MACROECONOMIC DYNAMICS OF THE RUSSIAN FEDERATION: ECONOMETRIC MODEL - 2020

Abstract. Paper describes the results of 2020 version of author's econometric model of Russian Federation economy. The previous version of model was upgraded by including new variables and changing the specification of equations. It was totally re-estimated due to new data. The model analyzes and explains current trends in Russian economy and forecasts its dynamics. It calculates such macroeconomic indicators as gross domestic product, different indicators of inflation, investment, export and import volumes, households' incomes and consumption, etc. The model showed that if all exogenous variables (export and import prices, the monetary base and economically active population, etc.) will have the same dynamics they had during last four years even in the absence of Covid19 the average annual growth rate of Russian economy for the next four years will be about zero while inflation about 3 - 4 % annually. Russian economy have significant growth rate only when the world economy grows rapidly. Model showed strong dependence of Russian economy on demographic and international factors. The fiscal should be liberalized in order to restore growth.

Keywords: Econometric model; Macroeconomics; Russian Federation.

1 Introduction

Our goal is to analyze and explain current trends in Russian economy and to forecast its dynamics using an econometric model. A comprehensive econometric model of Russian economy is a rather rare phenomenon. We mention first of all such works as [1], [2], [3], [4], [5], [6], [7] devoted to this problem.

The works [1], [2], [3] are devoted to econometric modeling of Russian economy and its links with economy of Armenia. But they published only different equations that are maybe only part of the model. The model in [4] is rather small and estimated on old data. The approach in [5] is based on hypothesis of decisive role of aggregate demand in economic growth. But the growth of Russian economy is limited not only by demand but by supply factors also (production factors, technology etc.). That's why it is necessary to include them in the model. The model in the work [6] includes only 2 equations and 9 variables.

The model in [7] describes different sectors of economy. But the author published only standard errors of parameters and didn't mention other important econometric outcomes (residual analysis etc.). This model doesn't include many factors which we consider important. Among them there is the impact of demand and liquidity on production, the role of non-price factors in export dynamics, etc. Without them the specification of equations seems incomplete and estimation of parameters may be biased.

With all these considerations we tried to construct our model aiming that it should be satisfactory in following points 1) be sufficiently extensive and include different sectors (production, investment, prices, export and import, etc); 2) reflect our understanding of economic process that is include a set of variables that is as full as possible; in other words the specification of equation should be complete; and 3) meet the criteria of econometric estimation.

We used the experience of Austrian' economy model construction presented in [8] also.

2 Model

2.1 General description

The 2020-year version of the model consists of 24 equations and 66 identities that describe the relationships between 90 variables (14 exogenous among them).

Model is structural and totally recursive. That's why its equations were estimated separately by Ordinary Least Squares (OLS) and by Maximum Likelihood – Autoregressive Conditional Heteroskedasticity (ML – ARCH) methods. The estimators were White heteroskedasticity-consistent standard errors & covariance and Newey – West standard errors & covariance (OLS) and Bollerslev – Wooldridge robust standard errors & covariance (ML – ARCH).

The estimation was based on quarterly time series for the period Q1 1999 to Q4 2019. Regressors' selection in each equation was subjected to the following criteria: a) accordance with economic theory; b) appropriate statistical properties of estimation; c) optimal value of information criteria (Akaike etc). The new version of the model changed the previous one in the following points: the new estimates of parameters which we got and the new specification of equations that was changed as a result of estimation and regressors' selection. Some new variables (cash money, required banking reserves and some others) were also included in the new version.

Since the complete list of econometric outputs of all estimated equations takes more than 50 pages and does not fit into the scope of the article (but it can be provided to any reader upon request) we describe here the econometric technique and the results of estimation only briefly. All the series were estimated in the first differences (following the recommendations in [9]) and satisfied the criteria of stationarity such as Dickey – Fuller and other tests. The parameters of all regressors were significant in accordance with t-statistics (OLS) or z-statics (ML – ARCH) and correspond to economic theory and economic practice. The residuals of estimated equations are appropriate in accordance of normality (Jarque – Bera) and serial correlation (Breusch-Godfrey Serial Correlation LM Test for OLS)) and heteroskedasticity tests (Breusch-Pagan-Godfrey test for OLS and ARCH test for ML – ARCH).

The coefficients in identities were calculated on the basis of real statistics. For example the volume of corporate income tax paid (PTAX variable in identity 44) is calculated as gross corporate income (ROK) multiplied by the k_{PTAX} coefficient. The latter is a ratio if the first (PTAX) to the second (ROK) calculated on the real data (the "efficient tax rate"). All the details of econometric estimation the reader finds in [10].

2.2 A list of model variables

Exogenous variables

CAP: Capital account balance (in dollars); IND_G: Government purchases' index in constant prices; KEY: The Bank of Russia' key loan rate; M0M: share of cash in the money mass; MB: Monetary base; MROT: minimum wages; N: Economically active population, age 15-72; NONTAX: Nontax government revenues; OECD: OECD countries' total GDP index; PEXPD: Dollar index of export prices; PG: Government consumption' deflator; PIMD: Dollar index of import prices; RRESMN: ratio of required reserves to non-cash money mass; TARIF: Transportation services' tariffs' index

Endogenous variables

CH: Consumer bank loans, total; CONS: Households' consumption in current prices; CPI: Consumer price index; CR: Ruble bank loans to companies; CT: Bank loans to companies, total; CV: Foreign currency bank loans to companies; DEF: a proxy of the state budget balance; DEPRF: Companies' bank ruble deposits; DEPRP: Households' bank ruble deposits; DEPRT: Total bank ruble deposits; DEPT: Total bank deposits; DEPVF: Companies' bank foreign currency deposits; DEPVP: Households' bank foreign currency deposits; DEPVT: Total bank foreign currency deposits; DI: Gross fixed capital formation price index; DOLLAR: Ruble to dollar exchange rate index; EXPO: Export (volume of) in current prices; G: Government purchases in current prices; I: Gross fixed capital formation in current prices; IB: Investment in fixed capital through bank loans in current prices; IG: Investment in fixed capital from state budget in current prices; IMP: Import (volume of) in current prices; INCOME: Households' disposable income; IND_C: Households' consumption index in constant prices; IND_EXP: Export's index in constant prices; IND_I: Gross fixed capital formation index in current prices; IND_IMP: Import's index in constant prices; INTAX: Indirect taxes paid in current prices; IO: Investment in fixed capital on companies' own expense in current prices; K: Fixed capital volume in current prices; L: Number of employed; M0: the volume of cash; M: Money mass; MIACR: The MIACR interbank interest rate on Moscow market; MN: Non-cash money mass; NATTAX: taxes for the use of natural resources paid; NMPL: Net marginal product on labor; NMRK: Net marginal revenue on fixed capital; NROK: Gross profit net of corporate income tax; NX: Net export; P: the GDP deflator index; PEN: Energy inputs' price index; PERTAX – Personal income tax paid; PEXP: Ruble index of export prices; PIM: Ruble index of import prices; PQ: Nominal GDP; PTAX: Corporate income tax paid in current prices; Q: the GDP index in constant prices; REV: Total government revenue; ROK: Gross profit; S: Inventory change; SOCTAX: Social insurance payment; STTAX: Total taxes paid by companies as a share of the GDP; TRAN: the volume of social transfers paid; TTAX: total corporate taxes in current prices; W: Average gross wages per 1 employee; WL: Total gross wages paid in the economy; ε_K: Elasticity of GDP on fixed capital; ε_L: Elasticity of GDP on labor.
If divided one variable on another we merge their writing. For example when we deflate export in current price by the index of export prices we name the new variable as EXPEXP.

2.3 Equations and identities description

The description below presents a simplified version of the model as it includes only variables the elasticity of dependent variable on which in each equation is not less than 0.1 in absolute value.

Equation 1 shows that fixed capital stock depends on gross capital formation, its deflator and on some other variables.

$$K = f_K(I, DI, W, N, CT) \quad (1)$$

Equation 2 shows that number of employees depends mostly on the number of economically active population.

$$L = f_L(N) \quad (2)$$

Equation 3 is the production function.The production volume here depends not only on capital and labor but on and some other variables also as total factor productivity depend on external demand and liquidity conditions also.

$$Q = f_Q(K, L, DI, CT, OECD) \tag{3}$$

Equation 4 shows that the GDP deflator dependsmostly on export prices, on the GDP volume, on dollar exchange rate, on government consumption deflator and on average wages and on inventory change.

$$P = f_P(PG, PEXPD, DOLLAR, S, W, Q) \tag{4}$$

Identity 5 determines the nominal volume of the GDP.

$$PQ = P \times Q \tag{5}$$

Identity 6 determines the elasticity of GDP on fixed capital.

$$\varepsilon_K = \frac{\partial Q}{\partial K}\frac{K}{Q} \tag{6}$$

Identity 7 determines the elasticity of GDP on labor.

$$\varepsilon_L = \frac{\partial Q}{\partial L}\frac{L}{Q} \tag{7}$$

Identity 8 determines net marginal revenue on fixed capital.

$$NMRK = \varepsilon_K \frac{PQ - INTAX - PTAX - NATTAX}{K} \tag{8}$$

Identity 9 determines net marginal productivity of labor.

$$NMPL = \varepsilon_L \frac{Q \times (1 - STTAX)}{L} \tag{9}$$

Equation 10 shows that average gross wage per worker depends on net marginal productivity of labor first of all, but on government purchases and some other variables also.

$$W = f_W(NMPL, G, EXP, IMP, CT, MROT, P, N) \tag{10}$$

Identity 11 defines the total wages in the economy.

$$WL = W \times L \tag{11}$$

Equation 12 shows that households' consumption depends mostly on disposable income and on prices.

$$CONS = f_C(CPI, INCOME) \tag{12}$$

Identity 13 determines the volume of disposable income.

$$INCOME = PQ - REV + TRAN \tag{13}$$

Identity 14 determines total government revenue in the model as a sum of all taxes collected.

$$REV = TTAX + PERTAX + SOCTAX + NONTAX \tag{14}$$

Equation 15 shows that CPI depends mostly on the GDP deflator, on export prices and on the exchange rate.

$$CPI = f_{CPI}(P, DOLLAR, PEXP) \tag{15}$$

Identity 16 determines the index of households' consumption in constant prices.

$$IND\_C = CONS / CPI \tag{16}$$

Identity 17 determines the amount of gross capital formation as a sum of investment from all sources of funding.

$$I = IO + IG + IB \tag{17}$$

Identity 18 determines the volume of gross corporate income.

$$ROK = PQ - WL - INTAX \tag{18}$$

Identity 19 determines the volume of net corporate income.

$$NROK = ROK - PTAX - NATTAX \tag{19}$$

Equation 20 shows that investment in fixed assets at the companies' own expense depends on marginal revenue on fixed capital and on net corporate income first of all. The private investment is supported by the government one but the current government expenditures have negative impact on it.

$$IO = f_{IO}(NMRK, NROK, IG, DI, G, MN, TARIF) \tag{20}$$

Equation 21 shows that investment in fixed assets at the expense of state budget depends mostly on the government revenues and on liquidity conditions, but transportation' tariffs have negative impact on it.

$$IG = f_{IG}(REV, G, DI, TARIF, MN) \tag{21}$$

Equation 22 shows that investment in fixed capital by means of bank loans depends on total bank loans to companies and on net marginal revenue on fixed capital first of all.But it depends on government investment also.

$$IB = f_{IB}(NMRK, CT, IO, IG, G, DI, TARIF, MN) \quad (22)$$

Equation 23 shows that gross fixed capital formation deflator depends mostly on the GDP deflator, on import prices and on money mass and on return on fixed capital.

$$DI = f_{DI}(P, PIM, Q, K, M) \quad (23)$$

Identity 24 determines the index of gross fixed capital formation in constant prices.

$$IND\_I = I / DI \quad (24)$$

Equation 25 shows that households' bank ruble deposits depend on disposable income and on money mass and on some other variables.

$$DEPRP = f_{DEPRP}(INCOME, P, M, M0) \quad (25)$$

Equation 26 shows that companies' bank ruble deposits depend on money mass and on monetary base some other variables.

$$DEPRF = f_{DEPRF}(P, M, MB, M0) \quad (26)$$

Equation 27 shows that households' bank foreign currency deposits depend on disposable income and exchange rate and on money mass and on some other variables.

$$DEPVP = f_{DEPVP}(INCOME, P, DOLLAR, M) \quad (27)$$

Equation 28 shows that companies' bank foreign currency deposits depend on the volume of GDP and export, on exchange rate and on some other variables.

$$DEPVF = f_{DEPVF}(P, Q, EXPO, DOLLAR) \quad (28)$$

Identity 29 determines the volume of total ruble bank deposits.

$$DEPRT = DEPRP + DEPRF \quad (29)$$

Identity 30 determines the volume of total foreign currency bank deposits.

$$DEPVT = DEPVP + DEPVF \quad (30)$$

Identity 30 determines the volume of total bank deposits.

$$DEPT = DEPRT + DEPVT \quad (31)$$

Equation 32 shows that bank ruble loans to companies depend mostly on total ruble deposits and on GDP and investment in fixed capital volume that reflect the demand to such loans.

$$CR = f_{CR}(DEPRT, Q, I, P) \tag{32}$$

Equation 33 shows that bank foreign currency loans to companies depend mostly on total foreign currency deposits and on GDP and export volume that reflect the demand to such loans.

$$CV = f_{CV}(DEPVT, P, Q, EXPO) \tag{33}$$

Identity 34 determines the total volume of bank loans to companies.

$$CT = CR + CV \tag{34}$$

Equation 35 shows that the volume of consumer loans (which are given mostly in rubles) depend on total bank deposits, volumes of disposable income and consumption and on some other variables).

$$CH = f_{CH}(DEPT, P, INCOME, CONS) \tag{35}$$

Equation 36 shows that dollar to ruble exchange rate index depends mostly on the GDP level, on monetary indicators, on export and import prices, on the state of the world economy and on some other variables.

$$DOLLAR = f_{DOLLAR}(PEXPD, PIMD, MN, M0, Q, OECD, CAP) \tag{36}$$

Identity 37 determines ruble index of export prices.

$$PEXP = PEXPD \times DOLLAR \tag{37}$$

Identity 38 determines ruble index of import prices.

$$PIM = PIMD \times DOLLAR \tag{38}$$

Equation 39 shows that the volume of export depends mostly on the world demand and on export prices.

$$EXPO = f_{EXPO}(OECD, PEXP) \tag{39}$$

Identity 40 determines the index of export in constant prices volume.

$$IND\_EXP = EXPO / PEXP \tag{40}$$

Equation 41 shows that the volume of import depends mostly on prices and on the state of the world economy and the volume of money mass which represents the internal demand here (and is statistically significant unlike other demand indicators).

$$IMP = f_{IMP}(M, OECD, PIM) \tag{41}$$

Identity 42 determines the index of import in constant prices.

$$IND\_IMP = IMP / PIM \tag{42}$$

Identity 43 determines the volume of net export.

$$NX = EXPO - IMP \tag{43}$$

Identity 44 determines the volume of corporate income tax paid as a share of gross corporate income. The coefficient k_{PTAX} here and in other tax identities is calculated on the basis of real statistics and represents the efficient tax rate.

$$PTAX = k_{PTAX} \times ROK \tag{44}$$

Identity 45 determines the volume of indirect taxes paid as a share of GDP.

$$INTAX = k_{INTAX} \times PQ \tag{45}$$

Identity 46 determines the volume of taxes on natural resources extraction as a share of GDP.

$$NATTAX = k_{NATTAX} \times PQ \tag{46}$$

Identity 47 determines the total volume of taxes on companies.

$$TTAX = INTAX + PTAX + NATTAX \tag{47}$$

Identity 48 determines a share of total volume of taxes on companies in the GDP.

$$STTAX = TTAX / PQ \tag{48}$$

Identity 49 determines the volume of personal income tax paid as a share gross wages and net corporate income net of social payment. We used such formula as we have no dividend statistics and k_{PERTAX} coefficient here reflects the average efficient tax rate on these incomes.

$$PERTAX = k_{PERTAX} \times (WL + NROK - SOCTAX) \tag{49}$$

Identity 50 determines the volume of social payment contribution as a share gross wages.

$$SOCTAX = k_{SOCTAX} \times WL \tag{50}$$

Identity 51 determines the volume of government purchases.

$$G = IND\_G \times PG \tag{51}$$

Identity 52 determines the volume of social transfers paid as a share of the GDP.

$$TRAN = k_{TRANSFER} \times PQ \tag{52}$$

Identity 53 determines a proxy of state budget surplus.

$$DEF = REV - G - TRAN \tag{53}$$

Equation 54 shows that the volume of the money mass depends on the monetary base first of all but on the GDP volume and on price level and on a share of cash also.

$$M = f_M(MB, Q, P, M0M, RRESMN) \tag{54}$$

Equation 55 shows that internal energy prices depend on gross fixed capital formation deflator, on the exchange rate and on money mass and on transportation tariff rate.

$$PEN = f_{PEN}(DI, DOLLAR, TARIF, MN) \tag{55}$$

Identity 56 determines the inventory change which is included in the equation 4 which determines the GDP deflator. The sign of the parameter to this variable in equation 4 is significantly negative. This fact ensures a decrease of prices when inventories grow and their opposite movement when they reduce.

$$S = PQ - CONS - I - G - NX \tag{56}$$

Equation 57 shows that the MIACR interest rate is determined mostly by the Bank of Russia key loan rate and by price level, money mass and by volume of GDP also.

$$MIACR = f_{MIACR}(KEY, P, M, Q) \tag{57}$$

Identity 58 determines the volume of cash.

$$M0 = M0M \times M \tag{58}$$

Identity 59 determines the volume of non-cash money.

$$MN = M - M0 \tag{59}$$

3 Forecasts

3.1 General description

The ex-post-forecast simulations showed good properties of the model. That is the average value of Theil coefficient for the 19 main endogenous variables is 0.134 and 0.232 for the total sample of endogenous variables.

In the basic forecast variant we allowed the exogenous variables to change with the average rates similar to their four-year' past dynamics. In this variant the average annual growth rate of Russian GDP in 2020 - 2023will be close to zero while inflation (measured by the GDP deflator) will be +3.7 % annually. That is even in the absence of Covid19 the growth of Russian economy would be very weak.

The model was used to calculate the dynamics of Russian macroeconomic indicators under different variants of fiscal and monetary policy and of external circumstances. The single variant in which Russian economy demonstrates strong economic growth is a case of rapid (3 % annually) growth of world economy. The latter is represented in the model by the total GDP of OECD countries index (due to the absence of long series of the world GDP). All other variants which include prerequisites of either rapid growth of export prices or tax reduction or aggressive monetary or fiscal policy don't show any significant changes in growth perspectives.

3.2 Figures

In the Table below the annual growth rates for some important variables in the two first variants of forecast are shown.

Table 1. The basic and rapid world economy growth forecast variants; average annual growth rate of the most important variables, %

Endogenous variable / Variant	Basic	World economy
The GDP index	+0,0	+3,2
The GDP deflator	+3,7	+3,3
Real disposable households' income	+0,1	+1,8

3.3 Graphs

In this section graphs for some important variables in these variants are represented.

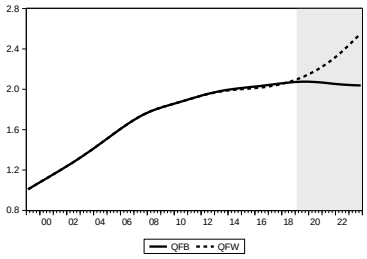

Fig. 1. Shaded area – forecast; QFB – the GDP forecast in the basic variant, QFW - the GDP forecast in the rapid world economy growth variant Q1 1999 = 1, smoothed by Hodrick – Prescott filter ($\lambda = 1600$)

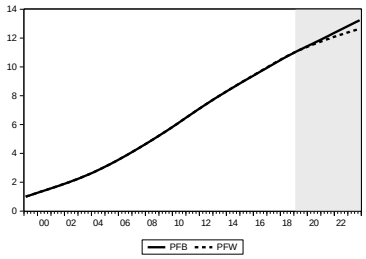

Fig. 2. Shaded area – forecast; PFB – the GDP deflator forecast in the basic variant, PFW - the GDP deflator forecast in the rapid world economy growth variant Q1 1999 = 1, smoothed by Hodrick – Prescott filter (λ = 1600)

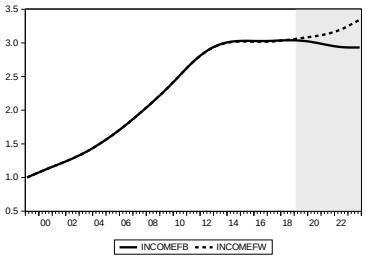

Fig. 3. Shaded area – forecast; INCOMEFB – the households' disposable income index forecast in the basic variant, INCOMEFW - the households' disposable income index forecast in the rapid world economy growth variant Q1 1999 = 1, smoothed by Hodrick – Prescott filter (λ = 1600)

4 Conclusion

Our other research can give a plausible explanation of results that this model shows. Russian economy suffers from two negative factors: 1) low investment and 2) total factor productivity (TFP) stagnation. The stagnation of private investment can be explained by weak private property protection and total underdevelopment of financial and legal systems (and international sanctions also). Government investment in turn declines due to the problems with state budget. The specifics of Russian economic system lead to the fact that the decline of the government investments has a negative impact on the private ones.

The TFP stagnation takes place due to strong government intervention in investment process and inefficient sectoral and regional structure of investment due to this fact. Another one factor was a slowdown of the process of development of digital economy in Russia. One more explanation can be low expenditures on science, education and healthcare. Finally the increase of prices for equipment and investment materials caused by international sanctions and ruble devaluation also made an input to productivity stagnation.

The results of the forecasts can be a useful picture of the future of Russian economy when consequences of Covid19 are overcome and the estimated dependencies will restore.

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Appendix 1

Long-term elasticities of dependent variables

Note 1. The values of all elasticities are smoothed by the Hodrick-Prescott filter, $\lambda = 1600$

Note 2. In the absence of data for Q1 1999, the values for the date closest to it are taken

Equation 1

Dependent variable: KDI	Q1 1999	Q4 2008	Q4 2013	Q4 2019
IDI	0,084	0,124	0,140	0,115
WDI	0,182	0,352	0,323	0,283
N	0,989	0,640	0,565	0,494
PENDI	0,916	0,760	0,666	0,587
CTDI	0,036	0,195	0,251	0,258

Equation 2

Dependent variable: L	Q1 1999	Q4 2008	Q4 2013	Q4 2019
N	1,630	1,610	1,593	1,582

Equation 3

Dependent variable: Q	Q1 1999	Q4 2008	Q4 2013	Q4 2019
KDI	0,393	0,246	0,166	0,106
L	0,607	0,754	0,834	0,894
OECD	1,718	2,048	2,217	2,468
PENP	0,211	0,221	0,235	0,250
CTDI	0,005	0,030	0,067	0,103
DI	-0,402	-0,294	-0,278	-0,282

Equation 4

Dependent variable: P	Q1 1999	Q4 2008	Q4 2013	Q4 2019
PG	0,225	0,225	0,225	0,225
WC	0,181	0,181	0,181	0,181
M	0,179	0,179	0,179	0,179
Q	-0,442	-0,442	-0,442	-0,442
PEXPD	0,189	0,189	0,189	0,189
DOLLAR	0,186	0,186	0,186	0,186
SG	0,094	0,094	0,094	0,094

Equation 10

Dependent variable: WP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
NMPL	2,776	2,599	2,731	2,663
SG	-3,348	-2,297	-2,133	-1,918
SIMP	-0,515	-0,319	-0,269	-0,248
SEXP	0,855	0,471	0,359	0,313
CTDI	-0,077	-0,221	-0,320	-0,420
MROTP	0,051	0,059	0,066	0,093

Equation 12:

Dependent variable: CONSCPI	Q1 1999	Q4 2008	Q4 2013	Q4 2019
INCOMECPI	1,206	1,175	1,261	1,244
SIMP	0,399	0,139	0,102	0,099

Equation 15

Dependent variable: CPI	Q1 1999	Q4 2008	Q4 2013	Q4 2019
P	0,316	0,547	0,628	0,653
DOLLAR	0,346	0,178	0,141	0,209
PEXP	0,148	0,161	0,169	0,166

Equation 20

Dependent variable: IODI	Q1 1999	Q4 2008	Q4 2013	Q4 2019
NROKDI	0,097	0,108	0,126	0,102
IGDI	0,920	0,964	0,890	0,667
GDI	-0,600	-0,511	-0,560	-0,497
MNDI	0,161	0,395	0,517	0,539
TARIFDI	-0,774	-0,496	-0,434	-0,344

Equation 21

Dependent variable: IGDI	Q1 1999	Q4 2008	Q4 2013	Q4 2019
REVDI	1,352	1,224	1,300	1,604
GDI	0,559	0,268	0,495	0,673
MNDI	0,105	0,238	0,390	0,578
TARIFDI	-0,631	-0,347	-0,382	-0,427

Equation 22

Dependent variable: IBDI	Q1 1999	Q4 2008	Q4 2013	Q4 2019
CTDI	1,042	1,830	2,992	3,320
IGDI	-2,147	-0,738	-1,163	-1,080
IODI	-3,503	-1,027	-1,439	-1,478

GDI	2,568	0,791	0,956	1,044
PENDI	8,360	1,261	1,327	1,463
TARIFDI	1,608	0,193	0,278	0,251

Equation 23

Dependent variable: DI	Q1 1999	Q4 2008	Q4 2013	Q4 2019
P	0,254	0,433	0,476	0,489
PIM	0,356	0,184	0,172	0,202
TARIF	0,040	0,076	0,089	0,091
M	0,034	0,290	0,478	0,599
PEN	-0,214	-0,335	-0,368	-0,390

Equation 25

Dependent variable: DEPRPP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
INCOMEP	0,518	0,295	0,228	0,188
MP	1,266	0,924	0,783	0,696
M0M	4,152	0,616	0,305	0,182
SWI	-1,953	-0,747	-0,401	-0,286

Equation 26

Dependent variable: DEPRFP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
MBP	1,201	0,292	0,267	0,167
MP	5,590	1,247	0,896	0,860
M0M	-39,569	-1,756	-0,756	-0,529
GP	-1,749	-0,190	-0,121	-0,098
TRANP	-6,879	-0,553	-0,489	-0,466
REVP	-1,467	-0,229	-0,136	-0,104
CTP	0,465	0,186	0,209	0,246

Equation 27

Dependent variable: DEPVPP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
SWI	0,691	0,595	0,315	0,190
STRI	0,808	0,679	0,423	0,307
MP	0,283	0,344	0,321	0,289
GP	-2,291	-1,610	-1,154	-0,853
DEPRPP	0,107	0,340	0,335	0,336

Equation 28

Dependent variable: DEPVFP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
MP	1,548	1,829	1,289	1,465
EXPPEXP	2,904	1,565	0,686	0,792
IMPPIM	0,151	0,104	0,100	0,087
DOLLARP	2,348	0,119	0,115	0,113
REVP	1,339	0,477	0,264	0,251

Equation 32

Dependent variable: CRP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
DEPRTP	0,396	0,589	0,699	0,792
Q	3,714	0,840	0,675	0,601

IDI	0,839	0,257	0,250	0,218

Equation 33

Dependent variable: CVP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
DEPVT	0,341	0,416	0,561	0,679
DEPRT	0,107	0,172	0,145	0,134
EXPPEXP	0,384	0,199	0,155	0,147
I	0,163	0,094	0,103	0,100
Q	1,034	0,589	0,467	0,389
M	0,132	0,109	0,127	0,128

Equation 35

Dependent variable: CHP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
DEPRTP	0,995	0,665	0,752	0,768
MP	1,468	0,277	0,279	0,255
STRI	-0,759	-0,171	-0,120	-0,098
CONS	2,547	0,212	0,177	0,121
M0M	11,500	0,368	0,283	0,162

Equation 36

Dependent variable: DOLLAR	Q1 1999	Q4 2008	Q4 2013	Q4 2019
PEXPD	-0,356	-1,175	-1,035	-0,298
MN	0,001	0,225	0,490	0,613
M0	0,006	0,315	0,474	0,431
Q	1,883	3,281	2,632	1,487
PIMD	0,386	0,479	0,433	0,206
SC	0,562	0,555	0,419	0,233
SI	-0,285	-0,397	-0,313	-0,162
OECD	-2,341	-2,969	-2,303	-1,361
N	-3,350	-3,829	-2,825	-1,518
CTD	0,000	0,087	0,167	0,098
G	-0,030	-0,349	-0,467	-0,375

Equation 39

Dependent variable: EXPPEXP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
OECD	3,723	2,320	2,270	2,137
PEXPD	0,098	0,109	0,138	0,064
GP	0,242	0,156	0,165	0,140
MPEXP	0,013	0,055	0,102	0,130

Equation 41:

Dependent variable: IMPPIM	Q1 1999	Q4 2008	Q4 2013	Q4 2019
DOLLAR	-1,659	-0,201	-0,105	-0,175
PIMD	-0,830	-0,197	-0,200	-0,192
MPIM	0,130	0,760	0,857	0,938
N	-7,305	-1,973	-1,712	-1,797
OECD	-6,461	-3,115	-2,808	-3,237

Equation 54

Dependent variable: MP	Q1 1999	Q4 2008	Q4 2013	Q4 2019
MBP	0,643	0,407	0,356	0,335
M0M	-2,467	-0,435	-0,267	-0,182
Q	1,805	0,765	0,637	0,536

Equation 55

Dependent variable: PEN	Q1 1999	Q4 2008	Q4 2013	Q4 2019
TARIF	0,329	0,329	0,329	0,329
M	0,351	0,351	0,351	0,351
OECD	1,009	1,009	1,009	1,009

Appendix 2

Impulse multipliers of exogenous variables, %

Note. The Table contains only those values of multipliers which absolute value exceeds 0.1. Multipliers of exogenous variables that do not exceed this value are not given.

Table 2.1

Exogenous / Endogenous	N	PEXPD	PIMD	PTAX
DOLLAR	0,47	-0,58		
PTAX	-2,55			1,00
INTAX	1,61	0,10		
NATTAX	1,60	0,10		
INTAXN	1,61	0,10		
TTAX	0,88			0,17
PERTAX	1,51	0,10		
SOCTAX	4,63	0,19		
NONTAX	1,65	0,10		
REV	1,82	0,11		
TRAN	0,78			
GOVEXP	0,28			
M2	0,22			
PEN				
KDI			-0,14	
L	1,38			
Q	1,37			
P	0,20	0,13		
WCPI	2,92	0,17		
WP	2,87			
INCOMECPI	1,18		-0,10	
IND_C	1,09	0,12	-0,14	
CPI	0,17		0,11	
IDI	-0,65	0,10	-0,14	
ROKDI	-2,43		-0,20	
NROKCPI	-3,39		-0,14	
MIACRP	-11,56	-0,51	-0,12	0,21
IODI	-0,69	0,10		

IGDI	-2,47	0,22	-0,24	0,14
IBDI	1,38		-0,44	
DI			0,18	
DEPRPP	-0,80	-0,11		
DEPRFP	-0,54		-0,12	
DEPVPP	-1,65	-0,18		
DEPVFP	-1,19	-0,14		
DEPTP	-0,87			
CRP	-0,18			
CVP	-0,93	-0,21	0,14	
CTP	-0,42			
CHP	-0,15			
CHCPI	-0,15	0,11	-0,16	
IND_EXP	0,17			
IND_IMP	-1,92	0,73	-1,35	
IMPPIM	-1,77	0,72	-1,34	
NXD	8,17	2,17	1,90	
AD	0,46		0,36	
ID	0,43	0,10	-0,11	
EXPODUT	0,67	0,44	0,12	
IMPDUT	-0,90	0,18	-0,33	

Table 2.1 Continued

Exogenous / Endogenous	INTAXN	PERTAX	SOCTAX	NONTAX
DOLLAR				
PTAX	-0,20			
INTAX	1,00			
NATTAX	1,00			
INTAXN	1,00			
TTAX	0,79			
PERTAX	-0,26	1,00	-0,11	
SOCTAX	-0,13		1,00	
NONTAX				1,00
REV	0,40	0,10	0,19	0,12
TRAN	-0,19			
GOVEXP				
M2				
PEN				
KDI				
L				
Q				
P				
WCPI				
WP	-0,10			
INCOMECPI	-0,21		-0,10	

IND_C	-0,23		-0,14	
CPI				
IDI	0,17		0,11	
ROKDI	-0,19			
NROKCPI	-0,42			
MIACRP	0,92	0,24	0,49	0,30
IODI	0,17		0,10	
IGDI	0,65	0,16	0,32	0,21
IBDI	-0,29			
DI				
DEPRPP				
DEPRFP				
DEPVPP				
DEPVFP				
DEPTP				
CRP				
CVP				
CTP				
CHP	-0,12			
CHCPI				
IND_EXP				
IND_IMP				
IMPPIM				
NXD	-0,32		-0,12	
AD	-0,21		-0,11	
ID				
EXPODUT				
IMPDUT				

Table 2.1 Continued

Exogenous / Endogenous	IND_G, G	PG, G	TRAN	MROT
DOLLAR	-0,38	-0,48		
PTAX	0,86	0,46		
INTAX	-0,20	0,22		
NATTAX	-0,19	0,23		
INTAXN	-0,19	0,22		
TTAX		0,27		
PERTAX	-0,17	0,22		
SOCTAX	-0,98			0,10
NONTAX	-0,21	0,20		
REV	-0,25	0,21		
TRAN		0,36	1,00	
GOVEXP	0,62	0,77	0,36	
M2	-0,11	0,42		
PEN		-0,56		

KDI	-0,15	-0,65		
L				
Q		-0,35		
P	-0,13	0,57		
WCPI	-0,73	-0,14		
WP	-0,82	-0,51		
INCOMECPI			0,13	
IND_C		0,19	0,33	
CPI	-0,23	0,22		
IDI	-0,22	-0,18		
ROKDI	0,95	-0,15		
NROKCPI	1,27	0,49		-0,10
MIACRP	1,80	0,36		-0,18
IODI	-0,29			
IGDI	-0,81	-0,72		
IBDI	0,74	-0,35	-0,10	
DI	-0,11	0,59		
DEPRPP	0,26			
DEPRFP			-0,16	
DEPVPP	-0,14	-0,26	-0,41	
DEPVFP		-0,13		
DEPTP				
CRP		-0,21		
CVP		-0,40	-0,12	
CTP		-0,27	-0,10	
CHP			-0,11	
CHCPI		0,37	-0,12	
IND_EXP	0,13			
IND_IMP	0,12	0,76		
IMPPIM	0,17	0,82		
NXD		-3,21	-0,12	
AD	-0,13	-0,34	0,51	
ID			0,18	
EXPODUT	-0,26	-0,44		
IMPDUT	0,15	0,77		

Table 2.1 End

Exogenous / Endogenous	MB	M0M	TARIF	OECD
DOLLAR	0,11	-0,11		3,12
PTAX				2,48
INTAX				2,18
NATTAX				2,18
INTAXN				2,18
TTAX				2,23
PERTAX				2,22

SOCTAX	0,11			1,91
NONTAX				2,24
REV				2,17
TRAN				1,34
GOVEXP				0,49
M2	0,29	-0,14		0,70
PEN			0,20	0,19
KDI			0,10	0,27
L				
Q				2,66
P				-0,52
WCPI				0,98
WP				2,34
INCOMECPI				1,20
IND_C				1,29
CPI				0,88
IDI		-0,13		1,57
ROKDI	-0,15			2,08
NROKCPI	-0,10			1,86
MIACRP	-0,41	-3,46	-0,22	1,27
IODI	0,10	-0,16	-0,10	1,42
IGDI				3,49
IBDI	-0,17			0,55
DI	0,14			0,47
DEPRPP	0,11			1,35
DEPRFP	0,20	-0,34		
DEPVPP				0,68
DEPVFP	0,20	-0,28		-0,70
DEPTP	0,15	-0,17		0,42
CRP	0,13	-0,14		1,63
CVP	0,16			1,30
CTP	0,14	-0,11		1,52
CHP	0,21	-0,12		1,53
CHCPI	0,21	-0,13		0,16
IND_EXP				2,08
IND_IMP	0,29			-3,38
IMPPIM	0,30			-3,30
NXD	-1,41	-0,46	0,25	23,98
AD	-0,10	-0,11		4,09
ID				1,42
EXPODUT		-0,12		5,14
IMPDUT	0,33			-0,11