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Factsheet

SWD/2018/081 final

Impact assessment accompanying the document Proposal for a Council Directive: laying down rules relating to the corporate taxation of a significant digital presence and; Proposal for a Council Directive on: the common system of a digital services tax on revenues resulting from the provision of certain digital services

Supporting model(s)

CORTAX

Impact assessment SWD/2018/081 final

Fact sheet on model contributions

Source: Commission modelling inventory and knowledge management system (MIDAS)

Date of Report Generation: 06/10/2020

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Overview

Title

Impact assessment accompanying the document Proposal for a Council Directive: laying down rules relating to the corporate taxation of a significant digital presence and; Proposal for a Council Directive on: the common system of a digital services tax on revenues resulting from the provision of certain digital services

Document ID

SWD/2018/081 final

Year of publication

2018

Led by

TAXUD

Model(s) used

CORTAX

CORTAX

Full title

Corporate Tax Model

Run for this impact assessment by

European Commission

Contributed to

Baseline and assessment of policy options

Helped to assess the following impacts

<i>Impact area</i>	<i>Impact category</i>	<i>Impact subcategory</i>
Economic impacts	Operating costs and conduct of business	Adjustment, compliance or transaction costs
Economic impacts	Operating costs and conduct of business	Affects on individual Member States
Economic impacts	Administrative burdens on businesses	Information obligations placed on businesses
Economic impacts	Trade and investment flows	Investment flows & trade in services
Economic impacts	Competitiveness (sectoral) of business	Cost of doing business
Economic impacts	Public authorities	Budgetary consequences for public authorities
Economic impacts	Macroeconomic environment	Economic growth and employment
Economic impacts	Macroeconomic environment	Investments and functioning of markets
Social	Employment	Indirect effects on employment levels

Corporate Tax Model

Fact sheet

Source: Commission modelling inventory and knowledge management system (MIDAS)

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Overview

Acronym CORTAX

Full title Corporate Tax Model

Main purpose

A macro-economic model designed to simulate corporate tax policies, providing the effects for key macroeconomic variables for EU Member States, USA and Japan.

Summary

CORTAX is a macro-economic model designed to evaluate the economic implications of unilateral and multilateral corporate tax policies as well as the harmonization of these policies. It includes 28 countries of the European Union, plus the US and Japan. Countries are linked to each other via trade in goods markets, international capital markets and multinational firms.

It is a computable general equilibrium (CGE) model that captures the behaviour of households, firms and the government sector. All countries have the same functional form structure in terms of consumption, savings, production and public finances, but the data are country-specific. Firms are divided into three categories: domestic firms, multinationals headquarters and multinational subsidiaries. Multinationals and domestic firms differ to the extent that the former optimise profits globally and are engaged in profit shifting activities across borders. However, domestic firms pay their corporate taxes in their country of residence according to the revenues generated in that particular country. The effects of reforms can be expressed as changes in GDP, household consumption, business investment and fiscal revenue. It is coded in GAMS software. The model was originally built at CPB Netherlands, and was inspired by the OECDTAX model (Sørensen).

CORTAX has been used for policy formulation for corporate tax policies, in particular the Impact Assessment for the Common Corporate Tax Base (CCCTB) and the Common Consolidated Corporate Tax Base (CCCTB).

Keywords

Computable General Equilibrium (CGE) Model , Corporate Tax

Model category (thematic)

Economy

Model home page

No information provided

Ownership & license

Ownership

Multiple copyright [Original code owned by 3rd party]

Ownership details

No information provided

Licence type

Free software licence. The license grants freedom to run the programme for any purpose; freedom to run the program for any purpose; freedom to study (by accessing the source code) how the program works, and change it so it does enable computing; freedom to redistribute copies; and freedom to distribute copies of modified versions to others.

Details

CORTAX structure and approach

The CORTAX model is a multi-country computable general equilibrium model designed for the EU-28 to evaluate the economic effects of corporate tax reforms. The general equilibrium framework captures the optimal behaviour of all agents in the economy, specifically households, firms and government; and offers an economy-wide analysis of policy proposals. In the model, each country is assumed to have the same theoretical setting in terms of consumption, savings, production and public finances, although data accommodate country-specific features of the economy and the tax system. Besides the EU, the model includes the U.S., Japan and a tax haven. Countries are linked to each other via international trade in goods markets, international goods markets and investment by multinationals.

CORTAX features three categories of firms: multinationals headquarters, their subsidiaries located abroad and domestic firms. Each country has one representative domestic firm, one multinational headquarter and several subsidiaries, which are owned by headquarters in every other country. Each firm maximizes its value, equal to the net present value of all future cash flows, subject to the possibilities of the production function and accumulation constraints on physical capital and fiscal depreciation. The production function is a Cobb Douglas combination of the fixed factor and the value added, which, in turn, is a CES aggregate of labour and capital. Labour is immobile across borders and wages are determined on national labour markets. Capital is assumed to be perfectly mobile internationally so that the return to capital (after corporate taxes) is given for each country on the world capital market. The fixed factor is location-specific (e.g. land) and supplied inelastically. The income from the fixed factor reflects an economic rent.

Multinationals and domestic firms differ to the extent that the former optimise profits globally and are engaged in profit shifting activities across borders, via transfer pricing. Domestic firms only produce and pay their corporate taxes in their country of residence according to the revenues generated in the country only. Both domestic and multinational firms shift profits to tax haven to reduce their tax burden. Multinationals decide about the location of investment across subsidiaries. The size of the subsidiary in each country is determined by data on bilateral foreign direct investment (FDI) stocks.

The model allows the parent company to charge a transfer price for intra-firm deliveries of a homogenous good to the foreign subsidiaries that deviates from the equivalent price that would be charged if it had been an inter-firm transaction (the 'arms-length' price). Specifically, there is an incentive in place to set an artificially low (high) transfer price for supplies to subsidiaries in countries that feature a lower (higher) statutory corporate tax rate. In this way, the multinational shifts profits from high- to low-tax countries, thereby reducing its overall tax liability. The benefits from profit shifting thus rise linearly in the tax difference between countries. In order to ensure an interior solution, a convex cost function is specified to describe the organisational costs associated

with the manipulation of transfer prices and that make profit shifting increasingly costly at the margin.

For domestic firms, practices of profit shifting are captured through the inclusion of a tax haven. The tax haven is modelled by setting an artificially low CIT rate and profit shifting depends on the difference between the statutory CIT rate in the country and the artificial rate. Also multinationals engage in this practise. The extent to which profit shifting to tax haven occurs is parameterised in line with the literature, in particular the elasticity estimates of a meta-regression study (Heckemeyer & Overesch, 2013). Multinational firms are considerably more able to take advantage of tax haven than domestic firms. Therefore firms in the model know that not all of their CIT tax base will be subject to statutory tax rate, meaning that their effective statutory tax rate is reduced.

Households are modelled in a two-generations overlapping framework with young and old. Households maximise their intra-temporal utility function subject to a budget constraint, where net savings from young workers (wages, current transfers and negative consumption) are equal to negative value of net savings from old households. Households' savings are allocated to bonds and stocks, which are imperfect substitutes and have different rates of return. The returns to assets are determined on world markets and are assumed to be the same irrespective of the residence of their owner. Total bond and stock holdings are derived from the maximisation of total assets CES combination of bonds and equities subject to their total value. The effects on welfare are calculated using the compensating variation, computed as the difference in transfers received by young households required to compensate the change in utility.

Government keeps the budget balanced with consumption and public debt as fixed shares of GDP. Tax revenues and/or transfer payments adjust to keep a constant public budget. The taxes included in CORTAX are indirect taxes consumption and direct taxes on income from corporate and labour, dividends, capital gains and interest. The expenditure side features government consumption, interest payments on public debt and lump-sum transfers.

Input and parametrization

Extracts from many databases are required:

- FDI, employment (Eurostat)
- National accounts, tax revenues (Ameco, OECD)
- Population and labour force (United Nations)
- Government debt (Ameco)
- Labour force statistics (Eurostat, OECD, World Input-Output Database)
- Purchasing power parity exchange rates (IMF)
- Implicit tax rates on consumption (Eurostat)

- Implicit tax rate on labour (calculated using EUROMOD)
- Statutory corporate tax rates (ZEW)
- Tax rates on dividends, interest and capital gains (ZEW)
- Firm-level balance sheet and ownership structure (Orbis from Bureau Van Dijk)
- Depreciation rules (ZEW)

The year 2012 was chosen as reference year for the calibration, as it represented a good compromise between timeliness and completeness. The countries covered are the 28 EU member states, the United States and Japan.

A detailed description of the structure and parameterization of the model is available at Álvarez-Martínez et al. (2016a).

Main output

The key outputs produced by the model are:

- GDP
- Consumption
- Welfare
- Tax revenues
- Investment
- Cost of capital
- Wages
- Employment

Additional information:

CORTAX provides economic responses to simulated changes in corporate tax systems, such as changing the tax bases or tax rates, either unilaterally or with an EU-wide harmonisation. Results can present a firm dimension: multinational headquarter, subsidiary and domestic firm. Welfare is measured as compensating variation. It is equal to the transfer that should be provided to households to maintain their utility at the pre-reform level. A positive compensating variation implies a welfare loss.

Spatial - temporal extent

The output has the following spatial-temporal resolution and extent:

Parameter	Description
Spatial Extent / Country Coverage	28 countries of the European Union, the US and Japan.
(Spatial) resolution	National and EU-wide results
Temporal extent	2012
Temporal resolution	Model solves to long-run equilibrium

Quality & transparency

Quality

Question	Answer	Details
Models are by definition affected by uncertainties (in input data, input parameters, scenario definitions, etc.). Have the model uncertainties been quantified? Are uncertainties accounted for in your simulations?	not_applicable	It would be unusual to include uncertainty in a deterministic model of this kind. (Extensive sensitivity analysis has been done, see next.)
Sensitivity analysis helps identifying the uncertain inputs mostly responsible for the uncertainty in the model responses. Has the model undergone sensitivity analysis?	yes	For example, in the report for the Common Consolidated Corporate Tax Base (CCCTB) Impact Assessment, many dozens of sensitivity runs are reported (Álvarez-Martinez et al., 2016).
Has the model undergone external peer review by a panel of experts, or have results been published in peer-reviewed journals?	yes	The model has not gone through formal peer review. However, numerous peer-reviewed journal articles have used CORTAX (see Bettendorf et al., 2009a, Bettendorf et al., 2010a, Bettendorf et al., 2010b)
Has model validation been done? Have model predictions been confronted with observed data (ex-post)?	not_applicable	As of yet, our simulations are for policies that have not yet been implemented.

References related to external peer-review and publication in scientific journals:

- Bettendorf Leon, Horst Albert van der. Corporate Tax Policy and Unemployment in Europe: An Applied General Equilibrium Analysis; World Economy. doi: 10.1111/j.1467-9701.2009.01211.x
- Bettendorf, Leon; Van Der Horst, Albert. Corporate Tax Consolidation and Enhanced Cooperation in the European Union*; Fiscal Studies. doi: 10.1111/j.1475-5890.2010.00121.x
- Leon Bettendorf, Michael P. Devereux, Albert Van Der Horst, Simon Loretz, Ruud A. de Mooi. jCorporate tax harmonization in the EU; Economic Policy, Volume 25, Issue 63, 1 July 2010, Pages 537–590, doi: 10.1111/j.1468-0327.2010.00248.x

Transparency

Question	Answer	Details
Is the model underlying database (i.e. the database the model runs are based on) publicly available?	yes	All data sources are publicly available, though Orbis data (firm-level micro-data) is proprietary.
Can model outputs be made publicly available?	yes	See Álvarez-Martinez et al., 2016b, Álvarez-Martinez et al., 2018.
Is the model transparently documented (including underlying data, assumptions and equations, architecture, results) and are these documents available to the general public?	yes	See Álvarez-Martinez et al., 2016, Álvarez-Martinez et al., 2016b.

Is the model source code publicly accessible or open for inspection?	no	Currently, the code is internal to the Commission and CPB.
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References related to documentation:

- Alvarez Martinez M; Barrios S; Bettendorf L; Gesualdo M; D`andria D; Loretz S; Pontikakis D; Pycroft J. A New Calibration for CORTAX: A computable general equilibrium model for simulating corporate tax reforms JRC Working Papers on Taxation and Structural Reforms No 9/2016. European Commission; 2016. JRC104930

The model's policy relevance and intended role in the policy cycle

The model is designed to contribute to the following policy areas

- Economy, finance and the euro
- Taxation

The model is designed to contribute to the following phases of the policy cycle

- Formulation

The model's potential

JRC offers modelling support to Commission for the Action Plan on Corporate Taxation (including the CCCTB) and OECD BEPS discussions. The CORTAX computable general equilibrium model is used to evaluate the macroeconomic and welfare effects of

- the Common Consolidated Corporate Tax Base policy proposal
- impact of anti-avoidance rules, earning stripping rules and controlled-Foreign corporation rules and loss-carry-forward rules,
- measures addressing the debt bias considering alternative policy proposals (including CBIT, ACE, ACC and COCA)
- policy reforms related to R&D and intangibles.

CORTAX is used to simulate options for corporate tax policy, such as the common corporate tax base (CCTB), the common consolidated corporate tax base (CCCTB) and addressing the "debt-bias" often present in corporate tax systems.

Previous use of the model in ex-ante impact assessments of the European Commission

Use of the model in ex-ante impact assessments since July 2017.

In the Year	CORTAX contributed to the Impact assessment called	Led by	By providing input to the	The model was run by	Details of the contribution
2018	Impact assessment accompanying the document Proposal for a Council Directive: laying down rules relating to the corporate taxation of a significant digital presence and; Proposal for a Council Directive on: the common system of a digital services tax on revenues resulting from the provision of certain digital services SWD/2018/081 final	TAXUD	Baseline and assessment of policy options	<i>European Commission</i>	The model helped to assess the following impacts: - Adjustment, compliance or transaction costs - Affects on individual Member States - Information obligations placed on businesses - Investment flows & trade in services - Cost of doing business - Budgetary consequences for public authorities - Economic growth and employment - Investments and functioning of markets - Indirect effects on employment levels

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- *Álvarez-Martínez, M. T., Barrios, S., d' Andria, D., Gesualdo, M., Pontikakis, D., & Pycroft, J. (2018). The economic consequences of corporate tax rates reductions in the EU: Evidence using a computable general equilibrium model. The World Economy. doi:10.1111/twec.12703*
- *Alvarez Martinez M; Barrios S; Bettendorf L; Gesualdo M; D`andria D; Loretz S; Pontikakis D; Pycroft J. A New Calibration for CORTAX: A computable general equilibrium model for simulating corporate tax reforms JRC Working Papers on Taxation and Structural Reforms No 9/2016. European Commission; 2016. JRC104930*
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- *Bettendorf, Leon; Van Der Horst, Albert. Corporate Tax Consolidation and Enhanced Cooperation in the European Union*; Fiscal Studies. doi: 10.1111/j.1475-5890.2010.00121.x*
- *Leon Bettendorf, Michael P. Devereux, Albert Van Der Horst, Simon Loretz, Ruud A. de Mooi. jCorporate tax harmonization in the EU; Economic Policy, Volume 25, Issue 63, 1 July 2010, Pages 537–590, doi: 10.1111/j.1468-0327.2010.00248.x*
- *Bettendorf Leon, Horst Albert van der. Corporate Tax Policy and Unemployment in Europe: An Applied General Equilibrium Analysis; World Economy. doi: 10.1111/j.1467-9701.2009.01211.x*