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By **Maria Berrittella**, Dipartimento di Scienze Economiche, Aziendali e Finanziarie, Università degli Studi di Palermo

Filippo Alessandro Cimino, Facoltà di Scienze Economiche e Giuridiche, Università Kore di Enna

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Summary

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Keywords: Domestic Emission Trading, General Equilibrium Analysis, Legislative Measures, Value-added Tax Fraud, Welfare

JEL Classification: C68, H26, K34, Q58

Address for correspondence:

Maria Berrittella
Università degli Studi di Palermo,
Dipartimento di Scienze Economiche, Aziendali e Finanziarie
Viale delle Scienze
90128 Palermo
Italy
Phone: +39 23895246
E-mail: maria.berrittella@unipa.it

THE CAROUSEL VALUE-ADDED TAX FRAUD IN THE EUROPEAN EMISSION TRADING SYSTEM[1]

Maria Berrittella[a, 2] and Filippo Alessandro Cimino[b]

[a] *Dipartimento di Scienze Economiche, Aziendali e Finanziarie, Università degli Studi di Palermo, Palermo (Italy).*
[b] *Facoltà di Scienze Economiche e Giuridiche, Università Kore di Enna, Enna (Italy).*

Abstract. In this article, we analyse the effects of the carousel value-added tax fraud in the European carbon market and the legislative measures that the EU Member States could adopt to deal with this phenomena. We use a computable general equilibrium model, called GTAP-E and the version 6 of the GTAP database to evaluate the economy-wide and terms of trade effects. The policy test has been designed for five European countries: Belgium, France, Germany, Italy, Netherlands and the United Kingdom. According to our findings, the legislative measures aimed to remove the VAT fraud in the European Emission Trading System will have positive effects in terms of GDP and welfare in the selected EU Member States.

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[1] The attribution of the sections is as follows: section 1 and 5 equally between the authors; section 2 and 4 by Cimino, F.A.; section 3 by Berrittella, M..

[2] *Corresponding author*. Università degli Studi di Palermo, Dipartimento di Scienze Economiche, Aziendali e Finanziarie, Viale delle Scienze, 90128 Palermo (Italy). Tel: +39 23895246. *E-mail address:* maria.berrittella@unipa.it (M.Berrittella).

1. Introduction

By signing the Kyoto Protocol in 1997, a number of industrialized countries, the so-called *Annex 1* countries, committed themselves to reduce the greenhouse gases (GHGs) emissions relative to their 1990 levels (UN, 1998). Different "*flexibility mechanisms"* were provided in order to allow emission reductions to be reallocated among *Annex 1* countries. The "Emission Trading" (ET) and the "Joint Implementation" (JI) mechanisms aimed at reallocating the burden of the emission reductions among *Annex 1* countries. In contrast, the "Clean Development" mechanism" (CDM) would allow *Annex 1* countries to fund emission reductions in *non-Annex 1* countries.

Therefore, in 2000 the EU Commission launched the European Climate Change Programme (ECCP), a continuous multi-stakeholder consultative process which serves to identify cost-effective ways for the EU to meet its Kyoto commitments, to set priorities for action, and to implement concrete measures. One of the main elements of this programme was the establishment of the European Union Emissions Trading Scheme (EU ETS), regulated by Directive 2003/87/EC of the European Parliament and Council of 13 October 2003 (EC, 2003) and, recently, amended by Directive 2009/29/CE of the European Parliament and Council of 23 April 2009 (EC, 2009). The EU ETS is a cap-and-trade system for transactions of European Unit Allowances (EUAs) and is implemented as a downstream system; i.e. the users (rather than the producers and importers of fossil fuels) will be obliged to hold emission allowances. Only CO_2 of the six greenhouse gases included in the Kyoto protocol is subject to the ETS.

There is a fundamental difference between the EU ETS and the emissions trading scheme as envisaged under the Kyoto Protocol. In the latter case, emissions trading is to occur between the Parties to the protocol at the level of the States. Under the EU ETS trading is to occur between individual emitters, which comprise 11,428 installations in the EU Member States.

Therefore, only installations belonging to one of four broad sectors (energy activities, production and processing of ferrous metals, mineral industry, pulp and paper), which are listed in the Directive and which exceed a sector-specific threshold, are subjected to emissions trading. In this regime, the EU Member States have three important tasks. First, they have to decide the quantity of emissions that should be allocated to the installations participating in the ETS. Second, they have to draw up a list of all installations which are subject to emissions trading. Third, they have to decide how to allocate the total quantity to individual installations. The Directive sets some general rules according to which the allocation has to be made, but there is substantial scope for national priorities. These decisions have to be set down in a national allocation plan (NAP).

The EU ETS started on 1 January 2005 and is being implemented in three main stages. The first trading phase– which has been nicknamed the "warming-up phase" or 'learning phase' – covers the years 2005–2007. The second phase runs from 2008 to 2012 and see the introduction of new industrial sectors, such as glass and petrochemical production. The third phase, due to start in 2013 and will run until 2020, will require an increased proportion of installations to buy emissions allowances via auction rather than receive free allocation. This phase will also include the abolition of the national allocation plans and adoption instead of a centralised emissions cap. The literature on the EU-ETS is by now very rich (i.e. Endres *et al.,* 2005; Betz *et al.*, 2006; Kemfert *et al.*, 2006; Eichner *et al.*, 2009; Stevanato, 2006) and different aspects have been covered: efficiency, effectiveness, environmental and distributional consequences.

If on the hand the EU ETS has grown in size and values, more than 11,000 installations in different 30 countries (the 27 EU Member States and Iceland, Lichtenstein and Norway) and was worth EUR 103 billion in 2009; on the other hand, the past two years have seen value-added-tax (VAT) carousel fraud emerges as major threats to the EU ETS market (Estrada *et al.*, 2010; Kogels, 2010; Nield *et al.*, 2011; Wolf, 2011). In more details, the carousel fraud in EAUs is a form of "missing trader fraud", well known in the trade of goods. Fraudulent traders, making use of stolen VAT identification numbers, buy carbon credits tax-free in one EU Member State, sell them in another Member State at a markup by including VAT. After one, or more transactions, they disappear without having paid the VAT to the fisc. It is estimated that up to 90% of the volume of the market for tradable emission rights was caused by fraudulent activities, leading to a loss of tax revenues of approximately EUR 5 billion.

Although there is by now a flourishing literature on the VAT carousel fraud in the EU ETS, less attention has been paid to the economic evaluation of this phenomena. In fact, despite its relevance, this issue has not been systematically addressed in this emerging literature. The present paper stands as a novel research that aims at evaluating the the economy-wide and terms of trade effects of the EU ETS VAT fraud and, in particular, examines the cost (in terms of welfare loss) reduction that may be obtained by the establishment of tax law adopted by the EU and its Member States to eliminate the phenomena.

We use a computable general equilibrium (CGE) model for the quantitative impact assessment. A CGE model describes an economy in equilibrium with endogenously determined relative prices and quantities. Whereas most empirical approaches study the policy effects under a *ceteris paribus* condition, CGE models allow for other variables to change as well. They incorporate factors markets, commodities markets and external trade markets. Interactions amongst these different markets are taken into account. Furthermore, as we use a general equilibrium multi-sectorial and multi-regional trade model, we can take account of the important interactions between changes in fuel prices, fuel and factor substitution, and therefore we can evaluate the macroeconomic effects, in terms of trade, GDP and welfare, of policy change in a more realistic fashion than by using partial equilibrium analysis. An assessment of the usefulness of CGE models for policy analysis can be found in Shoven *et al.* (1992). More specifically, we use in this article a modified version of the GTAP-E model by McDougall *et al.* (2007) and the version 6 GTAP database (Dimaranan *et al.*, 2006). This model has been widely used for the analysis of emission trading (i.e. Nijkamp *et al.,* 2005; Dagoumas *et al.*, 2006; Kemfert *et al.*, 2006).

The policy experiment has been designed to simulate the VAT fraud in the European carbon market. We first simulate a domestic emission trading in the countries where data on VAT fraud are available, which are Belgium, France, Germany, Italy, Netherlands and the United Kingdom; then we simulate the lost of tax revenues due to VAT fraud in the carbon market for these countries. Our findings show that the existence of the VAT fraud in the EU ETS implies GDP and welfare loss. Also the welfare loss is much more higher than the VAT fraud value. This means that the European countries would benefit from the application of legislative measures, such as the reverse charge, aimed to eliminate the VAT fraud in the carbon market.

The paper is organized as follows: the second section explains the VAT carousel fraud phenomena. The third section reports the quantitative impact assessment that allows of evaluating the effects of the VAT fraud in the EU ETS. The fourth section discusses the legislative measures aimed to eliminate the risks that VAT fraud will proliferate in the EU carbon market. In the last section we draw concluding remarks.

2. The VAT fraud phenomenon

Carousel fraud is nothing more than stealing VAT from the tax authorities. It all boils down to charging VAT on sales and collecting this VAT from customers. These amounts are than embezzled instead of being paid to the tax authorities.

Carousel fraud takes advantage of the workings of the VAT scheme to hit the system itself. At the heart of each carousel fraud is the so-called "missing trader": this is a company controlled by the "ringmaster" (the mastermind behind the fraud). Carousel fraud in not limited to trade in tangible goods (mobile phones, computer equipment, perfumes, and other high value, low volume goods, due to their ease of transportation and the high VAT revenues that can be generated from them); intangibles can also be used to set up a VAT carousel (Wolf, 2011).

A typical example would be one in which a company (X, or missing trader), registered for VAT in any Member State, acquires goods from another company of another Member State (Y) and then sells them to a company located in the same area (Z). As the first operation constitutes an intra-Community transaction, it is exempt from VAT, and the purchaser (X) does not incur any VAT from the seller (Y). However, the subsequent transfer to the company residing in the same Member State (Z) constitutes a supply of goods liable and non exempt, and the selling company (X) charges the VAT to the purchaser (Z). Thus, having charging VAT on the internal operation, the selling company (X) quickly disappears or declares itself insolvent without paying its dues to the Treasury, fraudulently obtaining the amount of VAT due. For its part, the purchaser (Z) subsequently applies to deduct the VAT, with the consequent loss to the corresponding Treasury. VAT fraud is difficult to detect and prosecute. In the case of carousel fraud, the crime is quick to execute and leaves little evidence. The crime is often embedded within a complex web of transactions, and therefore proof of fraudsters' failure to surrender VAT is difficult to obtain and involves sifting through a large amount of documentary evidence (Nield *et al.*, 2011).

Carousel fraud is a serious problem imposing a threat to government income of EU countries. Although large individual fraud cases are discovered now and then, it is not clear exactly how much the EU countries lose on carousel fraud each year. In 2009, the European Commission published a study on the VAT gap in the EU countries during the period 2000-2006. This VAT gap was calculated as the difference between the theoretical VAT liability for the economy as a whole and the accrued VAT receipts in a given year. In the report produced by Reckon LLP, following a study commissioned by the European Commission, Directorate-General for Taxation and Customs Union, the yearly EU-wide VAT gap is estimated to range around EUR 100 billion. This figure does not represent the actual level of fraud, as it also includes losses as a result of tax avoidance structures and regular insolvencies. However, it does seem to provide an upper limit for the losses as a result of VAT fraud including carousel fraud.

The nature of emission rights makes carbon market a perfect tool for the execution of fraud. In particular, the potential for large trading volumes together with their intangible nature enables quick operations with very large quantities and, hence, allows the theft of huge sums of money. Through (electronic) exchanges, carbon credits can be traded instantly avoiding the cost and delay involved in physical delivery (Wolf, 2011).

The carousel fraud in emission trading is a relatively simple form of "missing trader fraud": fraudulent traders, making use of stolen VAT identification numbers, buy carbon credits tax-free in one EU Member State, sell them in another Member State at a markup by including VAT and then (after one or more transactions, including those with bona fide traders) disappear without having paid the VAT to the Treasury of the country in which the sale was made (Kogels, 2010). By trading emissions allowances via a series of "carousels", the amount of VAT that can be fraudulently acquired is increased each time the allowances are circulated between this carousel of conspirator companies.

Sometimes transactions were apparently concluded at a loss. It did not matter, as the real profit was the embezzled VAT. With tax percentages ranging 15% and 25%, the VAT offered a comfortable profit margin. The missing trader's only interest was to make as much trade as possible. As a result, it created a situation where you have a party that is willing to buy at relatively high prices and sell at relatively low prices. In a electronic marketplace, such a party can generate huge trading volumes in the blink of an eye (Nield *et al.*, 2011; Wolf, 2011).

VAT fraud on the EU-ETS was first suspected due to an unprecedented rise in EU emissions allowance (EUA) spot trading volumes towards the end of 2008. This peaked on June 2nd

2009, when a record 19,8 million metric tons of CO_2 was traded on the Bluenext spot exchange (the largest carbon spot exchange in Europe). It appeared that allowances for immediate delivery were purchased by a company with little business activity and few assets, and VAT charged to other companies without its subsequent declaration. Rumors that these volumes were being driven by VAT carousel fraud prompted Bluenext to close its spot exchange. Before allowing the exchange to reopen, the French authorities imposed a zero-rated VAT status on domestic trades of emission allowances. It estimated that up to 90% of the volume of the market for tradable emission rights was caused by fraudulent activities, leading to a loss of tax revenues of approximately EUR 5 billion for a number of EU Member States (Nield *et al.*, 2011; Wolf, 2011).

3. Quantitative impact assessment

In this study we use the GTAP-E model, developed by Burniaux and Truong (2002), in the version revised by McDougall and Golub (2007).

The GTAP-E model is a comparative static, multi-commodity, multi-region CGE model with the assumptions of perfect competition, market equilibrium and open economy. Furthermore, the GTAP-E model incorporates energy substitution, carbon emissions from the combustion of fossil fuels as well as a full account of the carbon tax revenues and a more specific treatment of carbon emission trading into the standard GTAP model. As the GTAP-E model has bee widely used for environmental policy analysis and as the mathematical structure of the GTAP-E model is very complex including a large number of equations, this section aims to provide a concise description of the modelling framework. More details on the original GTAP model can be found in Hertel (1997); whereas a description of the GTAP-E model and its applications can be found in Burniaux and Truong (2002) and McDougall and Golub (2007). Also we discuss here data calibration, policy experiments and results for the quantitative impact assessment.

3.1 Model

On the consumption side, there is a representative household in region *r*, whose Cobb-Douglas utility function allocates expenditures between private consumption (C), government consumption (G) and savings expenditure (S) as follows:

$$U_r = C_r^{\alpha_{C,r}} G_r^{\alpha_{G,r}} S_r^{\alpha_{S,r}} \tag{1}$$

with $\alpha_{C,r}$, $\alpha_{G,r}$ and $\alpha_{S,r}$ income shares and $\alpha_{C,r} + \alpha_{G,r} + \alpha_{S,r} = 1$.

The constrained optimizing behavior of the household in region *r* for private consumption is represented by a non-homothetic Constant Difference of Elasticity (CDE) expenditure function for the set of goods and services. A Cobb-Douglas sub-utility function is employed for government spending. In this case the expenditure shares are constant across all commodities. Private and government consumption are split in a series of alternative composite Armington aggregates (Armington, 1969). Figure 1 and 2 show the consumption structures.

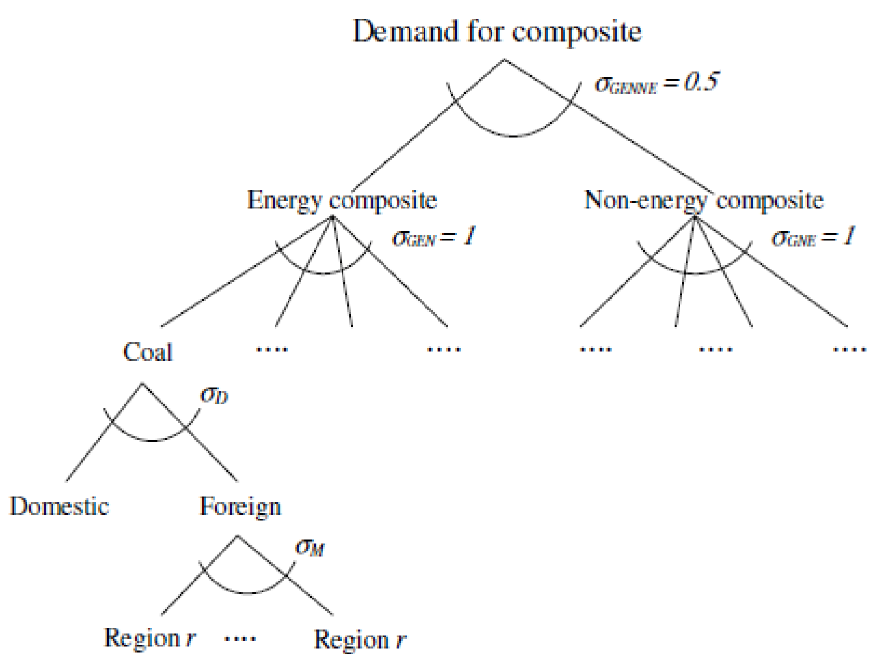

Figure 1. GTAP-E government purchases (Burniaux *et al.*, 2002).

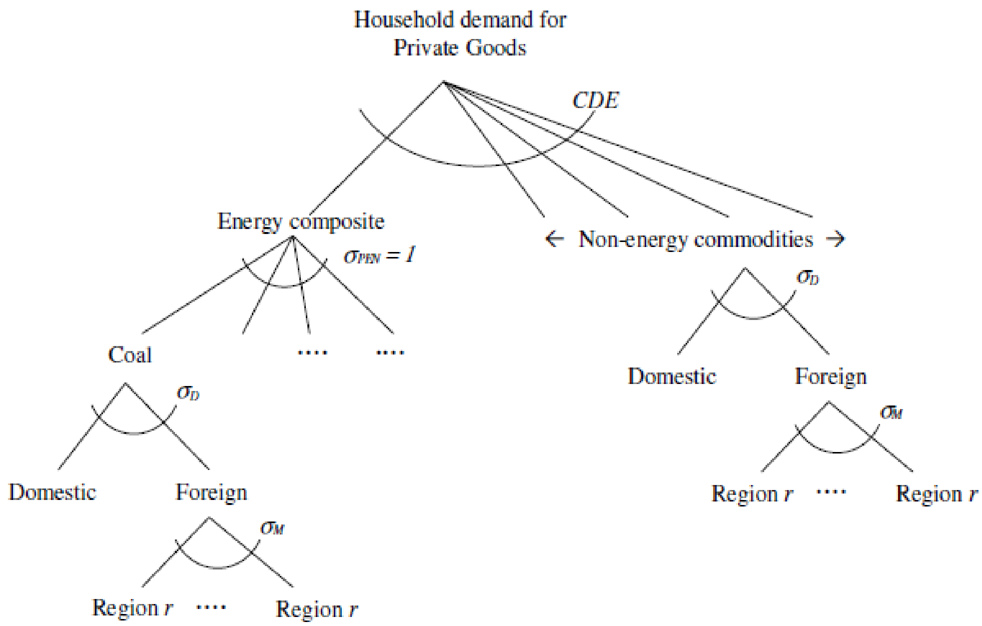

Figure 2. GTAP-E household private purchases (Burniaux *et al*., 2002).

Savings are exhausted on investment and capital markets are assumed to be in equilibrium only at the global level. In fact, a hypothetical world bank collects savings from all regions and allocates investments so as to achieve equality of changes in expected future rates of return:

$$\Delta\eta_r = \Delta\eta \tag{2}$$

where $\Delta\eta_r$ and $\Delta\eta$ are the percentage change, respectively, in region's rate of return and global rate of return.

On the production side, the producers receive payments for selling consumption goods to the private households and the government, intermediate inputs to other producers and investment goods to the savings sector. Under the zero profit assumption employed, these revenues must be precisely exhausted on expenditures for intermediate inputs and primary factors of production. The nested production technology exhibits constant returns to scale and every sector produces a single output. The technology is simplified by employing the Constant Elasticity of Substitution (CES) functional form:

$$y_{i,r} = \left(\sum_{j=1}^{n} \theta_j x_{j,r}^{1-\frac{1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (3)$$

where, in region r, $y_{i,r}$ is the production of the good i, $x_{j,r}$ is the input j, θ_j is a non-negative parameter, with $\sum_{j=1}^{n} \theta_j = 1$, and σ is the elasticity of substitution. In more details, we have the Leontief functional form between value added (including energy inputs) and all other inputs (Figure 3). Next, the energy composite is then combined with capital to produce an energy-capital composite, which is in turn combined with other primary factors in a value-added-energy (VAE) nest through a CES structure. The energy commodities are first separated into 'electricity' and 'non-electricity' groups. Some degree of substitution is allowed within the non-electricity group as well as between the electricity and the non-electricity groups (Figure 4). Both intermediate and final products from different regions are considered to be imperfectly substitutable with each other (Armington, 1969).

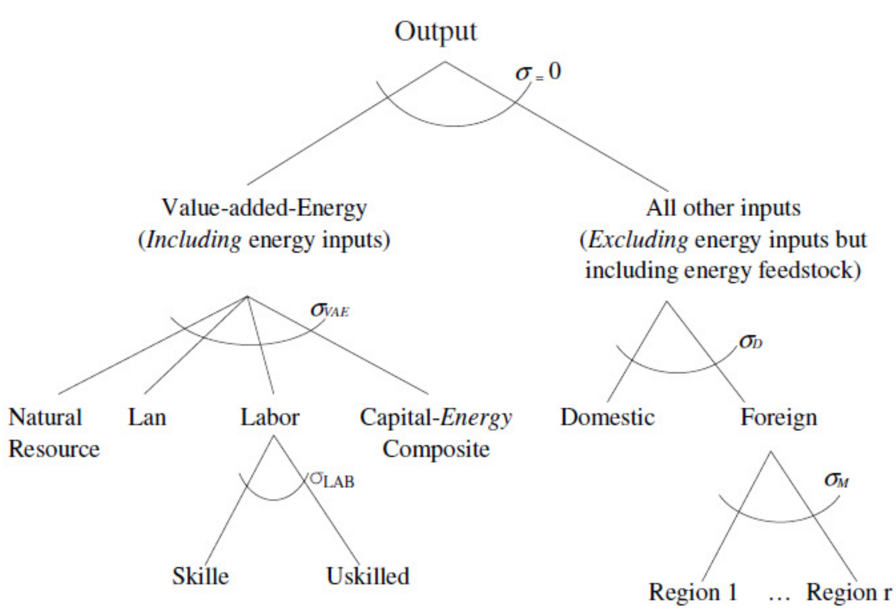

Figure 3. Standard GTAP-E production structure (Burniaux *et al.*, 2002).

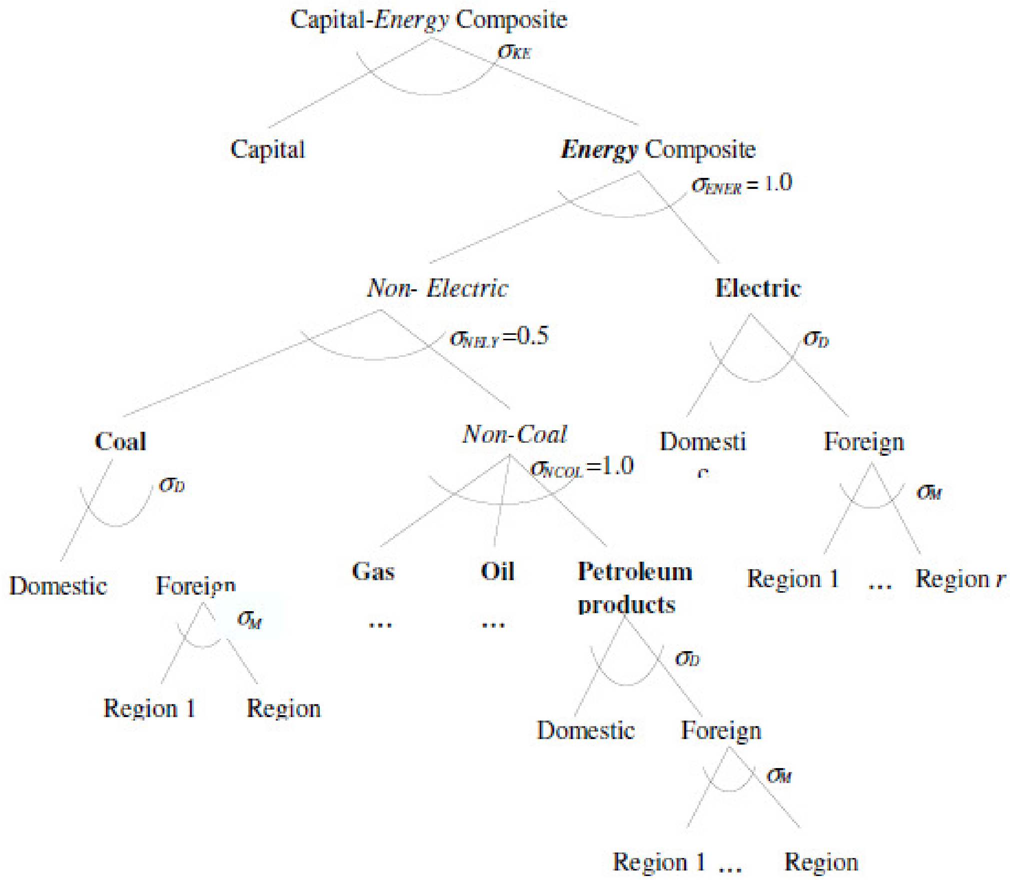

Figure 4. GTAP-E Capital-Energy composite structure (Burniaux *et al*., 2002).

All factor inputs (land, labor, capital and natural resources) are assumed to be fully employed and immobile across regions. Capital and labor are perfectly mobile across sectors and, hence, they earn the same market return regardless of where they are employed; land and natural resources are sluggish to adjust and their returns may differ across sectors. Every economy also includes government interventions. All taxes levied in the economy always accrue to the regional household.

In GTAP-E, CO_2 emissions are derived from energy volume data through fixed coefficients. Coefficients are fuel specific, but not region or sector specific. In calculating the emissions of CO_2 it is assumed that every use of fossil energy goods leads to CO_2 emissions except for the use of crude oil by refineries to produce petroleum products. Only when these petroleum products are used (combusted) is CO_2 emitted to the atmosphere. For the rest, no account is taken of energy goods used as non-energy feedstocks. Changes in regional CO_2 emissions are calculated as the changes in CO_2-weighted changes in domestic production of fuels plus changes in CO_2-weighted imports minus changes in CO_2 weighted exports of fuels.

CO_2 reduction policies can be implemented in GTAP-E through taxes and (tradable) quota. In the model, taxes and quota are completely equivalent, i.e., given a certain reduction target, CO_2 taxes are identical to CO_2 permit prices. Because both tax revenues and the revenues of the sale of permits are directly transferred to the regional household, there are also no differences in wealth effects between the two policy instruments. GTAP-E offers the possibility for regions to engage in emissions trading (international and domestic). The international emissions trading can take place within any group of countries or regions, the only precondition is that each of the regions in an emissions trading group has a fixed CO_2 quota. Furthermore, we allow the sectors of each region to trade in emissions with each other, but not to trade with other sectors in a different region. Within the emissions trading group (region or sector), the prices of CO_2 emissions and marginal abatement costs are equalized. If on the one hand, the domestic emission trading will result in a uniform marginal abatement cost (MAC) across all trading sectors for each region, but the MAC will be different for different regions; on the other hand, the international emission trading will result in a uniform MAC across all the trading sectors and regions. The monetary values of the international transfers of emissions permits are credited or debited to the regional income account.

The macroeconomic accounting identity that must be respected by the model is that the national savings (S_r) minus investment (I_r) is identically equal to the net exports (NX_r), that is:

$$S_r - I_r = NX_r \tag{4}$$

As global exports (X) need to be equal to global imports (M) such that

$$\sum_r X_r - \sum_r M_r \tag{5}$$

global investment will be equal to global savings by Walras' law:

$$\sum_r S_r = \sum_r I_r \qquad (6)$$

3.2 Data calibration

The GTAP-E model is calibrated using the version 6 of the GTAP data base, which consists of 57 commodities/sectors and 87 regions, including the 27 European Member states (Dimaranan *et al.*, 2006). The GTAP database is a cross-country data of international trade flows and national input-output tables. All the information in the data base is reported in values converted to US dollars adjusted to year 2001 values. The regional and sectoral aggregation used for this study is shown in Table 1. The GTAP data base has been integrated by CO_2 emissions data provided by Ludena (2007), that transformed the CO_2 emissions data (Lee, 2002) into a database for use in the GTAP-E model.

3.3 Policy experiment and results

The policy experiment has been specifically designed to simulate the VAT fraud in the European carbon market.

We first simulate domestic emission trading for those countries we have data on the VAT fraud, which are Belgium, France, Germany, Italy, Netherlands and the United Kingdom. Following Kemfert *et al.* (2006), we apply the "Business-*as-Usual* " (BaU) or reference emissions for the period up to 2007 for each of the sectors. These are then compared with the emissions caps as defined by the EU-ETS. We shock the emissions of each designated trading sector in each region by the projected percentage change to satisfy the NAP requirements as reported in Table 2. We allow all designated sectors of each region with a NAP allocation to trade in emissions with each other. For non-NAP sectors we assume that there is no abatement cost. This means that their emissions levels will be determined endogenously within the model, according to the production and relative price relationships between these sectors and the NAP sectors.

Table 1. Categorization of regions and sectors

Regions	Description	Sectors	Description
aut	Austria	coa	Coal
bel	Belgium	oil	Oil
dnk	Denmark	gas	Gas
fin	Finland	omn	Minerals nec
fra	France	tex	Textiles
deu	Germany	wap	Wearing apparel
gbr	United Kingdom	ppp	Paper products, publishing
grc	Greece	p_c	Petroleum, coal products
irl	Ireland	crp	Chemical, rubber, plastic prod
ita	Italy	nmm	Mineral products nec
lux	Luxembourg	i_s	Ferrous metals
nld	Netherlands	nfm	Metals nec
prt	Portugal	fmp	Metals products
esp	Spain	mvh	Motor vehicles and parts
swe	Sweden	ele	Electronic equipment
bgr	Bulgaria	ome	Machinery and equipment nec
cyp	Cyprus	omf	Manufactures nec
cze	Czech Republic	ely	Electricity
hun	Hungary	wtr	Water
mlt	Malta	cns	Construction
pol	Poland	roe	Rest of the economy
rom	Romania		
svk	Slovakia		
svn	Slovenia		
est	Estonia		
lva	Latvia		
ltu	Lithuania		
row	Rest of World		

Table 2. Percentage deviation of emissions from projected level for period 2005-2007 according to the NAP*.

	Belgium	France	Germany	United Kingdom	Italy	Netherlands
Minerals nec	-5.3	-8.1	-0.4	-5.7	-1.7	-7.8
Textiles	-5.3		-2.2	-2.5		-7.8
Wearing apparel	-5.3		-2.2	-2.9		-7.8
Paper products, publishing	-5.3		-1	-3.3	-3.4	-7.8
Petroleum, coal products	-5.3	-2.8	-2.6	-0.9		-7.8
Chemical, rubber, plastic prod	-5.3	-8.1	-0.4	-5.7	-1.7	-7.8
Mineral products nec	-5.3	-8.1	-0.4	-5.7	-1.7	-7.8
Ferrous metals	-5.3	-10.3	-0.5	-18.4	-4.2	-7.8
Metals nec	-5.3	-10.3	-0.5	-18.4	-4.2	-7.8
Metals products	-5.3	-10.3	-0.5	-18.4	-4.2	-7.8
Motor vehicles and parts	-5.3		-2.2	-3.3		-7.8
Electronic equipment	-5.3		-2.2	-2.9		-7.8
Machinery and equipment nec	-5.3		-2.2	-2.9		-7.8
Manufactures nec	-5.3		-2.2	-2.9		-7.8
Electricity	-27.4	-0.4	-3.1	-8.7	-5.5	-7.8
Water	-5.3		-2.2	-2.9		-7.8
Construction	-5.3		-2.2	-2.9		-7.8

* No emissions shock has been applied for the shaded areas.
Source: Kemfert *et al.* (2006).

Subsequently, we simulate that the VAT fraud will reduce the indirect tax revenues to government. The VAT evasion associated with the EU-ETS has been estimated in a total of approximately €5 billion in lost tax revenue in several countries. However, experienced market analysts argue that, based on the actual volume of asset transactions in the market and prevailing prices, the VAT fraud could not have reached that sum. In fact, on the basis of the available data, we calculate that the VAT fraud is almost €2 billion. Table 3 reports the VAT evasion in the carbon market by country in US dollars.

Table 3. VAT carousel fraud in the carbon market

Region	$ millions
Belgium	108
France	214
Germany	1166
United Kingdom	65
Italy	686
Netherlands	411

Table 4 shows the overall macroeconomic effects of the VAT carousel fraud in the carbon market. Compared to the domestic emission trading scenario, the VAT fraud will bring losses in terms of GDP and welfare, but the effects will be positive in terms of trade. As the VAT fraud implies a decrease in the indirect tax revenues that accrue to the regional household, the private and government consumption will decrease leading to negative change for the GDP. Furthermore, if on the one hand, the decrease in the domestic demand (private and government) will reduce the imports; on the other hand, the output supply excess will be exported leading to positive trade balance. Usually, the effects on trade balance yield opposite effects on welfare. The magnitude of trade and welfare effects may differ, due to the fact, that the effects on welfare change are not limited to terms of trade, but include allocative efficiency and income contributions. In fact, for most of the countries, welfare decomposition in figure 5 shows that the contributions to welfare change in terms of trade accounts for just 10 per cent, allocative effects accounts for 5 per cent and the highest contribution to welfare change is due to income change that accounts for about 85 per cent. For France and the United Kingdom positive contribution to welfare change in terms of trade is compensated by the substantial contribution to welfare change of income effects and slightly by the allocative effects. If we compare the VAT fraud values and welfare change, we can conclude that the welfare loss is much more higher than the VAT fraud value. In fact, we have that the welfare loss is four times (in average) higher than the VAT fraud value.

Table 4. Macroeconomic effects of VAT fraud (change w.r.t. domestic emission trading)

Regions	Real GDP (%)	Trade balance ($ millions)	Welfare ($ millions)
Belgium	-0.008	333.374	-467.659
France	-0.003	131.271	-592.707
Germany	-0.024	3589.408	-4871.618
United Kingdom	-0.002	16.535	-422.398
Italy	-0.027	2478.734	-3538.690
Netherlands	-0.015	905.845	-1215.225

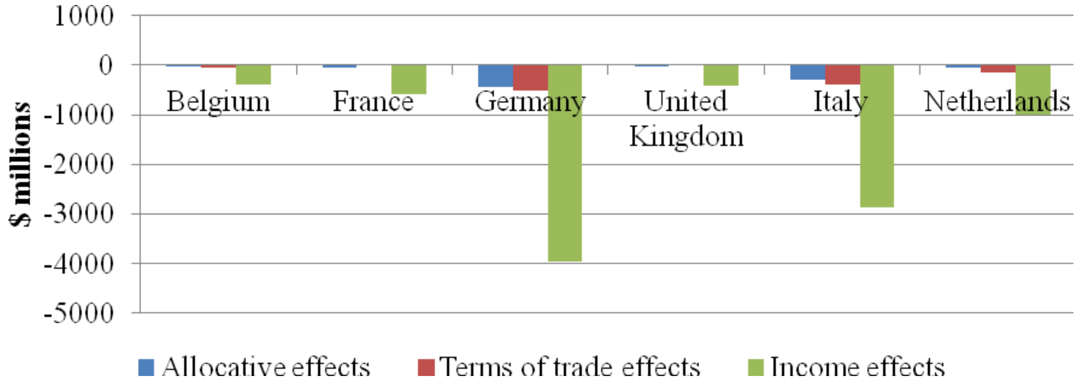

Figure 5. Welfare decomposition: equivalent variation due to various components (change w.r.t. domestic emission trading).

4. Legislative measures

Different legislative actions may be applied in order to reduce the GDP and welfare loss due to the VAT fraud in the EU carbon market.

For example, given these suspected cases of fraud, the governments of Britain, France, Spain, Netherlands and Denmark have reacted by applying a tax rate of 0%, or declaring emission rights transfer as VAT exempt, or reversing the liability in these transactions. Most of these national measures were not allowed under the VAT Directive at the time they were implemented.

In the meantime, however, the VAT directive has been changed, allowing EU countries to introduce a reverse charge for trade in emission rights. In particular, the Directive 2010/23/EC amended Directive 2006/112/EC on the common system of value added tax, as regards an optional and temporary application of the reverse charge mechanism in relation to supplies of certain services susceptible to fraud. This change of the VAT Directive entered into force on April 5, 2010 (EC, 2010). In more details, the reverse charge mechanism means that no VAT is charged by the supplier to taxable customers who, in turn, become liable for the payment of the VAT; the buyer only, not the seller is responsible for surrendering VAT on domestically traded emissions allowances. Thus, a reverse charge system obligates the buyer to pay the VAT on purchased allowances directly to the authorities, rather than including the VAT in the purchase price and leaving the seller responsible for the payment of this amount to the authorities. In practice, taxable persons with a full rights of deduction input VAT would declare and deduct VAT at the same time without effective payment to the treasury. These revisions enabled Member States to apply a reverse charge system mechanism to the VAT treatment of emission allowances, a measure that, if implemented consistently across the EU, would prevent the possibility of VAT fraud on the EU ETS. However, this Directive only imposed the option for Member States to temporarily adopt this regime. Since it entered into force on April 5, 2010 many Member States have failed to implement this reverse charge system. A reverse charge will stop carousel fraud with this specific carbon credits, but it is only effective if all EU countries apply this measure. Otherwise, fraudsters continue to move to countries where the reverse charge measure does not apply. Thus, cooperation and information sharing amongst European countries may be more useful than other measures implemented for other types of fraud (Nield *et al.*, 2011; Wolf, 2011).

Besides, it should be noted that emissions allowances are not real physical goods, but represent tradable dematerialized permits that exist electronically and have been created entirely by policy. As a result the market is a contained one, since in order to own EU emissions allowances one needs to have a registry account to electronically store them in. There is no way that emissions allowances can escape the system, as they only exist as codes within registry accounts and can only be traded from one registry account to another. In this sense, this type of market is more easily controlled. As it is much more difficult for emitting companies to be instigators of fraud, speculators (companies with no recognizable activity in the sector) are more easily detected (Kogels, 2010; Nield et al., 2011). This calls for legislative measures aimed to increase the control and security of the emission trading registry.

5. Conclusions

The EU ETS is an important policy instrument to achieve a particular climate policy objective such as the Kyoto obligations. But the past years have seen the VAT carousel fraud emerges as major threats in the European carbon market. Thus, this paper has investigated the macroeconomic effects due to the existence of tax evasion in the domestic emission trading in five countries applying a general equilibrium analysis. Our findings show that there will be GDP and welfare gains from the elimination of the VAT fraud in the European carbon market. Furthermore, the application of legislative measures to eliminate this phenomena has been discussed. As legislative measures to eliminate the VAT fraud, the reverse charge for trade in emission rights could be applied, but, to be successfully, this requires tax law harmonization amongst the European countries. Other legislative measures should aim to increase the control and security of the emission trading registry.

This paper provides to the policy-makers not only a quantitative analysis, in terms of amount of change in the macroeconomic indicators, but also a qualitative analysis, because the results are useful for understanding the conditions and directions of legislation aimed to eliminate the VAT fraud in the EU ETS.

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Abbreviations

- CDE = Constant Difference of Elasticity
- CDM = Clean Development Mechanism
- CES = Constant Elasticity of Substitution
- CGE = Computable General Equilibrium
- ECCP = European Climate Change Programme
- ET = Emission Trading
- EU = European Union
- EUA = European Unit Allowances
- EU ETS = European Union Emission Trading System
- GHG = Greenhouse Gas
- JI = Joint Implementation
- MAC = Marginal Abatement Costs
- NAP = National Allocation Plan
- VAT = Value Added Tax

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