WIFO
ÖSTERREICHISCHES INSTITUT
FÜR WIRTSCHAFTSFORSCHUNG

WORKING PAPERS

A WTO-compatible Border Tax Adjustment for the ETS to Finance the EU Budget

Alexander Krenek, Mark Sommer, Margit Schratzenstaller

596/2020

WIFO
ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG
AUSTRIAN INSTITUTE OF ECONOMIC RESEARCH

A WTO-compatible Border Tax Adjustment for the ETS to Finance the EU Budget

Alexander Krenek, Mark Sommer, Margit Schratzenstaller

WIFO Working Papers, No. 596

March 2020

Abstract

One element of the proposed European Green Deal is a border carbon adjustment mechanism. The introduction of a BCA would allow the EU to phase out current carbon leakage provisions of the ETS and to auction off all emission allowances, thus rendering the ETS a more effective unilateral tool to price and reduce carbon emissions. In theory a BCA would be a perfect instrument to ensure a level playing field for domestic and foreign producers, thus avoiding potential carbon leakage. Until now, however, the legal and administrative issues of implementation have been deemed too huge to overcome. We derive a WTO-compatible (full) border tax adjustment (BTA) design that could be implemented in the near future, and we estimate potential EU BCA and BTA revenues using a dynamic new Keynesian (DYNK) model. The BTA design of our choice would generate substantial and stable revenues that could be used as innovative sustainability-oriented own resource to finance the EU budget. We find that estimated revenues would suffice to finance between 5 and 7 percent of the EU's expenditure in the coming Multiannual Financial Framework period 2021-2027 and up to 16 percent in the year 2050. This new revenue source would allow member states to reduce their current contributions to the EU budget accordingly and would thus create space to cut other more distortionary taxes at the national level, enabling an EU-wide supranational sustainability-enhancing tax shift. Thus, a BTA could contribute to tackle both environmental and fiscal challenges currently facing the EU.

E-mail address: alexander.krenek@wifo.ac.at, mark.sommer@wifo.ac.at, margit.schratzenstaller@wifo.ac.at
2020/071/W/0

Medieninhaber (Verleger), Hersteller: Österreichisches Institut für Wirtschaftsforschung • 1030 Wien, Arsenal, Objekt 20 •
Tel. (43 1) 798 26 01-0 • Fax (43 1) 798 93 86 • http://www.wifo.ac.at/ • Verlags- und Herstellungsort: Wien
Die Working Papers geben nicht notwendigerweise die Meinung des WIFO wieder
Kostenloser Download: http://www.wifo.ac.at/wwa/pubid/65841

A WTO-compatible border tax adjustment for the ETS to finance the EU budget

Alexander Krenek, Mark Sommer, Margit Schratzenstaller

Austrian Institute of Economic Research
Arsenal Objekt 20
A-1030 Vienna, Austria

Alexander.Krenek@wifo.ac.at
Mark.Sommer@wifo.ac.at
Margit.Schratzenstaller@wifo.ac.at

Abstract

One element of the proposed European Green Deal is a border carbon adjustment mechanism. The introduction of a BCA would allow the EU to phase out current carbon leakage provisions of the ETS and to auction off all emission allowances, thus rendering the ETS a more effective unilateral tool to price and reduce carbon emissions. In theory a BCA would be a perfect instrument to ensure a level playing field for domestic and foreign producers, thus avoiding potential carbon leakage. Until now, however, the legal and administrative issues of implementation have been deemed too huge to overcome. We derive a WTO-compatible (full) border tax adjustment (BTA) design that could be implemented in the near future, and we estimate potential EU BCA and BTA revenues using a dynamic new Keynesian (DYNK) model. The BTA design of our choice would generate substantial and stable revenues that could be used as innovative sustainability-oriented own resource to finance the EU budget. We find that estimated revenues would suffice to finance between 5% and 7% of the EU's expenditure in the coming Multiannual Financial Framework period 2021-2027 and up to 16% in the year 2050. This new revenue source would allow Member States to reduce their current contributions to the EU budget accordingly and would thus create space to cut other more distortionary taxes at the national level, enabling an EU-wide supranational sustainability-enhancing tax shift. Thus, a BTA could contribute to tackle both environmental and fiscal challenges currently facing the EU.

Keywords: EU budget, sustainability-oriented taxation, border carbon adjustment, border tax adjustment, EU revenue system, EU own resources, emission trading system, carbon pricing

JEL classification code: F02, F36, F47, F53, H23, H87

1. Introduction[1]

The European Green Deal presented by the new President of the European Commission Ursula von der Leyen in November 2019 (European Commission 2019) and agreed upon by almost all Member States in January 2020 has revitalised the debate about the usefulness of a border carbon adjustment mechanism (BCA) for the EU: the Green Deal mentions both a reform that should increase the effectiveness of the EU Emission Trading System (ETS) and the introduction of a BCA mechanism as important measures to be further explored. Indeed, an in-depth discussion of the implementation of a BCA for the EU ETS is promising because it may offer solutions to a variety of problems.

In a recent contribution, Jean Pisani-Ferry (2019) addresses the fundamental problem of bringing in line the EU's free trade agenda, one of the very few exclusive competences of the EU, and the EU's ambition to lead the way in the field of climate protection. Effective unilateral climate action is already challenging under the current EU 2030/2050 goals, but the new push to pursue even more ambitious goals by the new von der Leyen Commission within the proposed European Green Deal needs to solve the issue of carbon leakage first.

Carbon leakage occurs when carbon emissions in third countries increase as a consequence of emission-reducing policies in a country or group of countries (Barker et al. 2007). Mehling et al. (2019) distinguish three channels of carbon leakage. First, the substitution of domestic products by goods produced in locations with no or lower carbon prices (strong carbon leakage[2]). Second, the relocation of investment to countries with no or lower carbon prices as a consequence of reduced domestic rates of return due to carbon pricing (weak carbon leakage). And third, the increase of demand for fossil fuel in low or no carbon pricing countries caused by the reduction of domestic demand and the ensuing reduction of global fossil fuel prices. In the current debate about the introduction of a BCA for the EU ETS, the first two channels, which can be characterised as a shift of (new) production to countries/regions with lower environmental standards, are more relevant because our proposed BCA design only concerns ETS sectors, thus not affecting EU demand for fossil fuels for the transport and heating sector.

[1] We are indebted to Andrea Sutrich for careful research assistance, and to Angela Köppl and Mathias Kirchner for valuable suggestions and comments on an earlier version of the paper. The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme 2014-2020, grant agreement No. FairTax 649439.

[2] For the differentiation between strong and weak carbon leakage see also Davis and Caldeira (2010).

The existence of carbon leakage in all its forms, especially the effect carbon pricing may have on the rerouting of new investment, is a contentious issue in the literature because it is hard to determine empirically. For this reason, the question whether the EU's carbon pricing mechanism, the EU ETS, was and is responsible for carbon leakage still remains to be answered. There is a body of literature demonstrating, based on model simulations, that unilateral carbon pricing leads to international carbon leakage (see, e.g., Böhringer et al. 2012; Fowlie, Reguant, and Ryan 2016; Fischer and Fox (2012[3]). This expectation is corroborated by various recent econometric analyses. Aichele and Felbermayr (2015) conclude that the Kyoto Protocol was indeed responsible for carbon leakage. For the US, Casey et al. (2020) show that state-level carbon pricing reduces employment, output and profits in the regulated state and increases them in nearby states. Naegele and Zaklan (2017), on the other hand, do not find evidence for carbon leakage in European manufacturing induced by the EU ETS, thus corroborating the results of several earlier empirical ex post analyses[4]. However, this finding may be explained by the low or zero emission costs the EU ETS imposed on firms during the first decade of its operation. As Lowe (2019) points out, more stringent emission-reducing policies in the EU, as planned within the European Green Deal, may well lead to carbon leakage in the future.

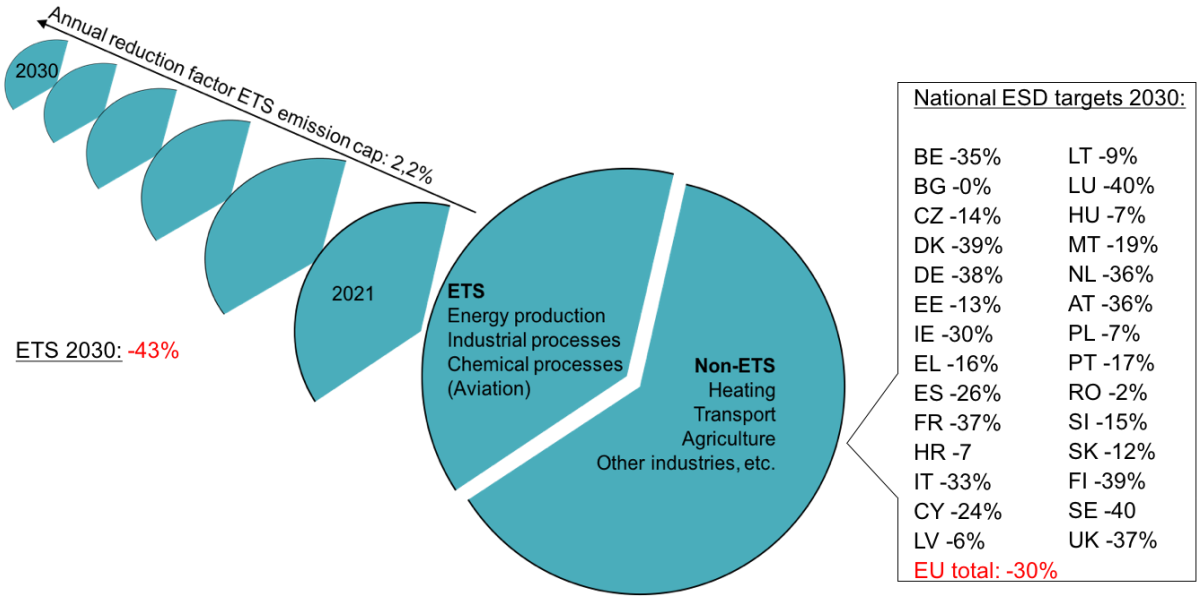
The problem of the EU is that the more ambitious carbon reduction targets are the quicker will the current ETS carbon leakage provisions run their course because the amount of 'free' European Emission Allowances (EUA) is reduced by the same annual reduction factor (at the moment 2.2% for the 4th trading period 2021-2030) as is the overall amount of EUA.

Graph 1 depicts the EU's (and the UK's) overall emission reduction path till 2030. The 43% reduction in the ETS sectors and the 30% reduction in the non-ETS sectors are relative to the 2005 emissions, so that combined the reduction will amount to 40% compared to the base year 1990 (Effort Sharing Decision 406/2009/EC, Regulation 2018/842 and Directive 2003/87EC). Currently, the price for one allowance, i.e. the right to emit one ton of carbon, amounts to about 25 €. Because of the Market Stability Reserve[5] (MSR) that finally deals with the oversupply of

[3] See also the brief review of model-based ex ante simulations in Condon and Ignaciuk (2013) and Naegele and Zaklas (2017) and the references cited therein.
[4] See Naegele and Zaklan (2017) for a brief review of these earlier studies.
[5] The MSR is a mechanism that ensures a certain level of liquidity in the EUA market. This means that the current oversupply of allowances will be put into the MSR and will not be available for auctioning. Should the amount of allowances in the market fall below a certain threshold, however, the MSR will release allowances. The MSR thus ensures a minimum and a maximum level of liquidity in the market.

allowances, and due to the increased annual reduction factor the price is likely to increase significantly in the 4th ETS trading period (2021-2030). More ambitious 2030/2050 reduction targets would imply an even larger annual reduction factor and thus even higher EUA prices.

Figure 1: Current EU carbon reduction path for the 4th trading period (2021-2030)



Source: Regulation 2018/842 and Directive 2003/87EC; own representation.

Article 10a(5a) of the amended ETS directive 2003/87 gives some flexibility regarding the annual ratio of auctioned to 'free' (57:43) allowances, but overall this ratio will remain fixed. Therefore, the amount of 'free' allowances, i.e. the protection against carbon leakage, will be reduced annually by the reduction factor of at least 2.2%. Combined with the fact that the United States formally notified the United Nations that they will withdraw from the Paris climate accord and that the same administration is continuously cutting back on environmental/emission standards, and considering that other big emitters of carbon are allowed to increase their carbon emissions until 2030, protecting European industry against carbon leakage should be at the top of the Commission's agenda.

In addition to the protection against carbon leakage, an EU BCA could also serve as an ideal green instrument to fund the EU budget. Brexit and the current efforts to initiate fundamental reforms within the EU (European Commission 2017a and 2017b) could have considerable implications on how the post-2020 Multiannual Financial Framework (MFF) for the period

2021-2027 is funded. The new dynamics in the debate about future EU funding fuelled by the final report of the High Level Group on Own Resources (HLGOR 2016) as well as the European Commission's reform proposals from May 2018 for the EU System of Own Resources (European Commission 2018a), both suggesting innovative 'genuine' own resources for the EU substituting a part of national contributions by Member States, should be used to also address some long-standing criticisms of EU finances such as the net position thinking embodied in every MFF. Schratzenstaller et al. (2017) introduce an innovative sustainability-oriented perspective for EU revenue reform, capturing the social, economic, environmental and cultural/institutional dimensions of sustainability. Hereby the basic idea is to increase sustainability within public finances at Member State and EU level by introducing such revenue sources, in particular taxes, at the EU level which cannot be implemented effectively at the national level (Hudetz et al. 2017). These revenue sources typically are either green taxes/levies or taxes on wealth, corporate profits, and financial transactions (Schratzenstaller and Krenek 2019). The revenues from these taxes or levies should be used to finance the EU budget, which would allow for reducing current Member States' contributions to the EU budget, creating space for national governments to reduce other, less sustainability-oriented taxes such as high taxes on labour. EU funds resulting from such a supranational tax shift across Member State and EU level are more adequate to finance European public goods with a true (sustainability-oriented) European added value (Schratzenstaller 2017). The case for a BCA as an instrument to finance the EU budget is made in chapter 2.

The concept of BCA is not new; however, no country or region has yet introduced a BCA (Lowe, 2019). These tariff-like levies would be imposed on EU imports based on the carbon emissions associated with the respective products, thus levelling the playing field for goods produced within the EU under a rigorous ETS. The complexity of this instrument, however, and the fear of potential WTO disputes have so far discouraged European policy makers to pursue this avenue, although the tentative legal framework in the form of the preamble in the revised EU ETS directive (2009/29/EC) is already in place. Given the political reality and existing international trade law, designing a BCA in a way that the actual amount of greenhouse gases emitted in the production of imported goods can be priced adequately is a huge political and legal challenge. That is why in chapter 3 we discuss the relevant articles of the General Agreement on Tariffs and Trade (GATT) one by one in order to eventually derive one of the very few options available to legally implement in the foreseeable future an EU BCA by

securing its WTO compatibility. The aim here is not to outline an optimal BCA design but a design that actually can be implemented unilaterally within the existing framework of international trade law. Chapter 4 models this specific BCA design with a dynamic new Keynesian (DYNK) model in order to estimate potential revenues. Chapter 5 concludes.

2. BCA as an element for a sustainability-oriented reform of the EU system of own resources

2.1 Strengths and weaknesses of the current EU system of own resource

Currently the EU system of own resources primarily rests on contributions from EU Member States' national budgets (see for a detailed description Schratzenstaller et al. 2016), with the bulk of revenues stemming from GNI- and VAT-based own resources representing, in principle, national contributions instead of 'true' own resources. As pointed out, for example, by Núñez Ferrer (2008), Begg (2011), or the HLGOR (2016), this revenue system certainly has its advantages (Hudetz et al. 2017). It guarantees steady, predictable and reliable revenues and a balanced budget. Ex ante at least, i.e. before the application of the various correction mechanisms, it provides for a 'fair' distribution of the financial burden across Member States. Moreover, national contributions respect the subsidiarity principle by leaving the decision on the distribution of the financial burden among individual taxpayers to Member States (Lipatov and Weichenrieder 2016).

However, various criticisms of the EU's revenue system have been brought forward during the last decades (Schratzenstaller et al. 2017). The EU system of own resources is being criticised for its opaqueness and in-transparency, rendering it impossible for EU citizens to assess their individual and their respective countries' contributions to the EU budget as well as the connection between EU revenues and expenditures (Schratzenstaller 2013; Fuest, Heinemann and Ungerer 2015). Other critics address the increasing dominance of direct contributions out of Member States' national budgets within the EU's overall revenues, which is continuously curtailing the EU's financial autonomy (European Commission 2011; Iozzo et al. 2008). Moreover, the application of various correction mechanisms impairs the fairness of the distribution of the financial burden across Member States. Finally, the EU revenue system does not contribute to core EU policies (Schratzenstaller 2013; European Commission 2011; HLGOR 2016; Schratzenstaller et al. 2017), such as sustainable growth and development as anchored in the Europe 2020 strategy, the 2030 Agenda for Sustainable Development, the 2015 Paris Climate Agreement, and the European Green Deal.

This lack of support of EU policies, which has been repeatedly stated also by the European Commission (e.g. European Commission 2011) and the European Parliament (e.g. European Parliament 2017) as well as by the HLGOR (2016), is not only caused by the concrete design of the individual own resources as such. It also results from the perception of the VAT-based own resource (making up for 11.1 percent of EU revenues in 2018) and the GNI-based own

resource (66.7 percent of EU revenues in 2018) as pure national contributions. Such a perception induces Member States to measure the benefits derived from the EU budget in terms of net financial contributions, i.e. as the balance of national contributions and transfers received from the EU budget, and to demand the maximisation of net benefits or at least the minimisation of net contributions from their respective country's position instead of the maximisation of an added value from an overall EU perspective (Iozzo et al. 2008). The dispute between 'net contributors' and 'net beneficiaries' also goes along with increasing tensions between Member States regarding the size and structure of the EU budget (HLGOR 2016) and exerts downward pressure on its overall volume (Haug et al. 2011). This is reflected in the most recent two MFF for the periods 2007-2013 and 2014-2020, each one lower in volume than the preceding one, as well as in the current negotiations on the MFF 2021-2027. Thus, the current structure of the EU system of own resources can be seen as an obstacle to further European integration as well as to policies supporting a sustainable economy and generating EU added value (European Commission 2011).

These shortcomings in the structure of EU revenues and expenditures form the general background against which innovative (tax-based) own resources – to replace current own resources within a fiscally neutral approach – have been discussed by some time now. The European Commission as well as the European Parliament have been in favour of substituting part of current own resources with tax-based own resources; a position supported by the results of the High Level Group on Own Resources (2016). Also, the proposal issued by the European Commission for reforms of the EU system of own resources in May 2018 (European Commission 2018b) suggests the introduction of various innovative own resources.

2.2 Sustainability-oriented tax-based own resources: a building block for financing European public goods and a supranational European tax shift

In the expanding field of 'international/global public finance'[6], the debate about innovative financing schemes and options for the provision of global/international public goods has been led for some time now. Somewhat surprisingly, the insights gained in this strand of the literature are only slowly feeding into the debate about the future financing of the EU. This may be explained by two specifics of EU finances in particular. First, national sovereignty in tax issues is fiercely defended by EU Member States, leaving only little space for EU competences in tax matters in the first place, which accordingly are defined rather narrowly in

[6] See, for instance, the contributions in Atkinson (ed.) (2005) or Kaul and Conceicao (eds.) (2006).

the EU treaties and require unanimous decisions of Member States to become effective at all. Second, a large share of EU expenditures is not perceived as creating EU added value, but to serve national interests.

If – as following from the subsidiarity principle – EU revenues in the future should be used to primarily finance true European public goods[7], establishing a financing scheme at the EU level which is strongly resting on true own resources instead of pure national contributions appears to be a necessary precondition. Sustainability-oriented tax-based own resources could be established within the existing political, legal and institutional framework at EU level as the basis for such an EU financing scheme (Schratzenstaller and Krenek 2019). These tax-based own resources could substitute for national contributions, providing Member States with fiscal space to cut more harmful taxes at the national level, particularly the high taxes on labour. This would allow a fiscally neutral tax shift enhancing sustainability-orientation of the EU's as well as Member States' revenues systems, thus yielding a double dividend for Member States.[8]

Obvious candidates for sustainability-oriented tax-based own resources as a core element of a true EU revenue system are taxes or tax-like levies which cannot be enforced effectively at the national level mainly for two reasons.[9] First, because tax bases and/or tax subjects are mobile so that in an un-coordinated setting tax rates are reduced step by step ('race to the bottom'), or certain taxes are not introduced in the first place ('stuck to the bottom'; Weibust 2009). Second, because of transnational externalities, in which case national taxation would imply inefficiently low tax rates (Jones, Keen and Strand 2012). Moreover, unilateral taxation may reduce the pressure on other countries to tax the respective externalities themselves, as they can free ride on the reduction of the taxed externality and at the same time enjoy a tax advantage increasing their competitiveness (Auerswald, Konrad and Thum 2011). The fact that revenues from taxes or levies on cross-border externalities are not clearly attributable to individual nation states suggests assigning them to a supra-national budget (Keen, Parry and Strand 2012).

Climate levies aiming at slowing down global warming are a prime example for such innovative (tax-based) own resources. Options for 'green' own resources in the context of EU finances, which are also addressed in the final report of the HLGOR (2016), are EU-wide aviation taxes (Krenek and Schratzenstaller 2017), a carbon tax (Luptáčik and Luptáčik 2017), or revenues connected to the EU ETS. In light of this reasoning, the proposal by the European

[7] See for an elaboration of European public goods Fuest and Pisani-Ferry (2019).

[8] See for this double dividend argument in the context of the implementation of a system of global environmental taxation Sandmo (2005).

[9] See for this argumentation Boadway (2005) in the context of financing global public goods by global taxation.

Commission (2018b) to use a share of auctioning emission certificates as own resource for the EU budget may be justified for two reasons: First, these revenues stem from an EU-wide carbon pricing system implemented at the EU level. Second, the base of these revenues are carbon emissions which are associated with considerable cross-border externalities. In the same vein, the potential revenues from a BCA for the EU ETS should be assigned to the EU to finance its budget.

Implemented as own resource for the EU budget, a BCA for an EU ETS would yield a European triple dividend. The first dividend consists of a contribution to European/global climate goals. As a second dividend, Member States' tax systems would be improved in terms of growth- and employment-friendliness. Using the revenues of green own resources to provide European public goods with a (sustainability-oriented) European added value would create a third dividend. Finally, dedicating a substantial share of EU expenditures to programmes that would contribute to a European decarbonisation strategy as envisaged by the European Green Deal would establish a visible connection between EU-wide green own resources and their use and would thus strengthen their political acceptability (Grubb 2011).

3. Deriving a WTO-compatible BCA design for the ETS

When approaching the challenge to design a WTO-compatible BCA, it is useful to distinguish between the general rules that allow WTO member states and signatories of the GATT to introduce trade restricting measures on the one hand and exceptions to these rules on the other hand. The relevant general rules for the introduction of a BCA can be found in article I., II., III., XI. and XVI. of the GATT. The article that might allow a member state to deviate from these general rules in the case of implementing a BCA is Article XX[10].

3.1. Most favoured nation principle

Article I. of the GATT represents one of the two best known principles of the GATT, namely the 'most favoured nation principle' (MFN principle). It states that a country is not allowed to discriminate between imported products from different countries and/or producers if the products in question are considered as 'like' products, i.e. similar products. The debate of what constitutes the concept of 'likeness' ultimately produced 4 guiding principles: i.) characteristics of the product, ii.) end use of the product, iii.) how the respective product is qualified in the schedule of concessions of member states, and iv.) consumers' tastes and habits, i.e. whether a product is attracting the 'same' consumers. Thus, 'production method' is not an established criterion to determine whether or not two products are 'like' products. If, for example, two cars at the border of the EU are 'like products' according to the four criteria mentioned above but differ in their carbon footprints as a result of different production methods, the EU is not allowed to discriminate between the two cars. Although there is important case law, e.g. US – Import Prohibition of Certain Shrimp and Shrimp Products (WT/DS58) that deals with requiring a specific production method for environmental reasons, its applicability for carbon footprints would not be easy even in the case of perfect information, i.e. knowing the exact carbon footprint of every product.

It should be emphasised that a BCA design based on individual carbon footprints is not only doomed because of its impracticability. It would establish the 'production method' as the main criterion to discriminate between products in order to allow for different tax rates at the EU border for products identical in terms of characteristics, but produced, e.g., with a different carbon footprint. Such a radical approach of changing the MFN principle is not likely to succeed.

[10] See also Monjon and Quirion (2010, 2011).

3.2. Pacta sunt servanda

Even if there is a theoretical BCA design that would somehow be admissible under article I. and even if there was a universally accepted method to calculate the carbon footprint of imported products, article II. would quickly put an end to any attempts that propose an EU BCA design that tries to levy higher tariffs on relative 'dirty' products, i.e. 'like' products according to the four criteria mentioned above but with a bigger carbon footprint.

Article II(1) simply states the principle of pacta sunt servanda, i.e. existing laws that include the national tariff schedules are to be respected. For most of the traded goods (classes of goods) there are already agreements regarding tariff rates. It would be possible to lower tariff rates unilaterally, implying that these reduced rates have to be granted to all WTO member states due to the MFN principle. Increasing tariff rates, however, is subject to negotiation and agreement between WTO members. Details on how the schedules can be changed can be found in article XXVIII. of the GATT.

3.3. The way forward

Article II(2), however, is one of the few pathways that would allow to introduce a specific WTO-compatible BCA design. *"Nothing in this Article shall prevent any contracting party from imposing at any time on the importation of any product a charge equivalent to an internal tax imposed consistently with the provisions of paragraph 2 of Article III. in respect of the like domestic product or in respect of an article from which the imported product has been manufactured or produced in whole or in part; […]"*

This angle of levying a tax or a tariff equivalent to the burden imposed on domestic producers, irrespective of the carbon content of the imported product, appears as the only viable pathway to introduce a WTO-compatible BCA.[11] This approach has two prerequisites, namely a transparent calculation of the tax base and a transparent tax rate. Both is not a trivial undertaking but most feasible when compared to other approaches. For the tax base the existing carbon leakage benchmarks within the ETS would be the basis to establish a so-called EU best-technology standard. These benchmarks are in most cases already product-based. Undoubtedly the calculation of these standards would have to undergo renewed scrutiny before becoming the basis of a BCA, but this can be achieved in the very short term.

[11] See https://www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf, and Trachtman (2016), Mehling et al. (2019) and Bueb et al. (2017).

The identification of an acceptable tax rate is definitely the most difficult part of the reform. Most recently Kemfert et al. (2019), with regard to the current carbon pricing debate in Germany, emphasise the importance of a stable, predictable CO2 path (mainly) within the ETS. Firms have to know beforehand what additional costs they will face in the future in order to plan and make the necessary (technological) adjustments and investments. A strongly volatile EUA price will have a negative impact on the technological transition of EU industries to less carbon-intensive methods of production.

Thus, we suggest the introduction of a very narrow price corridor within the ETS of which at least the lower bound can be used as a tax rate for imports. The already existing MSR makes this additional reform step significantly easier to implement.

3.4. National treatment principle

The second well-known principle is the 'national treatment' principle, i.e. article III. of the GATT. This article is also based on the concept of 'likeness'. GATT parties have agreed to not discriminate between imported products and domestically produced 'like' products. This refers to domestic taxes and levies, but also regulations and implies that member states not only are not allowed to discriminate between two 'like' imported products but they are also not allowed to discriminate between one imported product once it has entered the country and a 'like' domestically produced product. Solving the problem through national tax schemes is therefore not an option if the regulator tries to tax the imported product differently than the domestic product by assuming a different carbon footprint. It would, however, be feasible to tax two 'like' products, one produced in the EU and one outside the EU, with the same tax rate, i.e. irrespective of their carbon content. In this regard the Value Added Tax (VAT) is a good example how a future border tax adjustment could be put into practice.

With reference to the Working Party Report on Border Tax Adjustments[12] of 1970 the Interpretative Note of Article III[13] states that our proposed border tax design is admissible under the condition that it is product-based. Thus, the usage of the product-based benchmarks of the ETS is crucial.

3.5. Unlikely success of integrating foreign producers into the ETS

Article XI. is relevant because it emphasises that among trade restrictions quantitative restrictions are to be avoided above all else. This means that every tariff is to be preferred over

[12] https://www.wto.org/gatt_docs/English/SULPDF/90840088.pdf.
[13] https://www.wto.org/english/res_e/booksp_e/gatt_ai_e/art3_e.pdf, pp.137-138.

a quota. This is important because forcing foreign producers to participate in the EU ETS can be interpreted as a quantitative restriction and is therefore very unlikely to be WTO compatible. In 2009 due to political pressure the attempt to include foreign air travel providers into the ETS failed.[14] If this inclusion of foreign producers/providers would have been subject to the Dispute Settlement Body of the WTO it is very likely that a panel would have deemed it not compatible with WTO rules, especially Article XI. of the GATT.

3.6. Full carbon border adjustment

Article XVI. is relevant for the implementation of a full border carbon adjustment. In such a full border carbon adjustment, for every (ton of) product that is exported to countries outside the EU the respective producers would get their costs for buying allowances refunded or would not have to buy allowances in the first place. This process has to be as transparent as possible in order to not be classified as an export subsidy. It should be noted, however, that the wording of article XVI. is less strict than in other, more important articles, thus making it very likely that a full border carbon adjustment based on article II(2) is WTO compatible.

3.7. Deviation from the general rules of the GATT

Finally, under article XX. of the GATT there is the possibility to argue in front of a WTO panel that a specific BCA design is necessary, even though it violates the MFN, national treatment and/or pacta sunt servanda principle, in order to protect human and animal health and life or for the preservation of exhaustible natural resources. Proving this necessity might be possible and it should be mentioned that a WTO panel in US – Gasoline (WT/DS2) ruled that trade restricting policies that protect the natural and exhaustible resource, namely clean, air is permitted under XX(g). However, fulfilling all the requirements of article XX. is not as easy as it might seem because a two-tier analysis is necessary. Once the necessity of a measure (e.g. to protect human life) is established it has to be demonstrated that this measure is not applied in a manner which would constitute 'a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail' and is not 'a disguised restriction on international trade'[15]. Regarding this second tier, every BCA design that is not based on article II(2) would face the same difficulties as in complying with article I. and III. of the GATT. In the case that our proposed BCA design based on article II(2) is found to be not compatible with

[14] See also Fouré (2016).
[15] See also https://www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf, p.100.

the relevant general rules of the GATT (articles I., II., III., XI. and XVI.) it would still have the best chances to pass the two-tier test of Article XX.

3.8. Border tax adjustment instead of border carbon adjustment

Ultimately, we do not propose a border carbon adjustment (BCA), but rather transforming the ETS into a quasi-carbon tax that would allow for the introduction of a simple EU border tax adjustment (BTA).

The tax base for the BTA has to be calculated based on the benchmarks already available in the EU ETS[16]. These benchmarks might need new scrutiny, but they are already product-based and thus applicable for calculating a border tax adjustment. The second requirement is the introduction of a narrow EUA price corridor in order to use the lower bound of this corridor as a non-volatile tax rate. This has the additional advantage of ensuring predictability of the future price path for firms allowing them to prepare long-term plans and to make the necessary (technological) adjustments and investments, thus avoiding lock-in effects.

It is fully acknowledged that the approach put forward in this paper would abandon one of the key features of a BCA mechanism economists cherish the most, namely the incentives for foreign firms/countries to change their production methods. However, every attempt to implement a true BCA that discriminates either between importing countries or an importing country and the EU is doomed to fail. The proposed BTA design, in contrast, is likely to be considered compatible with the relevant general rules of the GATT (articles I., II., III., XI. and XVI.) and has in addition the best chances to pass the two tier test of Article XX., which would allow the EU to introduce it irrespective of the BTA's compatibility with the general rules.

Finally, if a BTA is the measure the EU decides upon to prevent carbon leakage it should aim for a full border tax adjustment, i.e. exempting EU exports from any form of carbon pricing.

[16] This is equivalent to a BCA that assumes that the carbon intensity of foreign production is identical to that of the most efficient production inside the EU.

4. Estimated revenues

4.1. The model

In order to estimate potential revenues of the proposed BTA we employ a slightly modified version of a specific DYNK (DYnamic New Keynesian) model which was developed and described by Kratena and Sommer (2014). Their approach is a hybrid between an econometric input-output (IO) and a CGE model and is characterised by the integration of rigidities and institutional frictions. In the long-run the model has similarities to a CGE model and explicitly describes an adjustment path towards a long-run equilibrium on the labour market. The term 'New Keynesian' refers to the existence of a long-run full employment equilibrium, which will not be reached in the short run due to institutional rigidities. These rigidities include liquidity constraints for consumers (deviation from the permanent income hypothesis) and wage bargaining (deviation from the competitive labour market). The model describes the inter-linkages between 59 industries (NACE rev. 1.1) as well as the consumption of 5 household income groups by 47 consumption categories (COICOP) and covers the EU 27 (as one economy). The model of household demand comprises **three** nests, where in the **first** nest the demand for durable commodities (own houses, vehicles) and total nondurable commodities is derived from a buffer-stock model of consumption. The **second** nest links energy demand (in monetary and physical units) to the durable stock (houses, vehicles, appliances), taking into account the energy efficiencies of embodied carbon in the stocks. Direct CO2 emissions of households are derived from these energy flows. The **third** nest comprises non-energy and non-durable commodities and is simulated by implementing an almost ideal demand system (AIDS) model with 8 commodity categories. The model of production links the input-output structures (Leontief technologies) of 59 intermediary inputs to a production function with a TRANSLOG specification that has 5 factors (capital, labour, energy, domestic materials and imported materials) as inputs. This specification allows simulating endogenous shares of factors in the production of each sector depending on relative prices and technological trends. The factor energy is further split up into 26 types of energy, from which CO2 emissions of production are derived, a part of which constitutes the domestic indirect CO2 emissions due to household consumption. The indirect CO2 emissions of imports are based on calculations of Arto et al. (2014) using the world input output database (WIOD, Version 2013. The labour market is depicted via wage curves, where wage increases by industry depend on productivity, the consumer price and the distance to full employment. The model is closed by endogenising

parts of public expenditure in order to meet the mid-term stability program for public finances in the EU27[17].

4.2. Tax scenarios

The original version of our model was used by Kratena and Sommer (2014) to analyse the effects of two different EU27 carbon tax scenarios. One of these tax scenarios was a 'classical' green tax reform, which taxes production-based GHG emissions on an increasing scale and uses revenues to reduce social security contributions, thus representing a revenue neutral tax shift. This scenario is now modified to also include the taxation of carbon embodied in imports. We model both a classical BCA and our proposed BTA scenario as a tax on EU imports combined with a classical carbon tax for all domestic sectors[18]. The main difference between the BCA and BTA scenario is the assumed carbon content of imported products. As we propose reforming the ETS into a quasi-carbon tax, which is then complemented by the introduction of a BTA, this model is well suited for our purposes estimating potential BTA revenues and the effect a BTA has on economic growth and employment. The recycling of revenues to reduce social security contributions can be seen as national governments using the combined ETS and BTA revenues[19] to reduce domestic taxes on labour. The price path for all scenarios starts at € 36 per tonne carbon emissions in 2018, increasing steadily to € 250[20] in 2050.

In contrast to our simple two country model, where one country represents the EU27 economy and the other one 'the rest of the world', a more elaborate global G-Cubed model was used by McKibbin et al. (2017) to analyse the effects of a 'carbon tax – BCA combination' for the United States. The study offers several important findings. The most important insight in our context is that overall welfare losses expressed in GDP growth deviating from a baseline scenario are small in general, and even smaller if a carbon tax is combined with a BCA and revenues are used to reduce other distortionary taxes. Using the revenues to reduce other distortionary taxes is especially important with regard to employment. From a fiscal perspective the most important result is that revenues from a carbon tax-BCA combination are increasing over time.[21]

[17] Croatia, which joined the EU on July 1, 2013, is not included.
[18] The carbon tax for all domestic sectors can be interpreted as national governments introducing a carbon tax for the non-ETS sectors at the national level based on the same price path as in the ETS.
[19] Of course, for the simulation results it is irrelevant whether BTA revenues are directly recycled or used to finance the EU in a first step, reducing by the same amount member states GNI contributions and allowing them to reduce the taxes on labour/social security contributions in a second step.
[20] Real value; the price path is determined in line with the EU roadmap for a low-carbon economy.
[21] See also Yuan et al. 2017 for the long-term stability of carbon tax revenues in general.

As in McKibbin et al. (2017), and only for the sake of simplicity, our model does not consider export rebates, i.e. exemptions from carbon taxation, for EU exports. Our prime focus lies on estimating potential revenues for the EU budget in the long run stemming from a WTO-compatible BTA specification in order to demonstrate that a considerable share of the annual EU budget of about € 180 billion[22] could be financed. A full BTA would of course lead to a substantial reduction of regular ETS revenues.

We simulate three scenarios: a BCA scenario and two BTA scenarios.

Scenario 1 (BCA) accounts for all direct and indirect carbon emissions embodied in EU imports. Tariffs are levied on EU imports and are determined based on the average sectoral carbon content of non-EU countries. Although it is the most efficient BCA design, its implementation as argued in chapter 3 is considered unlikely and is presented here only as a reference point for the WTO-compatible BTA scenario.

Scenario 2 (BTA) taxes only those imported products/inputs that are produced in sectors equivalent to ETS sectors, but this scenario assumes the same carbon intensity of production for imported products as is prevalent in the EU. In line with Art II(2) of the GATT it taxes also the relevant products if they are used as inputs for other products ,i.e. steel is also taxed if it is imported in form of a car. It should be noted, however, that EU energy producers are subject to the ETS and that EU manufacturers in many cases have their energy prices cut by the government in order to protect competitiveness. France for example uses about 60% of ETS revenues for indirect carbon cost compensation (European Commission 2018b). This scenario also taxes indirect, energy-related carbon emissions (assuming the same carbon intensity as in the EU). It would thus allow for a discontinuation of Member States' rebates on electricity for their industries.

Scenario 3 (BTA realistic) is identical to Scenario 2 but excludes the taxation of electricity inputs of imported products. Thus, all imported products equivalent to those produced within the ETS, except electricity, are taxed directly and indirectly, assuming the same carbon intensity as within the EU. The intuition behind this scenario is straightforward. Even under the assumption of identical carbon intensity of production, the administration of taxing electricity inputs in every product seems unrealistic. Fortunately, electricity is almost exclusively imported indirectly via products, i.e. there is no direct competition between domestically produced electricity and electricity produced in third countries. If EU Member

[22] According to the proposal put forward by the European Commission in May 2018.

States continue with carbon cost compensation, i.e. reducing the increasing cost of electricity for their industries, excluding electricity inputs from a BTA would not harm competitiveness. This is the BTA scenario with the best chances of implementation.

4.3. Simulation results

Our primary focus is to estimate potential long-term revenues of an EU BTA. Welfare effects of green tax shifts are in general ambiguous and certainly depend on the usage of revenues. If other harmful taxes are cut, as in some scenarios in McKibbin et al. (2017) and all three scenarios in our own model, almost no effect on GDP growth and even positive effects on the labour market can be expected.

Both the results derived for the US by McKibbin et al. (2017) and our own results for the EU suggest that revenues from BTA are not only substantial but increasing over time. BTAs ought to be introduced first and foremost to make domestic effective carbon pricing possible, which should actually lead to a declining tax base. Why would revenues from a BTA still increase over time? Demand for imports is decreasing as prices are raised by our BCA and BTA scenario. This effect, however, only dampens the overall increasing trend of the share of imports in EU GDP. Accordingly, a BTA would only dampen the rate of imported emission growth. The major uncertainty with regard to revenues for a classic BCA is the future carbon intensity of foreign production. The overall trend of carbon intensity in production in non-EU countries is decreasing and we assume that this trend continues in the long run.[23]

In all three scenarios potential revenues are substantial. Implementing a classical and most efficient BCA specification would generate enough revenues by 2027 to finance the current EU budget completely.[24] As mentioned above, however, this scenario should only be regarded as a reference scenario as its implementation is very unlikely. The share of the EU budget that our BTA (realistic) design would be able to finance starts with 5% in 2021 and increases to 16% in 2050. This increase, as mentioned above, is caused by an overall increasing trend of the share of imports in EU GDP but also an increasing carbon price path[25].

[23] Examples like China, which after three years of decline of carbon intensity of production, increased its burning of coal since 2017again should emphasise that such an assumption can turn out to be wrong already in the short term.

[24] For the sake of comparability, we assume that the volume of the EU budget proposed by the European Commission for the years 2021-2027 is increased annually from 2027 on by an inflation factor of 1.5%.

[25] In 2050 the nominal price of carbon would be € 400, the real carbon price would be € 250.

Figure 2: Revenue potential of a border carbon adjustment

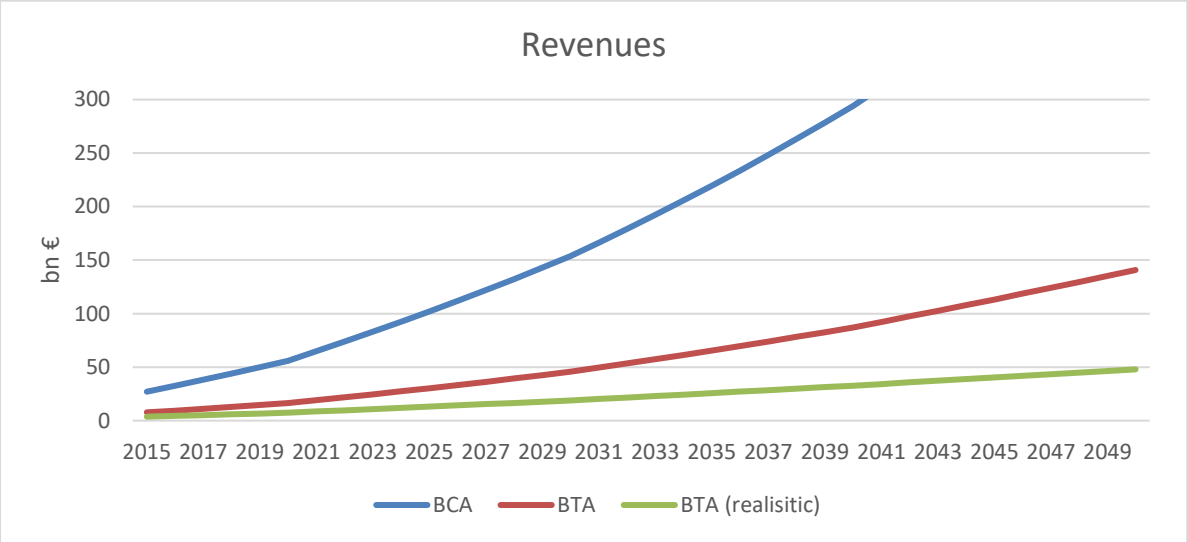
	BCA revenues*	BTA revenues	BTA (realistic) revenues	nominal carbon price path**	EU budget***	BTA revenues in % of EU budget	BTA (realistic) revenues in % of EU budget
2015	27	8	4	22	163	5	2
2016	33	9	4	26	155	6	3
2017	38	11	5	31	156	7	3
2018	44	13	6	36	160	8	4
2019	50	15	7	41	164	9	4
2020	56	16	7	46	169	9	4
2021	65	19	9	54	167	11	5
2022	74	22	10	61	177	12	5
2023	83	25	11	69	184	13	6
2024	93	27	12	77	191	14	6
2025	102	30	13	86	198	15	7
2026	112	33	14	94	209	16	7
2027	122	36	15	103	214	17	7
2028	132	39	17	112	217	18	8
2029	143	43	18	121	220	19	8
2030	154	46	19	130	224	20	8
2031	166	50	20	141	227	22	9
2032	179	53	22	152	231	23	9
2033	192	57	23	163	234	25	10
2034	206	61	24	174	238	26	10
2035	220	65	26	186	241	27	11
2036	234	70	27	197	245	28	11
2037	248	74	28	209	248	30	11
2038	263	78	30	222	252	31	12
2039	278	83	31	234	256	32	12
2040	294	87	33	247	260	34	13
2041	312	92	34	261	264	35	13
2042	330	97	36	275	268	36	13
2043	348	103	37	290	272	38	14
2044	367	108	39	305	276	39	14
2045	386	113	40	320	280	40	14
2046	405	119	42	336	284	42	15
2047	425	124	43	351	288	43	15
2048	446	130	45	367	293	44	15
2049	466	135	46	384	297	46	16
2050	487	141	48	400	301	47	16

Source: own calculations. *bn €, **nominal values, *** 2028 to 2050: budget of 2027 according to the proposal by the European Commission from May 2018 kept constant, assuming a standard inflation rate of 1.5% annually.

In addition to projected revenues shown in figure 3, figure 4 shows the effect of the BCA and BTA scenarios have on total EU employment. Although the proposed tax shifts have no significant effect on economic growth, figure 4 shows that total EU employment is positively influenced by the reform as a consequence of the revenue recycling. These results are clearly encouraging but it should be noted that further research on the distributional effects of such a

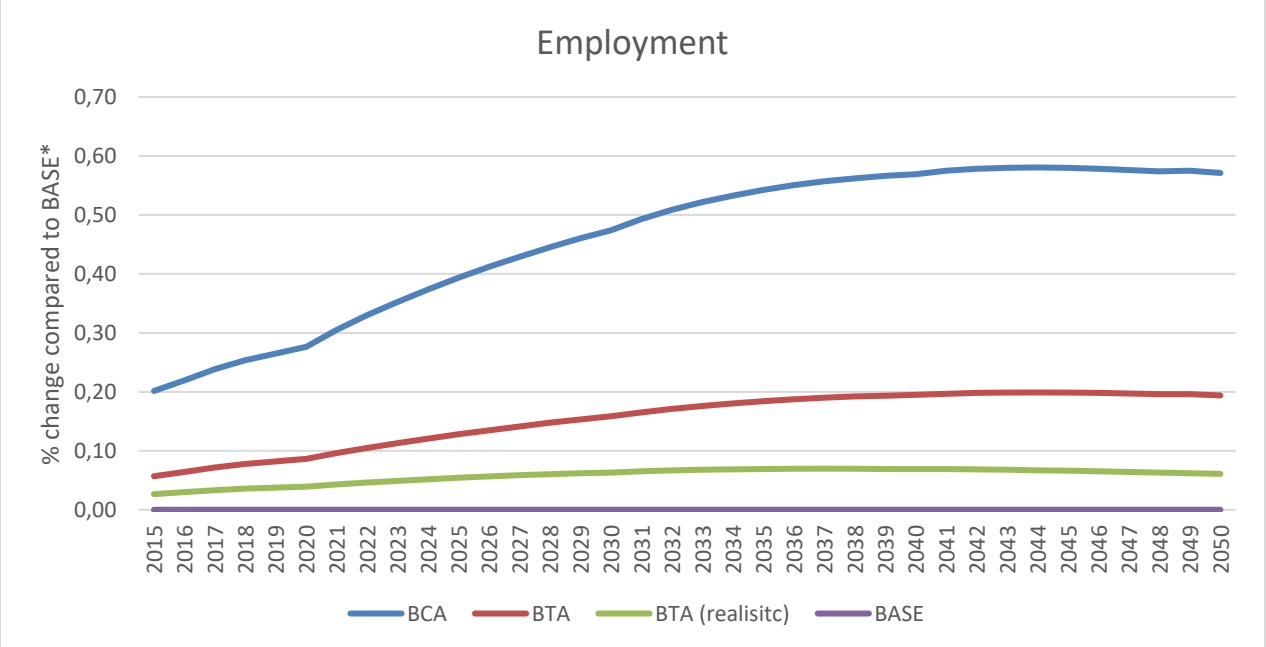
reform on Member States and economic sectors is necessary. If the proposed tax shift is coordinated, for example, with EU regional and cohesion spending to counter potential negative effects of such a reform the EU budget could be transformed into an effective tool to foster environmental, economic, social and institutional sustainability.

Figure 3: Potential revenues in billion € of a BCA and a BTA scenario



Source: own.

Figure 4: Employment effects of a BCA and a BTA scenario



Source: own, *BASE: scenario of taxing direct EU carbon emissions without BCA and BTA.

5. Conclusions

By addressing both the issues of necessary reform of EU funding and the need for effective unilateral carbon pricing with the proposal to introduce a Border Tax Adjustment (BTA) for the EU ETS we aim at contributing to the current discussion about the European Commission's European Green Deal. Compared to a classic BCA, our proposal of a BTA has the advantage of being WTO compatible and rather easily implementable in the near future. The main difference between the two instruments is that a BCA tries to account for as much carbon of imported products as possible whereas a BTA only tries to levy exactly the same financial burden on foreign producers as on domestic ones subject to the EU ETS. In order for a BTA to be successful the ETS would have to be transformed into a product-based quasi-carbon tax. The already existing ETS benchmarks currently used for the distribution of free allowances could serve for determining the BTA tax base as well as the amount of allowances a domestic producer has to buy inside the ETS. As non-volatile tax rate we propose the introduction of a very narrow price corridor within the ETS. The already existing market stability reserve (MSR) will make the introduction of such a price corridor easier if the EU should pursue such a reform. Such a price corridor has the additional advantage of ensuring predictability of the future price path for firms, allowing them to prepare long-term plans and to make the necessary (technological) adjustments and investments, thus avoiding lock-in effects. Finally, we come to the conclusion that a BTA would be a perfect instrument to fund the EU budget. It could not be implemented by individual Member States. Its tariff-like characteristics makes it clearly a candidate for a new sustainability-oriented own resource. Its base are carbon emissions, i.e. the textbook example of a cross border externality, and its revenues are difficult to attribute to individual Member States.

By employing a DYNK (DYnamic New Keynesian) model, which is a hybrid between an econometric input-output (IO) and a CGE model, we are able to simulate our proposed BTA design and estimate its long run potential revenues and its effect on economic growth and employment. The model is recycling the revenues from the ETS as well as the BTA to lower social security contributions. This is of course equivalent to a scenario in which a BTA would fund parts of the EU budget, allowing Member States to lower their national contributions accordingly and to use their freed-up contributions to reduce more harmful taxes on labour in the form of social security contributions. Our model predicts that there would be de facto no effects on economic growth and an even slightly positive effect on EU employment. A realistically designed BTA could finance up to 7% of the 2021-2027 MFF proposed by the

European Commission. If the budget of the year 2027 were to stay constant in real terms till the year 2050 the proposed BTA design would be able to finance it up to 16%.

References

Aichele, Rahel and Felbermayr, Gabriel. 2015. Kyoto and Carbon Leakage: An Empirical Analysis of the Carbon Content of Bilateral Trade. *The Review of Economics and Statistics* 97 (1): 104-115.

Arto, Iñaki, Rueda-Cantuche, José M. and Peters, Glen P. 2014. Comparing the GTAP-MRIO and WIOD Databases for Carbon Footprint Analysis. *Economic Systems Research* 26 (3): 327-353.

Atkinson, Anthony B. (ed.). 2005. *New Sources of Development Finance.* Oxford: Oxford University Press.

Auerswald, Heike, Konrad, Kai A. and Thum, Marcel P. 2011. Adaptation, Mitigation and Risk-taking in Climate Policy. *CESifo Working Paper Series* No. 3320.

Barker, Terry et al. 2007. Carbon Leakage. In: Metz, B. et al. (eds.) Chapter 11.7.2. Mitigation from a Cross-sectoral Perspective. In IPCC (ed.). Climate Change 2007: *Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Print version: Cambridge University Press, Cambridge, U.K., and New York, N.Y., U.S.A.

Begg, Ian. 2011. *An EU Tax: Overdue Reform or Federalist Fantasy?* International Policy Analysis. Berlin: Friedrich-Ebert-Stiftung.

Boadway, Robin. 2005. National Taxation, Fiscal Federalism and Global Taxation. In: Atkinson, Anthony B. (ed.). *New Sources of Development Finance*. Oxford: Oxford University Press: 210-237.

Böhringer, Christoph, Balistreri, Edward J. and Rutherford, Thomas F. 2012. The Role of Border Carbon Adjustment in Unilateral Climate Policy: Overview of an Energy Modeling Forum study (EMF 29). *Energy Economics* 34 (2): 97-110.

Bueb, Julien, Richieri Hanania, Lilian and Le Clézio, Alice. (2017). Border Adjustment Mechanisms - Elements for Economic, Legal, and Political Analysis. In: Arent, Douglas, Arndt, Channing, Miller, Mackay, Tarp, Finn and Zinaman, Owen. *The Political Economy of Clean Energy Transitions.* 2017. Oxford: Oxford University Press: 60-79.

Casey, Brendan J., Gray, Wayne B., Linn, Joshua and Morgenstern, Richard. 2020. How Does State-Level Carbon Pricing in the United States Affect Industrial Competitiveness? *NBER Working Paper* No. 26629.

Condon, Madison and Ignaciuk, Ada. 2013. Border Carbon Adjustment and International Trade: A Literature Review. *OECD Trade and Environment Working Paper* No. 2013/06.

Davis, Steven J. and Caldeira, Ken. 2010. Consumption-based Accounting of CO_2 Emissions. *Proceedings of the National Academy of Sciences* 107 (12): 5687-5692.

European Commission. 2011. Financing the EU Budget: Report on the Operation of the Own Resources System. Accompanying the Document Proposal for a Council Decision on the System of Own Resources of the European Union. *Commission Staff Working Paper* No. SEC(2011) 876 final/2. Brussels: European Commission.

European Commission. 2017a. *White Paper on the Future of Europe – Reflections and Scenarios for the EU27 by 2025.* Brussels: European Commission.

European Commission. 2017b. *Reflection Paper on the Future of EU Finances.* Brussels: European Commission.

European Commission. 2018a. Report from the Commission to European Parliament and the Council: Report on the functioning of the European Carbon Market. *COM(2018) 842 final*. Brussels: European Commission.

European Commission. 2018b. Proposal for a Council Decision on the System of Own Resources of the European Union. *COM(2018) 325 final*. Brussels: European Commission.

European Commission. 2019. The European Green Deal. *COM(2019) 640 final*. Brussels: European Commission.

European Parliament. 2017. *Working Document on Reform of the European Union's System of Own Resources.* Brussels.

Fischer, Carolyn and Fox, Alan K. 2012. Comparing Policies to Combat Emissions Leakage: Border Carbon Adjustments versus Rebates. *Journal of Environmental Economics and Management* 64 (2): 199-216.

Fowlie, Meredith, Reguant, Mar and Ryan, Stephen P. (2016). Market-based Emissions Regulation and Industry Dynamics. *Journal of Political Economy* 124 (1): 249-302.

Fuest, Clemens, Heinemann, Friedrich and Ungerer, Martin. 2015. Reforming the Financing of the European Union: A Proposal. *Intereconomics* 50 (5): 288-293.

Fuest, Clemens and Pisani-Ferry, Jean. 2019. A Primer on Developing European Public Goods. *EconPol Policy Report* 16 (3).

Fouré, Jean, Houssein Guimbard and Monjon, Stéphanie. 2016. Border Carbon Adjustment and Trade Retaliation: What Would be the Cost for the European Union? *Energy Economics* 54 (C): 349-362.

Grubb, Michael. 2011. International Climate Finance from Border Carbon Cost Levelling. *Climate Policy* 11 (3): 1050-1057.

Haug, Jutta, Lamassoure, Alain, Verhofstadt, Guy, Gros, Daniel, De Grauwe, Paul, Ricard-Nihoul Gaëtane and Rubio, Eulalia. 2011. *Europe for Growth: For a Radical Change in Financing the EU*. Brussels: CEPS.

High Level Group on Own Resources – HLGOR. 2016. *Future Financing of the EU.* Brussels.

Hudetz, Alexander, Mumford, Ann, Nerudová, Danuše and Schratzenstaller, Margit. 2017. Reform Needs and Options in the EU System of Own Resources. *Empirica* 44 (4): 609-613.

Iozzo, Alfonso, Micossi, Stefano and Salvemini, Maria Teresa. 2008. A New Budget for the European Union? *CEPS Policy Brief* No. 159.

Jones, Benjamin, Keen, Michael and Strand, Jon. 2012. Fiscal Implications of Climate Change. *World Bank Policy Research Working Paper* WPS5956.

Kaul, Inge and Conceicao, Pedro (eds.). 2006. *The New Public Finance*. New York/Oxford: Oxford University Press.

Keen, Michael, Parry, Ian and Strand, Jon. 2012. Market-based Instruments for International Aviation and Shipping as a Source of Climate Finance. *World Bank Policy Research Working Paper* WPS5950.

Kemfert, Claudia, Schmalz, Sophie and Wägner, Nicole. 2019. CO_2-Bepreisung im Wärme- und Verkehrssektor: Erweiterung des Emissionshandels löst aktuelles Klimaschutzproblem nicht. *DIW Discussion Papers* No. 1818.

Kratena, Kurt and Sommer, Mark. 2014. Policy Implications of Resource Constraints on the European Economy. *WWWforEurope Policy Brief* No. 6.

Krenek, Alexander and Schratzenstaller, Margit. 2017. Financial Instruments to Foster Sustainability: Sustainability-oriented EU Taxes: The Example of a European Carbon-based Flight Ticket Tax. *Empirica* 44 (4):665-686.

Lipatov, Vilen and Weichenrieder, Alfons. 2016. The Subsidiarity Principle as a Guideline for Financing the European Budget. In: Büttner, Thiess and Thöne, Michael (eds.). *The Future of EU Finances.* Tübingen: Mohr Siebeck: 15-29.

Lowe, Sam. 2019. *Should the EU Tax Imported CO_2?* CER Insight. https://www.cer.eu/insights/should-eu-tax-imported-co2.

Luptáčik, Mikuláš and Luptáčik, Peter. 2017. Analysis and Quantification of a New Fiscally Neutral European Tax. *Empirica* 44 (4): 635-663.

McKibbin, Warwick J., Morris, Adele C., Wilcoxen, Peter J. and Liu, Weifeng. 2017. The Role of Border Carbon Adjustments in a US Carbon Tax. *CAMA Working Paper* No. 39.

Mehling, Michael A., van Asselt, Harro, Das, Kasturi, Droege, Susanne and Verkuijl, Cleo. 2019. Designing Border Carbon Adjustments for Enhanced Climate Action. *The American Journal of International Law* 113 (39): 433-481.

Monjon, Stéphanie and Ouirion, Philippe. 2010. How to Design a Border Adjustment for the European Union Emissions Trading System? *Energy Policy* 38 (9*):* 5199-5207

Monjon, Stéphanie and Quirion, Philippe. 2011. A Border Adjustment for the EU ETS: Reconciling WTO Rules and Capacity to Tackle Carbon Leakage. *Climate Policy* 11 (5): 1212-1225.

Naegele, Helene and Zaklan, Aleksandar. 2017. Does the EU ETS Cause Carbon Leakage in European Manufacturing? *DIW Discussion Paper* No. 1689.

Núñez Ferrer, Jorge. 2008. Can Reforming Own Resources Foster Policy Quality? *Sieps* No. 3.

Pisani-Ferry, Jean. 2019. *The Coming Clash between Climate and Trade.* www.project-syndicate.org/commentary/european-union-needs-carbon-neutrality-strategy-by-jean-pisani-ferry-2019-07?barrier=accesspaylog.

Sandmo, Agnar. 2005. Environmental Taxation and Revenue for Development. In: Atkinson, Anthony B. (ed.). *New Sources of Development Finance.* Oxford: Oxford University Press: 33-57.

Schratzenstaller, Margit. 2013. The EU Own Resources System — Reform Needs and Options. *Intereconomics* 48 (5): 303-313.

Schratzenstaller, Margit. 2017. *The Next Multiannual Financial Framework (MFF), its Structure and the Own Resources.* Study commissioned by the European Parliament. Brussels.

Schratzenstaller, Margit and Krenek, Alexander. 2019. Tax-based Own Resources to Finance the EU Budget. *Forum Intereconomics – Review of European Economic Policy* 54 (5): 171-177.

Schratzenstaller, Margit, Krenek, Alexander, Nerudová, Danuše and Dobranschi, Marian. 2016. EU Taxes as Genuine Own Resource to Finance the EU Budget – Pros, Cons and Sustainability-Oriented Criteria to Evaluate Potential Tax Candidates. *FairTax Working Paper* No. 03.

Schratzenstaller, Margit, Krenek, Alexander, Nerudová, Danuše and Dobranschi, Marian. 2017. EU Taxes for the EU Budget in the Light of Sustainability Orientation – A Survey. *Jahrbücher für Nationalökonomie und Statistik* 237 (3): 163-189.

Trachtman, Joel P. 2016. WTO Law Constraints on Border Tax Adjustment and Tax Credit Mechanisms to Reduce the Competitive Effects of Carbon Taxes. *Resources for the Future Discussion Paper* 16-03.

Weibust, Inger. 2009. *Green Leviathan: The Case for a Federal Role in Environmental Policy.* Surrey/Burlington: Ashgate.

World Input Output Database. 2013. *Data Release 2013.*

Yuan, Mei, Metcalf, Gilbert E., Reilly, John and Paltsev, Sergey. 2017. The Revenue Implications of a Carbon Tax. *MIT Joint Program on the Science and Policy of Global Change Report* No. 314.