 XD = CD+GD+JAD+DRD+ED-MD
 X = C+G+JA+DR+E-M
 XUSD = XP/WZLD
 GDPCAP = ((XP/WZLD)/L)*1000
 XFD = CD+GD+JAD+DRD
 XF = C+G+JA+DR
 XVA = X-DIFXVA
 DIFXVA = EXP(2.041134507

+ LOG(M) * 0.673510357
 + (U72+U73+U74+U75+U76) * -0.084721587
 + U80 * -0.090825517
 + U90 * -0.126463770)
 XP = X*PX
 Q = X/(1-A)
 QP = Q*PQ

FIXED ASSETS AND MATERIAL USE

DKKBT = 1400.74936
 + -3303.16975 * U8089
 -16283.99013 * TR9000
 -7494.95881 * U95
 + 0.25652 * JJT
 + 0.22401 * JJT(-1)
 + 0.19151 * JJT(-2)
 + 0.15900 * JJT(-3)
 + 0.12650 * JJT(-4)
 + 0.09400 * JJT(-5)
 + 0.06149 * JJT(-6)

KKBT = 0.9865*KKBT(-1)+DKKBT

DKKM = 2345.906777
 + DKKM(-1) * 0.688125
 + JV * 0.208657
 + U80 * -7046.207641
 + U96 * 7643.000782

KKM = 0.91*KKM(-1)+DKKM

KM = (KKM+KKM(-1))/2

KK = KKM+KKBT

KKP = KK*PKK

A = EXP(-0.957292119
 + TT * 0.007905336
 + TT * U6079 * -0.018127636
 + TT*TT * U6079 * 0.000855110
 + U8089 * 0.041382927)

AT = A*(1-0.031309422)

LABOR AND CAPITAL PRODUCTIVITIES, POTENTIAL GDP AND TFP

TU = WKZ*KK/N

TUM = EXP(-0.442419898
 + (LOG(TUM(-1))-LOG(PJV(-1)/WBP(-1)/8291)) * -0.076592134
 + LOG(PJV(-1)/WBP(-1)/8291) * -0.108972800
 + TT(-1) * 0.001777797
 + LOG((PJV/WBP/8291)/(PJV(-1)/WBP(-1)/8291)) * -0.016276805
 + U7479 * 0.058558006
 + U8184 * -0.037583195) * TUM(-1)

WXNML = EXP(0.007473485
 + LOG((TUM/HKLZ)/(TUM(-1)/HKLZ(-1))) * 0.400362881
 + LOG(WN/WN(-1)) * 1.159465972
 + LOG(BIRKSI/BIRKSI(-1)) * 0.181402079
 + ((M7/JV)*LOG(BIRMSI)-(M7(-1)/JV(-1))*LOG(BIRMSI(-1)))) *

0.040864262

+ U7981 * -0.091761159
 + U8384 * 0.034300822
 + U90 * -0.069750263) * WXNML(-1)

WXNMLT = EXP(0.007473485
 + LOG((TUM/HKLZ)/(TUM(-1)/HKLZ(-1))) * 0.400362881
 + LOG(WNT/WNT(-1)) * 1.159465972

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+ LOG(BIRKSI/BIRKSI(-1)) * 0.181402079
+ ((M7/JV)*LOG(BIRMSI)
- (M7(-1)/JV(-1))*LOG(BIRMSI(-1))) * 0.040864262
+ U7981 * -0.091761159
+ U8384 * 0.034300822
+ U90 * -0.069750263) * WXNMLT(-1)
WXKMT = EXP(LOG((TUM/HKLZ)/(TUM(-1)/HKLZ(-1)))) * -0.520881961
+ LOG(WN/WN(-1)) * 1.167246903
+ LOG(BIRKSI/BIRKSI(-1)) * 0.137559893
+ ((M7/JV)*LOG(BIRMSI)
- (M7(-1)/JV(-1))*LOG(BIRMSI(-1))) * 0.051528961
+ U7981 * -0.087855198
+ U8384 * 0.038334276
+ U90 * -0.071672336) * WXKMT(-1)
TFP = EXP(-0.520881961*LOG(HKLZ/HKLZ(-1))
+ 0.137559893*LOG(BIRKSI/BIRKSI(-1))
+ 0.051528961*((M7/JV)*LOG(BIRMSI)-(M7(-1)/JV(-1)))
* LOG(BIRMSI(-1)))
TFPCOMP1 = EXP(0.520881961*LOG(HKLZ/HKLZ(-1)))
TFPCOMP2 = EXP(0.137559893*LOG(BIRKSI/BIRKSI(-1)))
TFPCOMP3 = EXP(0.051528961*((M7/JV)*LOG(BIRMSI)
- (M7(-1)/JV(-1))*LOG(BIRMSI(-1))))
TFPLEVEL = TFPLEVEL(-1)*TFP
WXKM = X/KM
WXK = X/KK
OWXKM = KM/X
OWXK = KK/X
WKZ = (WXKM/WXKMT)**(1/0.852583293)
XKMT = X/(WKM/100)
WKM = (WKZ**0.852583293)*100
NKLZS = NS*HKLZ
XNMT = WXNMLT*NKLZ
XNSMT = WXNMLT*NKLZS
WXNM = X/N
WXVA = XVA/N
XVAP = XVA*PX
WN = (((WXNM/(WXNMLT*HKLZ)))*((WXNMLT(-1)
* HKLZ(-1))/WXNM(-1)))**((1/1.159465972)
* WN(-1)*WNT)/WNT(-1)
WNT = EXP(-0.054343363
+ TT * -0.001294839
+ U8184 * -0.003786649
+ U9598 * 0.026399827
+ (1-U6098) * 0.039277016)

```

HUMAN CAPITAL, OUTLAYS ON R&D

```

RNPO = NPOB/N
RNSR = NSRB/N
RNWY = NWYB/N
HKLZ = (RNWY*1.75+RNSR*1.2 +RNPO*1)
NKLZ = N*HKLZ
NPO = EXP(-0.217697684
+ LOG((1-0.025) * NPO(-1)+(1-WAPOSR)* ABPO) * 1.024710293
+ U9092 * -0.074957316
+ U96 * 0.059223970
+ U99 * -0.070557903)
NTECH = NPO+NSR+NWY
NPOB = NPO/(NTECH/N)

```

```

NSR      = EXP(-0.344826695
+ LOG((1-0.025) * NSR(-1)+ (1-WASRWY)* ABSR) * 1.035984262
+ U9093 * -0.031529259
+ (1-U6093) * 0.047201390)
NSRB     = NSR/(NTECH/N)
NWY      = EXP(-0.152490185
+ LOG((1-0.025) * NWY(-1)+ ABWY) * 1.022282403
+ (1-U6098) * -0.069018963)
NWYB     = NWY/(NTECH/N)
ABPO     = EXP(-5.532168268
+ LOG((STUDPO(-8)+STUDPO(-7)+STUDPO(-6)+STUDPO(-5)
+ STUDPO(-4)+STUDPO(-3)+STUDPO(-2)+STUDPO(-1))/8) *
* 1.400246537 + U8284 * -0.053572854
+ (1-U6097) * 0.072220311)
ABSR     = EXP(0.378840875
+ LOG((STUDSR(-1)+STUDSR(-2)+STUDSR(-3)+STUDSR(-4))/4) *
* 0.816342097 + U70 * -0.235677210
+ U7381 * 0.110433032
+ U91 * -0.145797220
+ (1-U6091) * -0.299720978)
ABWY     = EXP(-3.874096676
+ LOG((STUDWY(-1)+STUDWY(-2)+STUDWY(-3)+STUDWY(-4)
+ STUDWY(-5))/5)*1.342816082
+ U6668 * -0.110987844
+ (U7374+U75) * 0.138665711
+ U77 * -0.125655741
+ (1-U6092) * -0.177304678)
WSTSR    = 1/(1+3.074851146*EXP(-0.095654706*TT))
+ U7477 * 0.048318528
+ U8289 * TT * -0.008665849
+ U81 * -0.099684839
+ U85 * 0.253740058
+ (1-U6095) * 0.027661472)
WSTWY    = STUDWY/L1924
WASRWY   = 1.38389631
+ 1/TT * -34.43874492
+ (1-U6096) * 0.14079919)
WSTPO    = 0.998
STUDPO   = WSTPO * L714
STUDSR   = WSTSR * L1518
STUDWY   = (BEDWP/PX)/KJAW
KJAW     = EXP(0.73379830
+ TT * 0.03643454
+ (1/TT) * (1-U6092) * -23.99643036
+ U7479 * 0.18408741
+ (U91+U92) * -0.41329638
+ U9395 * 0.33687264
+ (1-U6097) * -0.47117002)
BEDOP    = BBGOP+CEDOP
BBGOP    = EXP(-2.978428482
+ LOG(BCCP) * 1.104695599
+ LOG(BCCP) * U7175 * 0.057792929
+ LOG(BCCP) * U7881 * -0.036046242
+ (1-U6098) * 0.205157330)
CEDOP    = EXP(-5.254181285
+ LOG(CP) * 0.985563043
+ (1-U6098) * -0.325524181)
BCBWP    = EXP(-4.312346451
+ LOG(BCCP) * 1.072567392)

```

```

+ LOG(BCCP) * U6570 * -0.055769398
+ LOG(BCCP) * U7377 * 0.025848615
+ U8081 * -0.185096977
+ U8990 * 0.191586649
+ U9495 * -0.220450751
+ (1-U6098) * 0.180774660)
CEDWP = EXP(-4.597764601
+ LOG(CP) * 0.985563043
+ (1-U6098) * -0.325524181)
BEDWP = BCBWP + CEDWP
BIRKB = EXP(2.594729853
+ LOG(BCC) * 0.411139799
+ LOG(BCC) * U7079 * 0.047523829
+ LOG(BCC) * U8389 * -0.051437600
+ LOG(BCC) * (1-U6095) * 0.007590369
+ U87 * -1.495013405
+ U89 * -1.035049841
+ U90 * -1.898057303
+ U91 * 0.415830416)
BIRKQ = EXP(2.188365084
+ LOG(AFZSP/PX) * 0.511099117
+ LOG(AFZSP/PX) * U7079 * 0.061462995
+ U8081 * 0.654396950
+ U8285 * -0.766276518
+ U91 * -1.907290856
+ LOG(AFZSP/PX) * (U9097) * -0.051597470)
BIRK = BIRKB+BIRKQ
BIRM = EXP(-18.12501528
+ LOG(XW) * 1.69850328
+ U8289 * LOG(XW) * -0.04348594
+ (1-U6091) * LOG(XW) * 0.01982577
+ U78 * -0.91463358
+ U7980 * -0.29106066
+ U8889 * 0.35132009
+ (U99+U2000) * -0.23499548)
BIRKS = BIRKS(-1)-0.05*BIRKS(-1)+BIRK
BIRMS = BIRMS(-1)-0.05 *BIRMS(-1)+BIRM
BIRKSI = BIRKS/59463.140201571
BIRMSI = BIRMS/188932.06438815

```

LABOUR MARKET

```

NS = (1.050543573
+ LOG(YBSP/YP) * -0.089737979
+ LOG(WNP/PYW) * -0.046073395
+ UNR(-1) * 0.000899891
+ U8082 * 0.012012130
+ U90 * -0.018618581
+ (1-U6096) * -0.019560428) * LP
NDT = X/(WXNML*HKLZ)
NK = XKMT/WXNM
N = IF ( NS < ND & NS < NK ) THEN 0.98*NS
      ELSE IF ( NS > ND & NK > ND ) THEN ND
      ELSE IF ( NS > NK & ND > NK ) THEN NK ELSE 0.98*NS
UN = (IF (0.98*NS > N) THEN NS-N ELSE 0.02*NS)*(1-U6089)
UNRE = IF (UNR > 0) THEN 1/UNR ELSE 0
UNR = (UN/NS)*100*(1-U6089)
ND = EXP(0.057413004
+ (LOG(ND(-1))-LOG(NDT(-1)))

```

```

- LOG(LB(-1)/LZ(-1)) * U6089) * -0.403825272
+ LOG(LB(-1)/LZ(-1)) * U6089 * -0.398686856
+ LOG(NDT/NDT(-1)) * 0.787044470) * ND(-1)
NZ = EXP(-5.863730808
+ LOG(N) * 1.564672202
+ LOG(N) * U6070 * 0.003568497
+ LOG(N) * U7180 * 0.006244477
+ LOG(N) * U8190 * 0.003451122
+ LOG(N) * (1-U6095) * -0.005607899
+ U91 * 0.034643828)

```

WAGES AND INCOMES

```

XX = IF (WXNM > WXNM(-1) ) THEN (WXNM/WXNM(-1)) ELSE 1
WBP = EXP(LOG(PC/PC(-1)) * 0.97
+ LOG(XX) * 0.670770360
+ IZZ * 0.898999326
+ UNRE * 0.454379126
+ U75 * 0.092156310
+ U82 * -0.269844523
+ U89 * 0.119878056
+ U90 * -0.259604436) * WBP(-1)
W = WBP/PYW
WNP = WBP*(1-WNB)
WBPUSD = WBP/WZLD
FBP = EXP(-0.040218028
+ LOG(WBP*NZ/1000) * 0.993600952
+ LOG(WBP*NZ/1000) * (1-U6089) * 0.025787327
+ U8083 * -0.026357973
+ U90 * -0.290760883)
WERP = EXP(-0.025460911
+ LOG(WBP/WBP(-1)) * U6094 * 1.056086335
+ LOG(PC/PC(-1)) * (1-U6094) * 1.129617533
+ U75 * -0.139417996
+ U82 * 0.367722756
+ U83 * -0.127786389
+ U99 * 0.114855101) * WERP(-1)
YBSP = (WERP*NER)
YRPWOP = EXP(-0.895343283
+ (LOG(YRPWOP(-1))-LOG(XP(-1))) * -0.761156661
+ LOG(XP(-1)) * -0.027140477
+ LOG(XP/XP(-1)) * 1.142325020
+ U81 * 0.215234272
+ U99 * -0.325802753) * YRPWOP(-1)
YP = YRPWOP+FBP+YBSP
Y = YP/PY

```

DEFLATORS

```

BYVP_X = BYVP/X
KIP = BYVP_X+PM*(1+BYCP/MP+(1-U6089)*BYVP_X)*(MZ/X)+(AMKKP*KKP(-1))/X
+ (((WBP*(1+AFFP*U6090+AFFP*3*(1-U6090))*NZ))/1000)/X
+ (RKFR*BZNGP(-1))/X
KWNXP = (((WBP*(1+AFFP*U6090+AFFP*3*(1-U6090))*NZ))/1000)/X
PX = EXP(0.169855416
+ 0.98078684*((AFZSP(-1)/XP(-1))*(LOG(AFZSP/(KIP*X))*U6090
+ LOG(WKZ)*(1-U6090))
+ LOG(0.20*KIP+0.80 *KIP(-1)))
+ U81 * -0.213716471
+ (U8388+U91) * 0.233960053

```

```

PC      + U8990 * 0.805796838)
        = EXP(-0.011415827
        + (LOG(PX)*X/(X+M)+LOG(PM*(1+BYCP/MP))*M/(X+M)) *
        * 0.902439592 + (LOG(PX)*X/(X+M)
        + LOG(PM*(1+BYCP/MP))*M/(X+M)) * (1-U6092) * 0.124448147
        + LOG(BYVP_X) * 0.083165104
        + U6770 * 0.032297890
        + U88 * -0.07117512 + U92 * 0.128469910
        + (1-U6092) * 0.178373343)
PG      = EXP(-0.528368094
        + (LOG(PX)*X/(X+M)+LOG(PM*(1+BYCP/XP))*M/(X+M)) *
        * 0.875327622 + U8084 * -0.245149154
        + (1-U6089) * 0.522245113)
PJA     = PJV*JV/JA+PJJT*(1-JV/JA)
PJV     = BYVP_X + EXP(-0.103506848
        + LOG(PX) * 0.621940269
        + LOG(PM) * 0.286733324
        + LOG(PX) * U6069 * -0.018994673
        + LOG(PM) * U8088 * 0.048303429
        + (1-U6096) * -0.481331232)
PJJT    = BYVP_X + EXP(0.237585785
        + LOG(PX) * 0.678676094
        + LOG(PM) * (1-0.678676094)
        + U80 * -0.191011699
        + U81 * -0.330312687
        + (U94+U95+U96) * -0.350821748
        + (1-U6096) * 0.125809192)
PDR     = DRP/DR
PED     = EXP(LOG(PH/PH(-1)) * 0.426413961
        + LOG((PX/(WZLD/2.4244))/(PX(-1)/(WZLD(-1)/2.4244)))) *
        * 0.574253284 + (U80+U81) * -0.217822841
        + U89 * -0.139848963) * PED(-1)
PE      = PED*(WZLD/2.4244)
PMD     = EXP(LOG(PH/PH(-1)) * 0.513240585
        + U81D * -0.481501754
        + U99D * -0.115690551) * PMD(-1)
PM      = PMD*(WZLD/2.4244)
PM7D    = EXP(-0.015332819
        + LOG(PH59/PH59(-1)) * 0.868486254
        + (U79+U80+U81) * -0.310757002) * PM7D(-1)
PM7     = PM7D*(WZLD/2.4244)
PYW     = EXP(-0.002055301
        + LOG(PC/PC(-1)) * 1.028528310
        + U80 * -0.064217730
        + U92 * 0.177555140
        + U99 * 0.193484700) * PYW(-1)
PY      = EXP(-0.000580587
        + LOG(PC/PC(-1)) * 1.003673545
        + U91 * -0.132826812
        + U97 * -0.041689998) * PY(-1)
PKK     = EXP(-0.172546714
        + LOG(PKK(-1)) * 0.480419146
        + LOG(PJA) * 0.502628427
        + U90 * 1.930781076
        + (U95+U96) * 0.379711731)
PQ      = EXP(0.054636618
        + LOG(A(-1)*PQ(-1)) * 0.094117115
        + LOG(PX) * 0.845093523
        + U8088 * -0.158205669

```

+ U9091 * 0.136733454)
 RKFR = 0.024569103 + ((PY-PY(-1))/PY(-1)+
 + (PJA-PJA(-1))/PJA(-1))/2) * 1.159123211
 + U97 * -0.102464028
 + (U99+U2000) * 0.101948542
 WZLD = EXP(-0.060754515
 + LOG(PX/PH) * 0.933398547
 + LOG(PX/PH)*(1-U6089) * -0.364536850
 + LOG(E/M)*(1-U6079) * -1.201611368
 + (1-U6091) * ((RKFR-(PX/PX(-1)-1))/(RKFNIEI- INFNIEI)) *
 * -0.02 + U6072 * -0.296036755
 + U8790 * 0.342192487) * 2.4244

MONEY MARKET

DKKI = 14842.67576
 + JA * 0.04805
 + ((1+RKFR)/(PJA/PJA(-1))) * (1-U6089) * -4256.30001
 + (KKIP(-1)/PJA(-1)) * -0.21245
 + U90 * -2396.43618
 + ((1+RKFR)/(PJA/PJA(-1))) * (1-U6098) * -2870.53449
 KKIP = KKIP(-1)+DKKI*PJA
 DOP = 3394.06952
 + (0.09*(YP-YP(-1))+0.45*(YP-CP)
 + 0.02*XP+6000*WZLD*(RKFR-(PX-PX(-1))/PX(-1))
 - (RKFNIEI- INFNIEI)) * 1.03423
 - 13336.42701 * U2000
 OP = OP(-1)+DOP
 BZNPP = 8712.39762
 + (C-C(-1)) * 0.39426
 + ((1+RKFR)/(PC/PC(-1))) * -4933.11234
 + U6098 * -4392.66136) * PC + BZNPP(-1)
 BZPPP = EXP(-23.75135928
 + TT * 1.69338303
 + TT*TT * -0.02026492
 + U92 * -0.26165781)
 BZAKP = BRP
 BRP = EXP(1.5687193764
 + LOG(BRZFP+OP) * 0.9227010114)
 KKO = EXP(-15.51730326
 + LOG(X) * 1.23538341
 + LOG((1+RKFR)/(PX/PX(-1))) * -1.28041962
 + U96D * 0.20861828) * KKO(-1)
 KKOP = KKO*PX
 BZNGP = KKIP+KKOP
 BZRESP = BZAKP- (BZNPP+BZNGP+BZPPP)
 AFZSP = EXP(0.611642909
 + LOG(XVAP-(BYVP+((WBP*(1+AFFP*U60
 + AFFP*3*(1-U6090))*NZ)/1000)+RKFR*BZNGP(-1)))*0.928983856
 + LOG(XVAP-(BYVP+((WBP*(1+AFFP*U6090
 + AFFP*3*(1-U6090))*NZ)/1000)+RKFR*BZNGP(-1))
 * U6072 * -0.302660519
 + LOG(XVAP-(BYVP+((WBP*(1+AFFP*U6090
 + AFFP*3*(1-U6090))*NZ)/1000)+RKFR*BZNGP(-1))
 * (1-U6091) * -0.088713729
 + U91 * -0.915203108
 + (U98+U99) * -0.569428271)
 SAV = EXP(LOG(YDIS/YDIS(-1)) * 0.941567922
 + (RKFR-(PY/PY(-1)-1)) * 0.733384633

+ LOG(PY) * -0.102662922) * SAV(-1)

STATE BUDGET

BCP = EXP(-0.065135890
 + LOG(BCP(-1)) * 0.044689887
 + LOG(BYP) * 0.969480441
 + U7678 * -0.095079638
 + U81 * 0.087706440
 + U89 * 0.113152009
 + U92 * 0.129602795)

BCJP = RELBCJP*BCP
 BCCP = BCP-BCJP
 BCC = BCCP/PG
 BDP = BYP-BCP
 BDPR = BDP/XP*100
 BYP = EXP(0.769428892
 + LOG(BYVP+BYIFP+BYFPF+BYCP) * 0.939944411
 + U7173 * -0.152903896
 + U7681 * 0.206140395
 + U8289 * -0.151781258)

BYVP = EXP(-1.557639514
 + LOG(CP+MP+BYCP) * 0.957689594
 + U73 * -0.158274468
 + U8384 * 0.180440604
 + U9092 * -0.306537444
 + U9496 * 0.123229317)

BYFPF = EXP(-0.309300547
 + LOG(0.2*YP)*(1-U6091)*0.961035124
 + LOG(0.2*FBP)*U6091*1.022452371
 + LOG(0.2*YP)*(1-U6098)*-0.055274852
 + U7881 * -0.589883919
 + U91 * -0.740377836)

BYIFP = EXP(-0.392358580
 + LOG(AFZSP) * 1.025524467
 + LOG(AFZSP) * U7478 * -0.136614758
 + LOG(AFZSP) * U8388 * -0.075305567
 + LOG(AFZSP) * U9497 * -0.055803783
 + U80 * 0.633562618
 + U89 * -1.310990729
 + U92 * 0.852897313)

BYCP = BYCCOEF*MP
 KZBP = 54832.886231
 + (KZBP(-1))+(-BDP) * 0.809801

BALANCE OF PAYMENTS

ETUUSD = EXP(-0.681093822
 + LOG(EP/WZLD) * 1.001551204
 + LOG(EP/WZLD) * (1-U6089) * 0.043245401
 + U2000 * -0.259381072)

MTUUSD = EXP(-1.298536366
 + LOG(MP/WZLD) * 1.067843140
 + LOG(MP/WZLD) * (1-U6089) * 0.049673997
 + U89 * 0.333197433
 + U91 * -0.186978212
 + U2000 * -0.281830502)

STUUSD = ETUUSD+MTUUSD
 STUUSDX = STUUSD/XUSD

```
SOBUSD = -1941.040978
        + (EP/WZLD-MP/WZLD) * 0.660189
        + U8990 * -2973.994947
        + U95 * 6351.839974
SOBUSDX = (SOBUSD/XUSD)*100
SJBUSD = EXP(-57.5865875
        + (((PX-PX(-1))/PX(-1))*100-100) * -0.04557626
        + LOG(X) * 4.87073695)
SOBKFRES = EXP(1.6992039179
        + LOG(SJBUSD+SJPUSD) * 0.8462804254)
DSRUSD = (SOBUSD+SOBKFRES)
SRUSD = SRUSD(-1)+DSRUSD
SRUSDM = SRUSD/MTUUSD
BIRKX = (BIRK/X)*100
SJBUSDX = (SJBUSD/XUSD)*100
BEDOPX = (BEDOP/XP)*100
BEDWPX = (BEDWP/XP)*100
KZBPXP = (KZBP/XP)*100
BIRKBX = (BIRKB/X)*100
```