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International tax models towards multinational companies from the perspective of national welfare

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ABSTRACT

The article is dedicated to the development of mathematical models to solve the real scientific task of supporting tax policies for counter-acting tax planning of multinational companies (MNCs) that are working in the field of production and engineering, forming the scheme international prosecutor, from the position of national welfare. Based on the analysis of the existing models of international taxes and on the peculiarities of the real mechanism of tax regulation of capital movement, new models have been developed with a balance orientation. The main points for this balance are: a) an approach aimed at determining the final results of international taxation from the perspective of national economies; b) Take as an example the gap between tax planning measures by multinationals and measures contrary to government tax planning. The approval of models with the case study of the multi-level structure in which, to counteract the tax planning of multinational companies, the Government uses rules of controlled transactions, demonstrated that due to the possibility of development of multinational companies in convenient and extraterritorial jurisdictions, for Government the final result of the application of these rules can be negative. Instead of additional income, you risk reducing the tax base and reducing budget income; And from the perspective of national welfare, this implies losing the income and capital of multinational companies. It is considered important that the rules for the taxation of multinational companies should not focus on taxes as such, but should encourage the maintenance of capital within the territory or facilitate the return of previously disinvested income.

KEY WORDS: international taxation; economic-mathematical modeling; multinational company; tax planning; controlled transaction rules; withdrawal of income; return of income; national welfare.

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Modelos tributarios internacionales hacia empresas multinacionales desde la perspectiva del bienestar nacional

RESUMEN

El artículo está dedicado al desarrollo de modelos matemáticos para resolver la tarea científica real de fundamentar las políticas tributarias para la planificación fiscal contra-actuante de las compañías multinacionales (MNC) que están trabajando en el campo de la producción y la ingeniería, formando el esquema fiscal internacional, desde la posición de bienestar nacional. Con base en el análisis de los modelos existentes de impuestos internacionales y en las peculiaridades del mecanismo real de regulación tributaria del movimiento de capital, se han desarrollado nuevos modelos con orientación hacia el equilibrio. Los puntos principales para este equilibrio son: a) un enfoque dirigido a la determinación de los resultados finales de la fiscalidad internacional desde la perspectiva de las economías nacionales; b) se toman como ejemplo la brecha entre las medidas de planificación fiscal por parte de las multinacionales y medidas contrarias a la planificación fiscal de los gobiernos. La aprobación de modelos con el estudio de caso de la estructura de varios niveles en la que, para contrarrestar la planificación fiscal de las empresas multinacionales, el Gobierno utiliza reglas de transacciones controladas, demostró que debido a la posibilidad de desarrollo de las empresas multinacionales en jurisdicciones convenientes y extraterritoriales, para Gobierno el resultado final de la aplicación de estas reglas puede ser negativo. En lugar de ingresos adicionales, corre el riesgo de reducir la base impositiva y reducir los ingresos del presupuesto; y desde la perspectiva del bienestar nacional, esto implica perder los ingresos y los capitales de las empresas multinacionales. Se considera importante que las reglas para la tributación de las empresas multinacionales no deben centrarse en los impuestos como tales, sino que deben fomentar el mantenimiento del capital dentro del territorio o facilitar el retorno de los ingresos desinvertidos anteriormente.

PALABRAS CLAVE: fiscalidad internacional; modelado económico-matemático; compañía multinacional; planificación fiscal; reglas de transacciones controladas; retiro de ingresos; devolución de ingresos; bienestar nacional.

Introduction

Problems of economic-mathematical modelling of international taxation of multinational companies (MNC) are permanently within the focus of scholars and practitioners. This is objectively conditioned by processes of globalisation and increase in competition for capital, by huge volumes of international trade (Acuña, 2011), cross-border

investments and, respectively, by the impact of taxation policy upon international flows of goods, services and capitals. One of the latest examples is a recent tax reform in the USA which is purposed, among others, for creating favourable conditions for return of capitals into the country (Feldstein, 2017).

A number of empiric assessments, which survey is represented in OECD, evidences that sensitivity to direct taxes is substantial: semi-elasticity index in the average constitutes -3.72, i.e. tax cut by 1 percent point results in growth of foreign direct investment (FDI) by 3.72%. Moreover, "...studies in which more updated data are used, demonstrate an increase in semi-elasticity, which evidences that over time FDI become more sensitive to taxation" (OECD, 2007). This means that international taxation of MNC capitals and income, along with other factors, preserves its role and, other things being equal, it is an important reason which determines their flow.

Besides, one should take into account that in connection with the digital revolution and increased development of cyber-physical production facilities, cross-border business activity has dramatically surged. It displays itself in respect of: "(i) intangible assets upon which digital economy mainly rests, (ii) users and (iii) business functions as a result of a decrease in a necessity to employ local personnel for performing certain tasks, as well as elasticity (in a number of cases) in selecting the location for servers and other resources" (OECD, 2014).

In this connection, on the one hand, new opportunities for forming more efficient "smart" systems of international trade and international taxation occur. They render essential influence over capital location and competitiveness of national economies. Whereas, on the other hand, new opportunities for cutting tax expenditures occur with subjects of international trade in goods, services and capitals. In their turn, governments of different countries and international organisations undertake measures as to counter-acting new methods of tax evasion and competition infringement (OECD, 2015; Polezharova, Lipatova, 2015).

Both of them actively employ mathematical instruments for substantiating ways of increasing benefits and cutting expenditures which relate to new economic reality.

Purposes of such modelling are different, but instruments used are often similar, so far as operation of the same economic agents is simulated (which are engaged into international economic relations or are subjected to influence of such relations) and one and the same business sphere (connected with international flows of capital, goods and services).

The purpose of this study is in development of economic-mathematical models which allow to substantiate measures of state's tax policy as to counter-acting MNCs' tax planning as well as to forming up the national scheme of international taxation which would be favourable for preservation and attraction of capitals which are necessary for modernisation of production technologies and growth of social welfare. That is, influence of international taxation of MNC is evaluated not from the perspective of interests of economic agents, but from the perspective of national welfare (subject to tax influence over MNC behaviour).

1. Methods

1. 1. Types of international taxation models

There exists a big number of very different international taxation models. Considering them in detail herein is impossible and unnecessary. Therefore, further, we will consider only key characteristics of the most important model types, which are based on the neoclassical theory of investment. They have become widely spread in economic literature and represent the greatest interest from the perspective of achieving the set goal.

The performed analysis demonstrates that the specified models may be divided into the following categories:

by the way of establishing economic equilibrium - models with equilibrium calculated, which is usually established by way of finding the extremum of function of economic agent income, depending on taxes (OECD (2007); OECD (2013); Haufler, Mardan, Schindler (2014); models with equilibrium being postulated, in which economic equilibrium is postulated instead of being calculated (Haufler, Mardan, Schindler (2014); Grubert (2003); Whalley (2001); Vishnevskiy, Grechishkin (2002);

by types of financial structure - models of bilateral or direct (direct, non-intermediated) holding structures, models of trilateral structures (i.e. structures with participation of a mediator who is usually registered in a tax haven) (OECD (2007); OECD (2013);

by kinds of economic equilibrium - models with equilibrium of tax rates, in which it is considered that values of income as obtained by companies, do not have critical significance for taking investment decisions; and the only thing which is compared is effective tax rates in different territories (Whalley (2001); Vishnevskiy, Grechishkin (2002); Sutyrin, Pogorletskiy (1998); models with equilibrium of enterprise incomes, in which the principle driver for enterprise behaviour is considered to be net (subject to taxation) income instead of taxes as such (Haufler, Mardan, Schindler (2014); Grubert (2003); models with profit equilibrium of the jurisdictions, in which not only tax rates, as well as not only enterprise income which remains within the country, are compared, but, as well, tax revenues of governments are compared (Haufler, Mardan, Schindler (2014).

It is necessary to note, that the above specified economic-mathematical models most often apply methodological approaches which are based on equilibrium of tax rates and company income (after taxation, including understated incomes). This is feasible and convenient from perspective of assessment of consequences of tax policy for companies which are the principle agent of economic relations. However, upon that, there occur problems with accounting of interests of governments of separate jurisdictions or, more generally, for interests of national economies, including subject to factors of counter-acting the outflow and/or return of profits and capitals.

For example, in the work by H. Grubert (2003) who is one of the leading global experts in the area of international taxation – as the case study of a number of scenarios, advantages and disadvantages of the worldwide tax system as well as dividend release system, are considered. In particular, situations were simulated when at payout of interest and royalties by the subsidiary to the parent company, the amount of payment is underrated and tax saving for the company is calculated, so far as in the parent company's country the tax is considerably higher. However, given that, the issue of income loss by

the domestic jurisdiction is not handled, the same as the possibility of reverse adjustment (recovery) of revenues by the government is not taken into account. Possibilities of company's manipulations with active income are not analysed. This does not allow evaluating efficiency of governments' counter-acting the MNCs' methods of tax planning, including, in terms of economic welfare of any given territory.

Work by a group of authors (Haufler, Mardan, Schindler (2014) evaluates effects of rules of a controlled company and rules of thin capitalisation per amount of MNCs' taxes and profits in terms of country's welfare. As well, an approach has been considered from the point of view of tax saving for the account of MNC capabilities use. However, this is done, firstly, under ordinary neo-classical supposition of economic agents' maximising behaviour by way of differentiation by tax rates and finding the extremum of welfare function. Secondly, there is no separation into active and passive income, to which various approaches in taxation are usually applied. Thirdly, formula (Haufler, Mardan, Schindler (2014) does not account for influence of the basic rule of controlled transactions. Besides, the model does not enable to account of the amounts of withdrawn and returned income and capitals, which handicaps true evaluation of welfare value, as well taxes on profit repatriation are not accounted of.

Approach from the point of view of return of income as earlier transacted abroad was not also fully reflected in a fundamental research carried out by Organization for Economic Cooperation and Development (OECD) (OECD (2007). 6 cases of tax planning are considered, mainly, via the use of inter-company lending methods. In general, OECD believe that "... more work should be done to investigate the implications of tax planning to forward-looking effective tax rate analysis used to infer tax reform effects on FDI. Such work could usefully draw on the insights of recent work by Grubert (2004) analysing the effects of tax-planning on backward-looking tax burden measures" (OECD (2007).

This study in which research & methodological approaches elaborated by D.W. Jorgenson (Jorgenson (1963); J. Whalley (Whalley (2001); H. Grubert (Grubert (2003) are developed, is devoted to analysis of effects of such tax-planning measures and ways to counter-act those methods D.W. Jorgenson (Jorgenson (1963); J. Whalley (Whalley

(2001); H. Grubert (Grubert (2003); but only subject to the issues not fully studied in their works. In particular, it is about evaluation of tax-planning counter-acting measures as applied by governments of different countries. Within the frames of this context, the article considers the issue of convenient jurisdictions, namely, the countries possessing such parameters of tax policies which allow MNCs to avoid taxes and to divest capitals through subsidiaries incorporated therein.

Out of the above specified model types, for the purposes hereof, we suggest that there should be used models with balance being postulated, where trilateral financial structures (with participation of intermediary subsidiaries in convenient jurisdictions and with participation of affiliated entities in offshores) are considered. These simulation models, which are not though so mathematically rigor as optimisation ones, but they allow to better take account of institutional factors and to describe economic situations in relatively simple formulae which are easier subjected to economic interpretation.

We commence with consideration of equilibrium models of enterprise profits after taxation (as basic ones), then we proceed to more complex models with profit equilibrium of jurisdictions, which is aimed achieving the set goal.

Such choice is explained by the fact that this work is not aimed at substantiation of investment solutions or tax optimisation from the point of view of economic agents. The approach suggested is aimed at more correct establishment of final results of international taxation from perspectives of national economies, when they take account of both indices of private (economic agents) and public (government) economy sectors, which characterise aggregate resources of economic development, which remain in the country and which enter from abroad. This has principle significance, so far as for many countries taxes are important not as they are, but as a tool for observing national interests and increasing citizens' welfare.

1.2. Economic statement of a complex of MNC international taxation models. General task formulation

Three tax jurisdictions (three countries) exist: one ordinary - *A*, one convenient

(with weak anti-offshore legislation) - *B*, and tax haven - *C*.

There is also some MNC - parent company which is a resident of territory A (this is by default the territory of the country we are interested in and from which perspective the situation is analysed.

This parent company incorporates a subsidiary (owns over 50% of its property) within the convenient jurisdiction *B*, which also actively operates. Whereas, it is supposed that tax planning methods may be applied by MNCs with the help of affiliated companies which are incorporated by the parent company (*A*) and subsidiary company (*B*) (indirectly) in tax haven *C*. Territory of *C* is used not for real economic operations but for defrauding of income and tax evasion (in particular, through the mediation of the subsidiary company from convenient jurisdiction B).

Companies may apply (not apply, or apply to a limited extent) conventional tax-planning methods: transfer pricing, manipulation with direct investments and dividends; thin capitalisation, concealment of ultimate beneficiaries, etc. In their turn, governments may apply respective counter-acting measures, namely *Special Anti-Avoidance Rules*, which are aimed at fighting tax evasion by using definite tax schemes: rule of controlled transactions (CT) (based on arm's length principle), rule of controlled foreign corporations or companies (CFC), controlled debt rule (CD), as well as (thin capitalisation - (TC) secondary adjustments rule (SA)[1], etc.

2. Description of economic-mathematical models

Let us enter some designations. Let the net income (profit) norm of the parent company within territory A constitute D_A. The net income (profit) norm[2] of the

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[1] The sense of SA (secondary adjustment) is that the government aims for compensating the losses which resulted from income retaining by MNC abroad, considering them as imputed-income taxable assets. Usually, the withdrawn income is conditionally treated as a loan, for which late repayment the government accrues interest

[2] Net income (profit) margin may be expressed both in relative values (as a percentage ratio of income from investment to the amount of such investment), as well as in absolute values (as amount of profit as received

subsidiary within territory B constitutes D_B. Condition of economic equuilibrium is observed if

$$D_A = D_B k_B; \quad k_B > 0. \tag{1}$$

I.e. generally, as far as we have a simulation type model, $D_A \neq D_B$. And this thing may be taken into account when carrying out simulation experiments. However, so far as our task is, first of all, to study effects of tax policy, we will start analysis from the situation, when $k_B = 1 \Rightarrow D_A = D_B$.

One of the principle tools which are suggested to be used for studying effects of tax-planning measures by economic agents and counter-acting them by governments, are indices which arithmetically represent a share of the total norm of the net income (profit) by which the company (with the help of transfer pricing) and the country (by way of introducing CT rules) alter such approach:

$$\Delta \varphi = (\varphi_c - \varphi_g), \tag{2}$$

where $\varphi_c = \dfrac{D'}{D}$ – corrective factor which defines the fraction of income (D'), as exempted taxation by the company (which respectively decreases taxable base) relative to the total amount of its taxable income D;

$\varphi_g = \dfrac{D''}{D}$ – corrective factor which defines the fraction of income (D''), as returned by the government of jurisdiction (which restores taxable base) relative to the total amount of company's taxable income D;

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from the preset investment amount). For convenience of economic interpretation, hereinafter we will treat D as some amount of net income (profit) (for example, USD 100) as generated by this fixed amount of investment

$\Delta\varphi$ – remaining difference after performing such corrections and adjustments (in ordinary situations $\varphi_c \geq \varphi_g \Rightarrow \Delta\varphi \geq 0$).

Defining, that all D here and hereafter are the norm of normal net income which is formed on the basis of market (ordinary, fair) prices, which subsequently may be corrected (decreased) by value D' by companies and may be reversely corrected (restored) by value D'' by jurisdictions.

Kinds of revenues:

- received totally from economic operations D (include active and passive incomes, which will be taken into account in formulae separately in connection with peculiarities in their taxation);

- passive income as: dividends D_S, royalties D_R, interest D_I.

Tax rates:

- t_{AA}, t_{BB} – effective (medium) tax rates on net income (profit)[3];

- t_{AA}^n, t_{BB}^n – nominal rates of income tax for corporations;

- $t_{S_{BAA}}$, $t_{R_{BAA}}$, $t_{I_{BAA}}$ – real tax rates for passive types of income: dividends, royalties, interest (in this case, the ones being paid out by the subsidiary company from the convenient jurisdiction B in favour of the parent company to jurisdiction A, and which are subject to taxation in jurisdiction A – see suffix number BAA); those tax rates result from adjustments of nominal rates, for whatever reason $(t_{X_{BAA}} = f(t_{X_{BAA}}^n))$;

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[3] In this case, we understand the effective tax rate upon net income, as some average percent of income seizure from a typical enterprise (representative enterprise) effected by *all* the taxes as provided by the national Law (but not only the corporate income tax), i.e. as interpreted by Paying Taxes: "Paying Taxes measures all taxes and contributions that are government mandated (at any level - federal, state or local) and that apply to the standardised business and have an impact in its financial statements" (PWC, World Bank Group (2015)

- $t_{S_{BAB}}$, $t_{R_{BAB}}$, $t_{I_{BAB}}$ – nominal rates of taxes on repatriation of dividends, royalties, interest, respectively, which are collected from the source of payment (in this case - in jurisdiction B – see suffix number BAB).

As OECD officers note (OECD (2013), from perspectives of empirical analysis of tax effects upon FDI, backward-looking average effective tax rates (*AETR*) yield more relative values and are a better predictor than forward-looking marginal effective tax rates (*METR*), and by far are much better than statutory nominal tax rates which do not take into account effects of tax planning and special taxation schemes.

 Based on the above said, most generally, expression of the main tool used in simulation -*AETR* (average effective tax rate) looks as follows:

$$AETR = \frac{D - D(1-\Delta\varphi)(1-t)}{D} = 1 - (1-\Delta\varphi)(1-t),$$

(3)

provided that $D > 0$.

Thus, when comparing *AETR* of territories *A* and *B* the equilibrium formula may be represented as follows:

$$AETR_A = AETR_B,$$
$$1 - (1-\Delta\varphi_A)(1-t_A) = 1 - (1-\Delta\varphi_B)(1-t_B).$$

(4)

Similar formula was suggested by H. Grubert (Grubert (2003), however, in addition to a feature of correcting income by companies, which is accounted of in his study, in our statement a feature of reverse correction for such income by governments is added.

For the purpose of resolving the set problem, further herein we shall compare not just tax rates in interacting territories (subject to correction by companies and adjustment by governments), but rates of return (originally $D_A = D_B$) which remains in disposal of companies of different jurisdictions:

$$D_A(1-\Delta\varphi_A)(1-t_A) = D_B(1-\Delta\varphi_B)(1-t_B). \qquad (5)$$

This and below formulae of income equilibrium in furtherance may be used to calculate effective tax rates, actually obtained income and justification of conclusions regarding policy directions.

The below analysis is devoted to assessment of alterations of original situations under effects of various methods of tax planning from perspectives of MNCs, as well as counter-acting measures on part of governments (starting with application of CT rules).

2.1. Findings

2.1.1. Common formula of income calculation from perspectives of MNCs subject to income exempted from taxation.

Generally, income of the parent company in territory *A* (or, similarly, a subsidiary in territory *B*) may be represented as follows:

$$D^c = D(1-\Delta\varphi)(1-t) = D - D\Delta\varphi - Dt + D\Delta\varphi\, t = D - F - T^g + T^{c+}. \qquad (6)$$

Id est, company income remaining in the given territory (D^c) are determined as total income (D), less withdrawn "shadow" income (*F*) and paid taxes (T^g), plus funds saved by the company as a result of tax planning (T^{c+}) (which constitute, on the other hand, losses for the government).

From the point of view of MNCs' total income, this formula (6) is incomplete, meaning that it does not include the fraction of MNC income which is withdrawn from taxation. Therefore, for more correct calculation of the total volume of MNC income and evaluation of economic equilibrium subject to the factor of tax haven, expression (6) must be increased by the value *F*, which characterises the fraction of profit which is exempted from taxation to an offshore jurisdiction.

$$D^c_{all} = D^c + F = D(1-\Delta\varphi)(1-t) + D\Delta\varphi = (D - F) - (T^g - T^{c+}) + F. \qquad (7)$$

In other words, income transferred to tax haven *C* are actually income of MNC which are withdrawn from those jurisdictions for the purpose of decreasing the taxable base.

For example, under-rating of market value by the company for a part of the total profit φ_{AC} when exporting from country *A* to country *C* allows to cut the taxable base in the home country $D_A(1-\varphi_{AC})$ and, respectively, to increase income in country *C* by the same amount $D_A\varphi_{AC}$, so far as the goods will be sold in furtherance at market price, and the taxable margin will remain in tax haven *C*. Even, taking into account, that governments which apply CT rules, can adjust income for taxation purposes; non-taxable revenue will constitute value $D_A\Delta\varphi_{ACA}$, where $\Delta\varphi_{ACA} = \varphi_{AC} - \varphi_{ACA}$, and φ_{ACA} is the amount of correction of withdrawn income by government *A*.

Besides, it is important to stress that now such revenues may act as "shadow" revenues and/or "shadow" capital which in furtherance is not returned and brings no use in the home country; instead, they are used in economy of other countries.

Thus, application of correction methods within the frames of CT rules from perspectives of national welfare may be uneffective, even if the government fully restores (corrects) taxable base. In this case, corrections will happen only for taxation purposes: $\Delta\varphi_{ACA} = \varphi_{AC} - \varphi_{ACA} = 0$, whereas, in terms of counter-acting revenue outflow, or their return, they are ineffective: $\varphi_{ACA} = 0$, and, therefore $\Delta\varphi_{ACA} = \varphi_{AC}$, also revenues leave the territory in full.

In such scenarios non-returned "shadow" revenues

$$F_A = D_A\varphi_{AC} + D_A\varphi_{R_{AC}} + D_A\varphi_{I_{AC}} + D_{R_{CA}}\varphi_{R_{CA}} + D_{I_{CA}}\varphi_{I_{CA}}$$

are the result of the use by MNC of transfer pricing method both in respect of active operations $(D_A\varphi_{AC})$, and passive operations $(D_A\varphi_{R_{AC}}, D_A\varphi_{I_{AC}}, D_{R_{CA}}\varphi_{R_{CA}}, D_{I_{CA}}\varphi_{I_{CA}})$.

Now the reasons due to which MNC operations adversely affect economy of territory *A* become obvious - a considerable part of capitals irretrievably remains in tax haven *C*, and the revenues which remain, are still decreased for the account of additional taxation.

However, it is necessary to mention that until now a simplified scenario was considered. In such scenario taxes on repatriation as well as peculiarities of passive income taxation are not accounted of. Therefore, further we will proceed to consideration of the situation subject to these factors.

2.1.2. Full-fledged income equilibrium model from perspectives of MNCs subject to income exempted from taxation

Let us consider a more general scenario, when:

1) parent company invested into tangible and intangible assets of a subsidiary, as well it issued a loan to the subsidiary (acquired debt securities). Profit as obtained by the subsidiary in territory *B* is repatriated as dividends D_S, royalties D_R and interest D_I to territory *A*. Besides, parent company may as well be a recipient of intangible assets and loans from a subsidiary and, respectively, pays out royalties and interest to the latest;

2) parent company and subsidiary carry out active and passive operations with affiliated companies as incorporated in a tax haven, but given that, they make no direct investments to a company in territory *C*, or their such relations are concealed (indirect), so that a company in offshore jurisdiction *C* pays no dividends to companies in countries *A* and *B*. All the economic relations in conjunctions *A-C* and *B-C* are limited by lending and transfer of intangible assets from resident-company of tax haven *C* in favour of companies in territories *A* and *B* and, respectively, by payouts of royalties and interest to jurisdiction *C*, as well as by similar counter-operations *C-A* and *C-B*;

3) parent company and subsidiary apply methods of tax planning and carry out economic operations (including, export-import operations, operations with intangible

assets, lending operations) with the help of transfer-pricing through the affiliated company which is situated in tax haven C. This allows correcting (decreasing) taxable base by a certain part of rate of return. In their turn, governments make corrections (restore) taxable base.

In that case, tax equilibrium model looks as follows:

$$D_A^{all} = D_B^{all} \quad (8)$$

or:

$$D_A^m + D_{S_{AB}}^p + D_{CA}^p + F_{AC} = D_{S_{BA}}^m + D_{BA}^p + D_{S_{CB}}^p + F_{BC},$$

where:

$D_A^m, D_{S_{BA}}^m$ – net income from active economic operations of parent company and subsidiary in territory A and B, respectively;

$D_{CA}^p, D_{S_{CB}}^p$ – net passive income (which are specifically separated due to peculiarities of their taxation), as obtained, respectively, by parent company and subsidiary from affiliated companies from jurisdiction C;

$D_{BA}^p, D_{S_{AB}}^p$ – net passive income as received by the parent company and the subsidiary (respectively) from each other;

F_{AC}, F_{BC} – the total amount of "shadow" revenues (from all the active and passive operations) as withdrawn by the parent company and the subsidiary to offshore jurisdiction C less taxes on passive revenue repatriation (remark 1).

The represented equilibrium model demonstrates that the amount of withdrawn passive income decrease taxes on its repatriation. For example, the total volume of income as withdrawn from jurisdiction A to tax haven C will constitute:

$$F_{AC} = D_A \varphi_{ACA} + D_A \varphi_{R_{ACA}} + D_A \varphi_{I_{ACA}} + D_{R_{CA}} \varphi_{R_{CAA}} + D_{I_{CA}} \varphi_{I_{CAA}} -$$
$$-(D_A \varphi_{R_{AC}} t_{R_{ACA}} + D_A \varphi_{I_{AC}} t_{I_{ACA}}).$$

$$(9)$$

Also, it is worth mentioning, that in this scenario we proceed from a premise of equilibrium of MNC revenues as obtained in territories *A* and *B*, irrespective of the fact to which company they belong (plus income as obtained from offshore jurisdiction *C*). Further, let us proceed to consideration of the issue from another point of view - from perspectives of the national welfare of territory *A*.

2.1.3. Model of territory welfare (in case of A government's failure to return the income as earlier withdrawn to a tax haven)

All the above considered models are tentative. In the meaning, that they estimate economic interests from MNC point of view. However, national interests are somewhat wider than interests of economic agents in the private sector. Obviously, from the perspectives of country's economic interests, not all the global revenues must be taken into account, but only those which serve its territory, being a source of labour financing and capital, job creation, financing of the social sector, science, culture, etc., i.e. everything that forms welfare of a given country.

Such statement of the question considerably alters the logics of mathematical simulation.

In the simplest case, the function of public welfare of the state may be determined as follows:

$$D^w = D\ (1-\Delta\varphi)(1-t\ ) + D\ (1-\Delta\varphi)t\ = D^c + T\,. \tag{10}$$

The principle difference of this model from the basic one (5) is that in this case not only net income is taken into account, but also the taxes as collected by governments.

Now, let us consider a more general situation which occurs when all the three territories are taken into consideration as sources of income origin: *A*, *B* and *C*. Public welfare of territory *A* may be identified as:

$$D^w_{ABC} = D^c_{ABC} + T\,, \tag{11}$$

where D_{ABC}^{c} – amount of income as obtained from the three territories (as opposed to previous scenarios, where company income was accounted of only from the territory of registration and from tax haven C).

Based on the above said, the total income of jurisdiction A subject to tax income of the government will constitute the following value:

$$D_{ABC}^{w} = D_{ABC}^{c} + T =$$
$$= D_{A}^{m} + (D_{S_{BA}}^{m} + D_{S_{CB}}^{p} + D_{S_{AB}}^{p} + D_{BA}^{p}) + D_{CA}^{p} + T_{ABC}^{g} - T_{ABC}^{c+}, \qquad (12)$$

where income $D_{S_{BA}}^{m}, D_{S_{CB}}^{p}, D_{S_{AB}}^{p}$ is considered as dividends as obtained by the parent company from the subsidiary (income is broken into constituents, due to peculiarities of its accrual).

Taxes as collected by A country government consist of taxes as collected on the income as obtained from territories A, B and C, as well those repatriated into jurisdiction B and C, as decreased by the amounts saved by MNC as a result of tax-planning.

$$T = T_{ABC}^{g} - T_{ABC}^{c+} = (T_{A}^{m} + T_{ACA}^{p} + T_{ABA}^{p}) + (T_{S_{BAA}}^{m} + T_{S_{CBA}}^{p} + T_{S_{ABA}}^{p} + T_{BAA}^{p}) + T_{CAA}^{p} =$$
$$= [(T_{AC}^{m} - T_{AC}^{m+}) + (T_{I_{ACA}}^{I} + T_{R_{ACA}}^{R}) + (T_{I_{ABA}}^{I} + T_{R_{ABA}}^{R})] +$$
$$+ [(T_{S_{BAA}}^{m} - T_{S_{BAA}}^{m+}) + ((T_{S_{BAA}}^{I_{CB}} + T_{S_{BAA}}^{R_{CB}}) - (T_{S_{BAA}}^{I_{CB}+} + T_{S_{BAA}}^{R_{CB}+}) +$$
$$+ (T_{S_{BAA}}^{I_{AB}} + T_{S_{BAA}}^{R_{AB}}) + (T_{I_{BAA}}^{I_{BA}} + T_{R_{BAA}}^{R_{BA}})] +$$
$$+ [(T_{CA}^{I} + T_{CA}^{R}) - (T_{CA}^{I+} + T_{CA}^{R+})]. \qquad (13)$$

Thus, welfare model of country A turns into the following equation:

$$D_{ABC}^{w1} = D_{ABC}^{w2}. \qquad (14)$$

Its economic significance is that they compare total income of state A, which originates from territories A, B and C at various variants of situation development, on the basis of peculiarities of application of tax-planning methods as well as measures of counter-acting them in a given situation.

In order to have a picture of how the above specified models function, let us consider specific examples.

Let us use jurisdiction A - Russian Federation (RF) as the parent jurisdiction. Suppose, that the parent company from RF works with a convenient territory B (Laos), where it has incorporated a subsidiary. Suppose also, that the parent company and the subsidiary worked with affiliated offshore companies from C - British Virgin Islands (BVI), where taxes on foreign income are absent completely.

In Laos taxes constitute:

- effective tax rate – $t_{BB} = 26\%$;

- on royalties as obtained from abroad $t_{I_{ABB}} = t_{I_{CBB}} = 24\%$, royalties $t_{R_{ABB}} = t_{R_{CAA}} = 24\%$;

- on repatriation of dividends $t_{S_{BAB}} = 10\%$, interest $t_{I_{BAB}} = t_{I_{BCB}} = 10\%$ and royalties $t_{R_{BAB}} = t_{R_{BCB}} = 10\%$.

In the Russian Federation:

- effective tax rate – $t_{AA} = 48\%$;

- on obtained from a foreign company: dividends $t_{S_{BAA}} = 13\%$, interest $t_{I_{BAA}} = t_{I_{CAA}} = 20\%$, royalties $t_{R_{BAA}} = t_{R_{CAA}} = 20\%$;

- on repatriation of interest $t_{I_{ABA}} = t_{I_{ACA}} = 20\%$, royalties $t_{R_{ABA}} = t_{R_{ACA}} = 20\%$.

Let us adopt, that the total amount of rate-of-return in territories A and B is equal and constitutes conditionally 100 units.

Let us also consider effects from application of CT rule (meanwhile, without taking into account CFC and TC). In connection with application of CT rule in the Russian Federation, suppose, that the government restores for taxation purposes 100% of

withdrawn income or $\varphi_g^A = 1$. Laos Government does not apply CT rule which means

that it does not adjust them, i.e. $\varphi_g^B = 0$. Suppose also, that the parent company and the

subsidiary make corrections and make "shadow" withdrawal of 20 units of active income

to jurisdiction C, 5 units of royalty and interest payments are withdrawn for each of the

following: from jurisdiction A to C, from jurisdiction B to C, from jurisdiction C to A, as

well as from jurisdiction C to B. Besides, suppose that, 5 units of passive income (royalties,

interest) are remitted from jurisdiction A to B and from jurisdiction B to A.

Also, it is worth mentioning that in case of entering into force a double tax treaty

between Russia and Laos, it will be nulled with the use of tax-credit method.

From MNC perspective, by substituting to (8) we obtain the following:

$$D_A^m + D_{S_{AB}}^p + D_{CA}^p + F_{AC} = D_{S_{BA}}^m + D_{BA}^p + D_{S_{CB}}^p + F_{BC} + \Delta ;$$

$$(70,0 - 30,0 - 33,6) + (10,0 - 3,4) + (20,0 - 10,0 - 4,0) + (40,0 - 2,0) =$$
$$= (70,0 - 30,0 - 24,9 + 10,7) + (10 - 2) + (20 - 10 - 5,4 + 2,7) + (40,0 - 1,0) + \Delta;$$
$$6,4 + 6,6 + 6 + 38,0 = 25,8 + 8 + 7,3 + 39,0 + \Delta;$$
$$19,0 + 38,0 = 41,0 + 39,0 + \Delta$$
$$\Delta = -23,0.$$

Calculation outcomes demonstrate that at such source data, it has direct economic

sense to invest into a subsidiary in Laos, so far as the income which remains after taxation

constitutes a value which is substantially larger than the same when operating in the home

country (41.0›19.0 units). When accounting of "shadow" revenue (38.0 and 39.0 units),

delta remains practically unchanged (23.0 units, while it constituted 22.0 units).

In such situation advantages of opening a subsidiary in Laos are conditioned by the

fact that the jurisdiction of the parent company, having applied CT rules, additionally

attracts to taxation the income withdrawn in the amount of 16.4 units (or does not allow

to save on taxes as Laos does), as well as by a less effective tax rate in Laos. At the same

time, the amount of withdrawn revenues is equal (it is insignificantly decreased by taxes

on repatriation: in jurisdiction A - by 2 units, in jurisdiction B - by 1 unit).

As well, due to subsidiary's manipulations with taxes the government of jurisdiction B receives to its budget taxes by 12.7 units less than due. Besides, the government of country *A* also loses 0.7 unit of tax on dividends. As a result, totally MNC saves 13.4 units which constitutes approximately 7% of all their income from three territories (total revenue is 200 units).

On the basis of the above said, a conclusion can be made that the amount of income which remains in the parent company's disposal was not effected by counter-acting measures represented as CT rules as applied by the government of country *A*. Amounts of the income withdrawn by the economic agent are somewhat equal to subsidiary's operating results in Laos, although its government is loyal to such transactions and does not enter restricting rules. Besides, for the parent company the situation is getting complicated due to additional taxation on part of the government of country *A*.

However, if analysing the situation in terms of national welfare, one can come to substantially other conclusions.

For that purpose, let us make a calculation with variable parameters as identical to a previous scenario, substituting them to (14) (see also remark 1):

$$D_{ABC}^{w1} = D_{ABC}^{w2} + \Delta;$$

$$6,4 + (25,8 + 7,2 + 6,6 + 8) + 6 + (44,5 - 0,7) =$$
$$= 20,8 + (25,8 + 7,2 + 6,6 + 8) + 8 + (44,5 - 17,1) + \Delta;$$
$$6,4 + 47,6 + 6 + 43,8 = 20,8 + 47,6 + 8 + 27,4 + \Delta;$$
$$60,0 + 43,8 = 76,4 + 27,4 + \Delta;$$
$$103,8 = 103,8 + \Delta;$$
$$\Delta = 0.$$

In the first case (if *A* applies CT rules) the total revenues of territory A from operations in jurisdictions *A, B, C* constitute 103.8 units, including:

- tax revenues of the government - 43.8 units;

- revenues of the parent company - 60.0 units (obtained from territories A – 6.4, B – 47.6, including dividends 39.6, C – 6.0).

In the second case (if A does not applies CT rules) the total income of territory A from operations in jurisdictions A, B, C have not changed in general and constituted 103.8 units, but they are re-distributed between MNC and government:

- tax revenues of the government - 27.4 units;

- revenues of the parent company - 76.4 units (obtained from territories A – 20.8, B – 47.6, (including dividends 39.6), C – 8.0).

Thus, it becomes obvious that CT rules in perspective of country A welfare are ineffective, so far as in general revenues have not changed $(\Delta = 0)$. Total "shadow" revenues in both scenarios as withdrawn to jurisdiction C remained unchanged and constituted 77.0 units (from territories A – 38.0, B – 39.0).

It is worth mentioning, that if jurisdiction A would be able not to lose or to return revenues from territory C, the global revenues of the country from territories A, B and C would constitute 180.8 units.

The performed calculations allow to make a conclusion that in case if the government of the parent company is unable to return capitals or to prevent their outflow, the total revenue of territories A and B without taxes would constitute 60.0 units, which is considerably less than volumes of "shadow" revenues within offshore jurisdiction C - 77 units. Besides, governments of countries A and B lose 13.4 units of taxes (and this is considering that government of country A applies CT rules which somewhat restore the taxable base, however, in general, they are uneffective as a "shadow" revenue return method).

This evidences that when applying CT rules, jurisdiction A returned 16.4 units of income as taxes; but this is incomparable with the fact that territory A lost 77 units of withdrawn "shadow" revenues (inluding the revenues not-returned to country B, which would have finally returned to country A as dividends). As a result, income of territory A,

notwithstanding introduction of CT rules, shall shrink almost twice (from 180.8 to 103.8 units).

It is also necessary to point out that in connection with problems relating to establishment of market values and, respectively, with efficiency of CT rules application in operations with intangible assets - $\varphi_g^A \to 0,$, which means that jurisdiction A may also lose income as reconstituted taxes. This states about a necessity to improve CT rules in this direction.

3. Discussion

The given calculations demonstrate a difference in the considered statements:

a) from perspective of MNC - there are assessed net and "shadow" revenues of MNC, where they were not obtained;

b) from perspective of country welfare - only those revenues of MNCs and governments are assessed, which work for demands of the given territory.

From perspective of revenues of territories - return of withdrawn "shadow" revenues has the most substantive significance. So far as from perspective of total MNC income, the income is not only exempted from taxation, but it is also transferred to other territories; however, given that, MNC income does not shrink, but vice versa - it increases for the account of saved taxes. Therefore, from perspective of country welfare the exempted income considerably reduces it, whereas, restored taxes (even when restored in full) cannot reimburse those losses.

Predecessors (see for example, Grubert (2003); Vernon (1998); Krasnov (2013); Celestin (2000); Bhat (2009)), have already provided substantiated recommendations as to improvement of MNC taxation. In particular, in their works, some scholars stated suggestions about proceeding to fractional method of MNC taxation. European Commission's draft report "Company taxation in the internal market" as was originally

edited in 2001, actually substantiated fractional method for MNC taxation in EU countries (European Commission (2016).

However, they were focused on the matters of tax evasion and income correction by companies. However, our aspect of view is different, so far as it is not only about and not merely about tax revenues of the state, but it is about income and capitals of MNCs which are withdrawn and do not participate in improvement of national welfare.

The main conclusion by H. Grubert (Grubert (2003), which proceeded from establishing the company income equilibrium, was that multinational MNC strategies with the use of aggressive tax-planning schemes (and first of all, in operations with intangible assets) have the determinative effects upon effective tax burden over trans-border investments. And that such approach from governments may be definitive in the behaviour of the host country, when imposition of tax burden upon different types of companies depends on their coontribution to the national welfare. We agreed with the statement and proceeded further, but, given that, firstly, we focused on evaluating acts of MNC from perspectives of national welfare and, secondly, we considered efficiency of measures of tax-planning counter-acting rules on part of governments (these are not considered by H. Grubert).

From perspective of the presented approach, there is stressed the importance of forming-up such rules for MNC tax-planning counter-acting, which would focus not on taxes as such, but would foster keeping capitals within the territory and/or would facilitate the return of earlier divested income. Within this context, it is expedient to pay more attention, for example, to secondary adjustments rule (SA) in combination with the minimal taxation at income return. That is, the task is to sacrifice taxes, but to receive foreign-currency proceeds for country's benefit and, specifically, from high-tech companies which have digital capacities for income withdrawal.

Conclusion

One of the main problems of international taxation of MNC is tax-free outflow of

capitals and income of MNCs, as a result of their use of tax-planning methods, including those connected with development of digital economy.

In order to justify ways on counter-acting MNCs' tax planning as well as on forming up the national scheme of international taxation which would be favourable for preservation and attraction of capitals, there have been developed economic-mathematical models which develop predecessors' approaches.

Out of various model types which are usually applied in this area, for the purposes hereof, we have selected and suggested that there should be used models with balance being postulated, where trilateral financial structures (with participation of intermediary subsidiaries in convenient jurisdictions and with participation of affiliated entities in offshore jurisdictions) are considered.

The models allow analysing various tax-planning methods on part of MNC as well as various ways to counter-act tax-planning on part of governments. But their principle peculiarities are that, firstly, there is suggested an approach that is aimed at establishment of final results of international taxation from perspectives of national economies, when they take account of both indices of private (economic agents) and public (government) economy sectors, which characterise aggregate resources of economic development, which remain in the country and which inflow from abroad. And, secondly, that both measures of tax planning on the part of MNCs and counter-acting measures to tax planning on the part of governments, are taken into account as a complex.

Approbation of developed models (case study - CT rule which has fundamental significance for counter-acting MNC tax-planning) has evidenced the following.

(1) From perspective of MNC's economic interests, government's strict measures, like CT rules, may have direct negative effect. I.e. the more effective the rules function, the less income remains in company disposal in the home jurisdiction, so far as it is re-distributed in government's favour as taxes. As a consequence, MNC is interested to widen its activity in convenient and offshore jurisdictions in prejudice of the home one, which helps it to evade the effect of CT rules. Thus, for the government the final outcome of CT rules may be negative, so far as instead of additional revenues, it is at a risk of getting

a shrinking tax basis and a reduction in budget revenues. From the perspective of national welfare, the outcome is much more negative, so far as the country can lose both revenues and capitals of MNCs (as a consequence - jobs, production volume, etc.) and tax revenues.

And there is another important matter. Principally, CT rules function poorly with respect to intangible assets, so far as under advanced development of digital economy it is very difficult to justify conventional "market" price for them. This means that MNCs can always find mechanisms of exemption of a part of income from taxation with the use of transfer pricing method for intangible assets, and therefore, country's welfare will decline even more also due to tax reasons. In this relation, it is compulsory to improve them, including with the use of features of artificial intellect which is able to analyse large-volume databases and which will provide necessary information to competent agencies of the states concerned therein. However, given that, it is necessary to thoroughly consider whether it is expedient to invent more rigid CT rules, or to provide considerable tax relief for certain kinds of activities, because taxes will be lost anyway, but besides that, income will also be withdrawn.

(2) National tax policy with respect to MNC to a great extent depends on tax policies of other countries with which it is tied by economic relations, so that under conditions when in the world there exist convenient jurisdictions and offshores which are engaged, in particular, in conjunctions A-C and B-C, strict anti-evasion measures in jurisdiction A (conjunction A-C) may not work, so far as capitals have a possibility to outflow through A-B-C; in its turn, this puts a question regarding global agreement of taxation rules;

(3) The problem is not only in taxes as such and their distribution among national jurisdiction. If, for example, taxes upon MNC are additionally charged in jurisdiction A, but the earlier withdrawn capital is not factually returned to country A from jurisdictions B and C, this has no great economic sense so far as this does not increase national welfare of territory A, but merely re-distributes GDP between the private sector and government in favour of the government (which usually results in crowding-out effect of private

capitals with governmental ones);

(4) For substantiating the international taxation scheme as favourable for economic growth, there should be further developed an approach from perspective of national welfare, which requires account of global income of MNC and its distribution by jurisdictions (including with the use of fractional method). So far as, as noted before, after all, it is not the taxes which are important, but where the real capital settles down and works, where jobs and production facilities are created, innovations are generated, etc.

But these conclusions are tentative and further studies are necessary.

Their general logic may be to widen model parameterisation for the purpose of performing a complex of computational experiments with various typical variants of changes in state regulation rules by taxation agencies (CT, CFC, TC, SA) and based on results, to perform economic interpretation of obtained outcomes (consequences of various regulation variants);

Upon outcomes of such widened experimenting, it will be possible to substantiate additional suggestions in the area of national tax policies as to capital attraction, retain and return with the use of a special combination of available tax tools (tax rates, rules, methods, benefits, etc.). Its use will also allow to update the real taxable base and its current distribution by jurisdictions.

But in general, it is important in further researches to focus specifically on income and capital flow as well as on public welfare, but not on taxes as such.

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Annexes

Remark. Decryption of formula elements in equilibrium models

$$D_A^m = D_{AC}^m - F_{AC}^m - T_{AC}^m + T_{AC}^{m+} =$$
$$= \{D_A(1 - d_{R_{AB}} - d_{I_{AB}} - d_{R_{CA}} - d_{I_{CA}})\} - \{D_A\varphi_{AC} + D_A(\varphi_{R_{AC}} + \varphi_{I_{AC}})\} -$$
$$-\{[D_A(1 - d_{R_{AB}} - d_{I_{AB}} - d_{R_{CA}} - d_{I_{CA}})]t_{AA}\} + \{D_A\Delta\varphi_{ACA}t_{AA} + D_A(\Delta\varphi_{R_{ACA}} + \Delta\varphi_{I_{ACA}})t_{AA}\};$$

$$D_{S_{AB}}^{p} = D_{S_{AB}}^{p} - T_{ABA}^{p} - T_{ABB}^{p} - T_{S_{BAB}}^{p_{AB}} - T_{S_{BAA}}^{p_{AB}} =$$

$$= [D_{S_{AB}}^{I} + D_{S_{AB}}^{R}] - [T_{I_{ABA}}^{I} + T_{R_{ABA}}^{R}] - [T_{I_{ABB}}^{I} + T_{R_{ABB}}^{R}] - [T_{S_{BAB}}^{I} + T_{S_{BAB}}^{R}] - [T_{S_{BAA}}^{I} + T_{S_{BAA}}^{R}] =$$

$$= \{D_{R_{AB}} + D_{I_{AB}}\} - \{D_{R_{AB}} t_{R_{ABA}} + D_{I_{AB}} t_{I_{ABA}}\} - \{D_{R_{AB}} t_{R_{ABB}} + D_{I_{AB}} t_{I_{ABB}}\} -$$

$$-\{D_{R_{AB}} (1 - t_{R_{ABA}} - t_{R_{ABB}}) t_{S_{BAB}} + D_{I_{AB}} (1 - t_{I_{ABA}} - t_{I_{ABB}}) t_{S_{BAB}}\} -$$

$$-\{D_{R_{AB}} (1 - t_{R_{ABA}} - t_{R_{ABB}}) t_{S_{BAA}} + D_{I_{AB}} (1 - t_{I_{ABA}} - t_{I_{ABB}}) t_{S_{BAA}}\};$$

$$D_{CA}^{p} = [D_{CA}^{p} - F_{CA}^{p} - T_{CA}^{p}] = [D_{CA}^{I} + D_{CA}^{R}] - [F_{CA}^{I} + F_{CA}^{R}] - [T_{CA}^{I} + T_{CA}^{R}] + [T_{CA}^{I+} + T_{CA}^{R+}] =$$

$$= \{D_{R_{CA}} + D_{I_{CA}}\} - \{D_{R_{CA}} \varphi_{R_{CA}} + D_{I_{CA}} \varphi_{I_{CA}}\} - \{D_{R_{CA}} t_{R_{CA}} + D_{I_{CA}} t_{I_{CA}}\} +$$

$$+\{D_{R_{CA}} \Delta\varphi_{R_{CAA}} t_{R_{CA}} + D_{I_{CA}} \Delta\varphi_{I_{CAA}} t_{I_{CA}}\};$$

$$F_{AC} = [(F_{AC}^{m} - T_{ACA}^{p} + F_{CA}^{p})] = [(F_{AC}^{m} - (T_{I_{ACA}}^{I} + T_{R_{ACA}}^{R}) + F_{CA}^{I} + F_{CA}^{R})] =$$

$$= \{[D_{A}\varphi_{AC} + D_{A}\varphi_{R_{AC}} + D_{A}\varphi_{I_{AC}}] - (D_{A}\varphi_{R_{AC}} t_{R_{ACA}} + D_{A}\varphi_{R_{AC}} t_{R_{ACA}})\} + \{D_{I_{CA}}\varphi_{I_{CA}}\} + \{D_{R_{CA}}\varphi_{R_{CA}}\}$$

$$D_{S_{BA}}^{m} = D_{BC}^{m} - F_{BC}^{m} - [T_{BC}^{m} - T_{BC}^{m+}] - [T_{S_{BAB}}^{m} - T_{S_{BAB}}^{m+}] - [T_{S_{BAA}}^{m} - T_{S_{BAA}}^{m+}] =$$

$$= \{D_{B}(1 - d_{R_{BA}} - d_{I_{BA}} - d_{R_{CB}} - d_{I_{CB}})\} - \{D_{B}\varphi_{BC} + D_{B}\varphi_{R_{BC}} + D_{B}\varphi_{I_{BC}}\} -$$

$$-\{[D_{B}(1 - d_{R_{BA}} - d_{I_{BA}} - d_{R_{CB}} - d_{I_{CB}}) t_{BB}] - [D_{B}\Delta\varphi_{BCB} t_{BB} + D_{B}\Delta\varphi_{R_{BCB}} t_{BB} + D_{B}\Delta\varphi_{I_{BCB}} t_{BB}]\} -$$

$$-\{[D_{B}(1 - d_{R_{BA}} - d_{I_{BA}} - d_{R_{CB}} - d_{I_{CB}})(1 - t_{BB}) t_{S_{BAB}}] -$$

$$-[D_{B}\Delta\varphi_{BCB}(1 - t_{BB}) t_{S_{BAB}} + D_{B}\Delta\varphi_{R_{BCB}}(1 - t_{BB}) t_{S_{BAB}} + D_{B}\Delta\varphi_{I_{BCB}}(1 - t_{BB}) t_{S_{BAB}}]\} -$$

$$-\{[D_{B}(1 - d_{R_{BA}} - d_{I_{BA}} - d_{R_{CB}} - d_{I_{CB}})(1 - t_{BB}) t_{S_{BAA}}]$$

$$-[D_{B}\Delta\varphi_{BCB}(1 - t_{BB}) t_{S_{BAA}} + D_{B}\Delta\varphi_{R_{BCB}}(1 - t_{BB}) t_{S_{BAA}} + D_{B}\Delta\varphi_{I_{BCB}}(1 - t_{BB}) t_{S_{BAA}}]\};$$

$$D_{BA}^{p} = D_{S_{BA}}^{I} + D_{S_{BA}}^{R} - [T_{I_{BAB}}^{I} + T_{R_{BAB}}^{R}] - [T_{I_{BAA}}^{I} + T_{R_{BAA}}^{R}] =$$

$$= D_{I_{BA}} + D_{R_{BA}} - \{D_{I_{BA}} t_{I_{BAB}} + D_{R_{BA}} t_{R_{BAB}}\} - \{D_{I_{BA}} t_{I_{BAA}} + D_{R_{BA}} t_{R_{BAA}}\};$$

$$D^p_{S_{CB}} = D^I_{CB} + D^R_{CB} - [F^I_{CB} + F^R_{CB}] - [T^I_{CB} + T^R_{CB}] +$$

$$+ [T^{I+}_{CB} + T^{R+}_{CB}] - [T^{I_{CB}}_{S_{BAB}} + T^{R_{CB}}_{S_{BAB}}] + [T^{I_{CB}+}_{S_{BAB}} + T^{R_{CB}+}_{S_{BAB}}] - [T^{I_{CB}}_{S_{BAA}} + T^{R_{CB}}_{S_{BAA}}] + [T^{I_{CB}+}_{S_{BAA}} + T^{R_{CB}+}_{S_{BAA}}] =$$

$$= D_{I_{CB}} + D_{R_{CB}} - \{D_{I_{CB}}\varphi_{I_{CB}} - D_{R_{CB}}\varphi_{R_{CB}}\} - \{D_{I_{CB}}t_{I_{CB}} + D_{R_{CB}}t_{R_{CB}}\} +$$

$$+ \{D_{I_{CB}}\Delta\varphi_{I_{CBB}}t_{I_{CB}} + D_{R_{CB}}\Delta\varphi_{R_{CBB}}t_{R_{CB}}\} -$$

$$- \{[(D_{I_{CB}} - D_{I_{CB}}t_{I_{CB}} - D_{I_{CB}}\Delta\varphi_{I_{CBB}})t_{S_{BAB}}] + [(D_{R_{CB}} - D_{R_{CB}}t_{R_{CB}} - D_{R_{CB}}\Delta\varphi_{R_{CBB}})t_{S_{BAB}}]\} +$$

$$+ \{[(D_{I_{CB}}\Delta\varphi_{I_{CBB}}t_{I_{CB}})t_{S_{BAB}}] + [(D_{R_{CB}}\Delta\varphi_{R_{CBB}}t_{R_{CB}})t_{S_{BAB}}]\} -$$

$$- \{[(D_{I_{CB}} - D_{I_{CB}}t_{I_{CB}} - D_{I_{CB}}\Delta\varphi_{I_{CBB}})t_{S_{BAA}}] + [(D_{R_{CB}} - D_{R_{CB}}t_{R_{CB}} - D_{R_{CB}}\Delta\varphi_{R_{CBB}})t_{S_{BAA}}]\} +$$

$$+ \{[(D_{I_{CB}}\Delta\varphi_{I_{CBB}}t_{I_{CB}})t_{S_{BAA}}] + [(D_{R_{CB}}\Delta\varphi_{R_{CBB}}t_{R_{CB}})t_{S_{BAA}}]\}$$

$$F_{BC} = [(F^m_{BC} + F^I_{CB} + F^R_{CB})] = [(F^m_{BC} - (T^I_{I_{BCB}} + T^R_{R_{BCB}}) + F^I_{CB} + F^R_{CB})] =$$

$$= \{[D_B\varphi_{BC} + D_B\varphi_{R_{BC}} + D_B\varphi_{I_{BC}}] - (D_B\varphi_{R_{BC}}t_{R_{BCB}} + D_B\varphi_{R_{BC}}t_{R_{BCB}})\} + \{D_{I_{CB}}\varphi_{I_{CB}}\} + \{D_{R_{CB}}\varphi_{R_{CB}}\}$$