MIDAS includes the descriptions of models in use by the Commission in support to the policy cycle. MIDAS is developed and managed by the **Competence Centre on Modelling** of the European Commission.

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Factsheet

SWD/2023/302 final

Impact Assessment accompanying the document Proposal for a COUNCIL DIRECTIVE establishing a Head Office Tax system for micro, small and medium sized enterprises, and amending Directive 2011/16/EU

Supporting model(s)

CORTAX

Impact assessment
SWD/2023/302 final

Fact sheet on model contributions

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Contents

Overview of model contributions to the impact assessment SWD/2023/302 final

Title
Impact Assessment accompanying the document Proposal for a COUNCIL DIRECTIVE establishing a Head Office Tax system for micro, small and medium sized enterprises, and amending Directive 2011/16/EU

Document ID
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Year of publication
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Led by
TAXUD

Model(s) used
CORTAX

Additional information
The IA proposes a Head Office Tax system (HOT) for Small and Medium Sized Enterprises (SME). The idea of the initiative is to grant major simplifications to small firms who today shy away from expanding their business to other EU countries as they fear the consequences this may have on where they are taxed. Indeed, today they would need to comply with the rules of all countries where they have a permanent establishment. Through HOT, they would be allowed to apply only one set of corporate tax rules when they wish to expand abroad, namely the tax rules of the country where they have their head office. The initiative would therefore bring more transparency and legal certainty for SMEs. It would ultimately incentivize them to step up cross-border investment.

Cortax was used to quantify the long-term effect of these major simplifications on the economy. It was assumed that a certain share of so-far domestic SMEs would, through HOT, have an incentive to expand into the Single Market. Alternative values were assumed for that share. It was also assumed that cross-border operating firms are more productive than purely domestic firms. In that context, alternative “export premiums” on productivity are used, each based on literature. Cortax was used to simulate the effect of the productivity shock, mainly on tax revenue and GDP.

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

Impact area	Impact category	Impact subcategory
Economic	Conduct of business	Investment cycle
Economic	SMEs	Operation and competitiveness of SMEs and micro SMEs
Economic	Sectoral competitiveness, trade and investment flows	Cost of doing business
Economic	Sectoral competitiveness, trade and investment flows	Investment flows & trade in services
Economic	Functioning of the internal market and competition	Free movement of goods, services, capital and workers
Economic	Public authorities	Budgetary consequences for public authorities
Social	Working conditions, job standards and quality	Wages, labour costs or wage setting mechanisms
Economic & Social	Employment	Economic growth and employment
Economic & Social	Capital movements; financial markets; stability of the euro	Investments and functioning of markets

Additional Information

The year 2019 was chosen as reference year for the calibration.

Overview of models

CORTAX

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 27 countries of the European Union, plus the UK, 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
Co-ownership (EU & third parties)

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-27 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.K., 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)

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	EU Member states 27, United States, Japan Other: notional tax haven country
(Spatial) resolution	National
Temporal extent	Long-term (more than 15 years)
Temporal resolution	Years

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).
Have model results been published in peer-reviewed articles?	Yes	For details please refer to the 'peer review for model validation' documents in the bibliographic references
Has the model formally undergone scientific review by a panel of external experts? (Please note that this does not refer to the cases when model results were validated by stakeholders)	No	
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.

Transparency

Question	Answer	Details
To what extent do input data come from publicly available sources? (Note: this may include sources accessible upon subscription and/or payment)	Based on both publicly available and restricted-access sources	
Is the full model database as such available to external users? (The answer 'yes' comprises the cases when access to the database implies a specific procedure or a fee)	No	All data sources are publicly available, though Orbis data (firm-level micro-data) is proprietary.
Have model results been presented in publicly available reports?	Yes	For details please refer to the 'Studies that use the model or its results' in the bibliographic references

Have output datasets been made publicly available? (Note: this could also imply a specific procedure or a fee)	No	
Is there any user-friendly interface presenting model results – such as dashboards or interactive interfaces – that is accessible to the public?	No	
Is the model code open source?	No	
Can the code be accessed upon request?	No	Currently, the code is internal to the Commission and CPB.
Has the model been documented in a publicly available dedicated report or a manual? (Note: this excludes IA reports)	Yes	http://skp.jrc.cec.eu.int/skp/showPub?id=JRC104930 http://skp.jrc.cec.eu.int/skp/showPub?id=JRC134161
Is there a dedicated public website where information about the model is provided?	No	

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.