The Unlikely Pollution Haven

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Abstract
According to the pollution haven hypothesis more stringent environmental policy adversely affects international competitiveness in a polluting industry, and may shift production to environmentally lax countries increasing global pollution. To avert such impacts, Finnish energy intensive firms are entitled to a substantial refund on excise taxes paid on energy use. I explore its potential impact on exports, applying firm level data on energy and other firm-specific factors with instrumental variables methodology. Estimation results show insignificant, if any impacts from the energy tax refund. Results are consistent with the literature, and enjoy broader relevance in countries seeking to implement indirect fiscal devaluation measures.

Keywords: Competitiveness; energy taxes, export performance, fiscal devaluation, import substitution.

Introduction

In countries with fixed exchange rates, such as within the Eurozone, policy-makers cannot restore competitiveness by means of exchange rate adjustments. As an internal devaluation[1] is dauntingly difficult with institutionalized downward rigid wages and prices, governments may be tempted to experiment on various forms of fiscal devaluation to combat the effects of overvalued exchange rates. At the same time, fiscal devaluation is constrained by EU and World Trade Organization (WTO) regulations, which prohibit most subsidies directly linked to the volume of exports. Since pure fiscal devaluation[2] with export subsidies and import taxes over all products and services traded cannot therefore be imposed, indirect export subsidies in the form of tax reductions, present an imperfect alternative. Various attempts at fiscal devaluation may proliferate in inflation prone Eurozone countries. Indeed, despite EU goals to reduce subsidies and enhance the workings of the common market, direct subsidies have increased by 50 % over 2002 - 2012 (TEM 2013). This is particularly true in countries where large scale cost competing energy intensive industries, such as chemical, forestry and metal industries, which form the backbone of Finnish exports. The effectiveness of partial indirect measures is doubtful and may have undesirable side effects with respect to the environment.

Although one of the largest direct subsidies granted to firms rising to €320 million in 2011 (TEM, 2012), in practice there is little if any evidence that the subsidy fulfils its task. Based on a recent statistical analysis for 2010-2014, VATT researchers found no significant effects (2016). Another relevant recent study is TEM (2013), which groups the energy tax refund to "other subsidies" that not only delay positive structural renewal, but have negative productivity effects. As for efficiency, a comparison of Finnish industries to a sample from OECD countries, showed Finnish energy intensive industries to have lagged well behind the technology frontier when the subsidy was introduced in 2003 (Berghäll 2014).

The argument in favor of the refund draws on the pollution haven hypothesis, which postulates more stringent environmental policy to harm competitiveness in pollution-intensive industries and cause them to concentrate in countries implementing weaker environmental policy. Governments may similarly weaken their environmental standards to attract polluting industries (Copeland 2010).[3]

Earlier work found environmental regulations to have little impact on trade and investment flows (Jaffe et al., 1995, Tobey, 1990; Harris and al., 2002), with

[1] Subsequently, the refund and wages were formally linked. In 2011, the refund limit was further reduced to 0.5 % of value added. This increase of the refund was part of a collective corporatist deal in which employers' accepted wage raises, in return, among other things, to an increased energy tax refund to maintain competitiveness and employment. http://eur-lex.europa.eu/Notice.do?mode=dbl&lang=en&ihmlang=en&lng1=en,fi&lng2=en,fi,sv,&val=679466:cs and (HE 129/2011) http://www.finlex.fi/fi/esitykset/he/2011/20110129). In addition, the reduction in the limit was motivated by the crowding out concern to level the playing field for fair domestic competition. The government's commitment to the Kyoto protocol played no role.

[2] See e.g. Keynes (1931).

[3] The main alternative to the competitiveness hypothesis is the Porter hypothesis (Porter and van der Linder 1995) which argues that more stringent environmental policy can raise international competitiveness and shift supply curves outward.

exceptions such as Grossman and Krueger (1995) and Van Beers and van den Bergh (1997), but improved data and methodology has shown them to have been biased by unobserved heterogeneity, endogeneity and aggregation issues (Levinson and Taylor 2008). Panel data, fixed effects and instrumental variables methodology have tended to produce statistically significant evidence of pollution havens (Brunnermeier and Levinson 2004; Copeland and Taylor 2004). On the other hand, Arlinghaus' (2015) review of empirical evidence on carbon price impacts on competitiveness found most studies to show little impact even if the methodology applied is more advanced. The few ex post evaluation papers on carbon taxes arguing causality are limited to show short-run policy effects. Flues & Lutz (2015) find electricity tax subsidies in Germany to have no impact on sales, exports, value-added, investment or employment. Martin et al. (2014) find no competitiveness impacts on output, productivity, employment, or exit of firms from the UK Climate Change Levy. In contrast, according to Arlinghaus (2015), the empirical evidence in favor of significant energy intensity or other environmental benefits is fairly consistent.

To explore the potential contribution of the energy tax refund to the international competitiveness of Finnish firms, I estimate its potential impact on exports in 2004 – 2009. While competitiveness is a fairly broad concept, the use of exports is justified by the trade dependency of a small open economy. Meanwhile domestic demand for major export goods is relatively small and insignificant, but there may be crowding out effects. Since data on investments is limited to the home country, overseas production relocation impacts cannot be included. To what extent imports of intermediate goods substitute for domestic production is, however, estimated with separate regressions on domestic value-added. I build a panel from firm-level data on energy tax refunds, energy use and exports from several databases, and apply instrumental variables methodology to control for potential endogeneity. Results suggest the absence of an exports enhancing effect, consistent with the literature on the competitiveness impacts of environmentally related taxes.

I contribute to the literature on energy taxes and competitiveness, with a case example that shows how indirect attempts at fiscal devaluation[4] may prove to be counter effective, while having adverse side effects. The issue has broader relevance to those Eurozone countries in which pressures for fiscal devaluation have accumulated. The second section presents the methodology and third the data. Results are presented and discussed in section four. Section 5 summarizes the conclusions and policy implications that can be drawn from the evidence.

Data

The micro-level data is drawn from the VATT Institute for Economic Research (VATT), the Finnish Environment Institute (SYKE) and the Finnish Customs Office (Tulli). Reliable data is available only from 2004 to 2009. For brevity, a detailed description of the data and variables has been moved to the Appendix, and is available from the author upon request.

[4] In the absence of nominal exchange rate devaluations, misalignments in the euro can be readjusted by changing the relative tax burden on exports and imports or internal devaluations (see e.g. IMF 2011 or Keynes 1931).

On average, the recipients of the energy tax refund are large exporting firms concentrated into four export intensive industries, though not all firms that receive the refund export. To control for industry-specific impacts, the sample is reduced to them, i.e., to the wood, paper and pulp, chemical and metal industries.[5] In 2010, they accounted for altogether 87 % of total energy consumption in manufacturing.[6] Within these industries, the consumption of energy is further concentrated in about 100 firms which consume 60-80 % of all industrial energy. Industry-wise there are less than 20 large energy consumer firms. The robustness of the analysis is stirred, but not shaken by the fact that many of them are also energy producers, particularly in the paper and pulp industry. This effect is not fatal to the analysis, however, since it means that paper and pulp firms do not receive a refund on energy produced as a by-product, such as heat generated in the industrial process, [7] while the focus of the analysis is on export competitiveness.

The chief justification for the energy tax refund has been the desire to support the competitiveness of Finnish energy intensive firms. Competitiveness is a fairly broad concept, which can be measured by sales, survival, investment, value-added, growth, etc. Jaffe et al. (1995) claim the appropriate competitiveness indicator to be net exports, but this variable is not available due to the lack of data on respective imports. Hence the main dependent variable is exports (Exp_{it}) obtained from the YRTTI database (Figure 1). The choice is justified by the export reliance of the energy intensive firms in a relatively small open economy. That is, other competitiveness indicators may include crowding out effects of domestic competition due to the refund, while their overall impact is in any case limited in a small export oriented and specialized economy. To what extent imports of intermediate goods substitute for domestic production is, however, estimated with separate regressions on domestic value-added. Value-added is estimated by subtracting purchases and change in inventories (material use) from total sales available in the YRTTI database.

For energy efficiency impacts, the association of the refund with energy intensity is analyzed. The energy input (Figure 4) is based on total energy consumption, calculated as a sum of various types of energy use obtained from the SYKE database. Firm-level datasets were constructed by aggregating the plant level data according to the firm identifier number. Energy efficiency is computed by dividing deflated value-added with energy use. Logarithms were taken to moderate the impact of differing scale between energy input and monetary variables. Observations with zero or negative value-added were replaced by zero energy efficiency.

The main explanatory variable is the energy tax refund to firms. Since 2003, Finnish energy intensive industries have been entitled to a refund of energy taxes if they

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[5] The largest net recipients of energy tax refunds are also likely to be involved in emissions trade. Ample quotas have however mitigated the emissions price impact.

[6] Firms in other industries are too few and diverse to be controlled for industry specific effects.

[7] Power generators are taxable only if their capacity exceeds 2MVA (Megawatts). To avoid dual taxation Customs office data on the energy tax refund does not include refunds for those firms with no power production, as related energy taxes are paid and the energy tax refund received by the company that generates or supplies the energy to the consuming firm. In these instances the taxes are incorporated in the price paid for the energy supply. Firms receive either a reduction in the energy price or the tax refund. Power generators are taxable only if their capacity exceeds 2MVA (Megawatts).

exceed 3.7% of its value-added. This refund is at most 85% of the energy taxes paid minus a lump sum of €50 000[8] (Equation 1). Since observations for the energy tax refund are available only from the year 2004 onwards, the final sample was restricted to the period 2004 – 2009[9]. Missing refund observations were recoded as zero, since with the exception of outright mistakes, in practice a missing observation signifies that the firm has not received a refund of its energy taxes. Also zero observations that went missing after logarithms were taken were recoded as zero. These raised the number of observations significantly.

Energy tax refund = (Energy taxes paid – 0.037*Value-Added)* 0.85 - €50000 (1)

As is apparent, the refund declines with value-added, but increases with energy use. Hence, it provides an incentive to increase energy use or abstain from energy efficiency reductions. The incentive to reduce value-added encourages imports of intermediates instead of their local production. Hence, it actually acts against the original purpose of the refund, i.e., of maintaining domestic production competitive. As Table 2 shows, exports and the refund are significantly and positively correlated with value-added, labor use and efficiency.

The labor variable is based on the number of employees drawn from the YRTTI database to control for firm size effects. Data on investments is available only with respect to the home country. These proved too infrequent to analyze as a dependent variable with the time span available. Instead a capital stock (X_{1t}) measure is estimated from machinery and equipment investments in the YRTTI database. See the data appendix for more detail.

Firm efficiency (Figure 4) is estimated from value-added, capital and labor with the robust semiparametric order-m methodology proposed by Cazals et al. (2002). This method is more reliable and accurate than labor productivity or other simple productivity or efficiency measures. See the data appendix for more detail.

Profitability is included as an explanatory variable, since it is related to competitiveness and competition. The refund is granted on the assumption of competition being too intense. If this is true, profits should be approximately zero. Profitability is estimated from profits per value-added.

Renewables intensity (Figure 4) is the share of renewables in energy consumption. Their share is rather small and highly industry-specific, since the wood, paper and pulp industries maintain a natural resource advantage with respect to renewables such as forest chips (metsähake/murske)[10]. The share of non-fossil fuels or non-fossil fuel

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[8] In 2008, about €5.5 million were refunded to less than 10 firms. Source: Hallituksen esitys eduskunnalle laiksi sähkön ja eräiden polttoaineiden valmisteverosta annetun lain 8 a §:n muuttamisesta, HE 129/2011.

[9] The 2012 reduction of the refund limit from 3.7% of value-added to 0.5% raised the number of observations significantly, but towards non-exporting firms and industries, such as agriculture. The largest recipients in absolute terms were the same industries with the largest firms: paper and pulp, chemicals and chemical products, metals and metal products.

[10] Renewables is calculated as the sum of steam, metsä-, kuori, sahaku and puutähdeke.

intensity was also tested. It includes electricity, heat, etc. that are not necessarily produced with fossil fuels.

All variables are deflated with domestic or exports price deflators. Other variable transformations are presented in the data appendix. Descriptive statistics are presented in Table 1.

Table 1. Descriptive Statistics of deflated variables, with and without logarithms

	N	Minimum	Maximum	Mean	Std. Deviation
Energy tax refund	140	0	10061690	930362	2019430
Energy tax refund lag1	110	0	10061690	1128999	2228577
Energy tax refund lag2	82	0	10061690	1377523	2395676
Log energy tax refund	770	0.00	16.12	1.44	4.12
Log energy tax refund lag1	76	9.37	16.12	12.99	1.83
Exports	706	869	3437304291	133645480	390206698
Exports lag1	645	333	3437304291	146045634	405062052
Log exports	706	6.77	21.96	16.37	2.66
Log exports lag1	645	5.81	21.96	16.51	2.68
Export intensity (per sales)	705	0.00	4.62	0.48	0.36
Value-added	770	-1113861	25617978	831847	2459081
Log value-added	770	0.00	17.06	11.98	2.09
Capital stock	770	21	33801060	917784	3064551
Log capital stock	770	3.06	17.34	11.65	2.17
Personnel	770	1	9082	380	881
Log personnel	770	0.00	9.11	4.96	1.42
Efficiency (m700output)	769	0.00	2.95	0.63	0.33
Efficiency (m600output)	769	0.00	3.70	0.64	0.35
Profitability (profits/va)	766	-455.61	8.12	-0.61	16.48
Energy efficiency (va/e)	770	-13861	87924967	334859	5277011
Non fossil fuel intensity	770	0.00	1.00	0.81	0.29
Sales	770	0	5212649945	196785569	552736774

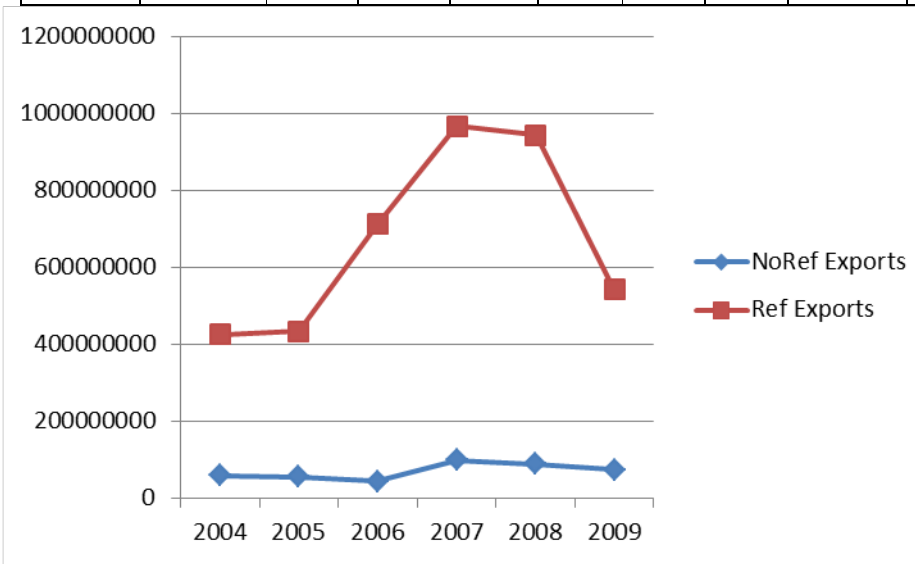
Variation by firm with respect to the impact of the refund on exports is unlikely to be driven by selection or sorting, because firms have limited control over these variables and there is no discretion in refund allocation. Yet, firms that receive the energy tax refund may differ from non-recipients in ways directly related to the terms and conditions of the refund. In addition to energy intensive industries, a distinguishing factor is mere size. Large energy intensive firms are more likely to be eligible as their energy taxes paid are more likely to exceed the value-added threshold. Recipient and non-recipient firms for which data is available in the sample, are compared in the figures below. As they and Table 2 show, the refund correlates significantly and positively with personnel, value-added and exports. Variables related to firm size, such as labor, value-added, exports, capital and industry dummies should capture such differences and no selection correction is included.

Table 2. Pearson correlations, significance (2-tailed), number of observations[11]

		Log of exports	Log lag of exports	Log of refund	Log lag of refund	Log value-added	Log labour	Efficiency (m700 out)	Energy efficiency (vad/e).	Non fossil fuel intensity
Log of exports	Pearson Correlation	1	.960**	.339**	.044	.714**	.738**	.131**	.004	-.101**
	Sig. (2-tailed)		0.000	.000	.715	.000	.000	.000	.923	.007
	N	706	637	706	72	706	706	705	706	706
Log lag of exports	Pearson Correlation	.960**	1	.334**	-.013	.723**	.708**	.127**	-.003	-.101*
	Sig. (2-tailed)	0.000		.000	.912	.000	.000	.001	.933	.010
	N	637	645	645	73	645	645	644	645	645
Log of refund	Pearson Correlation	.339**	.334**	1	.449**	.388**	.282**	.082*	-.022	-.118**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.023	.541	.001
	N	706	645	770	76	770	770	769	770	770
Log lag of refund	Pearson Correlation	.044	-.013	.449**	1	.242*	.081	.041	.065	.004
	Sig. (2-tailed)	.715	.912	.000		.035	.486	.723	.576	.973
	N	72	73	76	76	76	76	76	76	76
Log value-added	Pearson Correlation	.714**	.723**	.388**	.242*	1	.771**	.235**	.019	-.073*
	Sig. (2-tailed)	.000	.000	.000	.035		.000	.000	.590	.042
	N	706	645	770	76	770	770	769	770	770
Log	Pearso	.738	.708	.282	.08	.77	1	-.087*	.033	-

[11] ** Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed).

labour	n Correlation	**	**	**	1	1**				.079*
	Sig. (2-tailed)	.000	.000	.000	.486	.000		.016	.366	.028
	N	706	645	770	76	770	770	769	770	770
Efficiency (m700out)	Pearson Correlation	.131**	.127**	.082*	.041	.235**	-.087*	1	-.028	.008
	Sig. (2-tailed)	.000	.001	.023	.723	.000	.016		.441	.827
	N	705	644	769	76	769	769	769	769	769
Energy efficiency (vad/e).	Pearson Correlation	.004	-.003	-.022	.065	.019	.033	-.028	1	.042
	Sig. (2-tailed)	.923	.933	.541	.576	.590	.366	.441		.246
	N	706	645	770	76	770	770	769	770	770
Non fossil fuel intensity	Pearson Correlation	-.101**	-.101*	-.118**	.004	-.073*	-.079*	.008	.042	1
	Sig. (2-tailed)	.007	.010	.001	.973	.042	.028	.827	.246	
	N	706	645	770	76	770	770	769	770	770



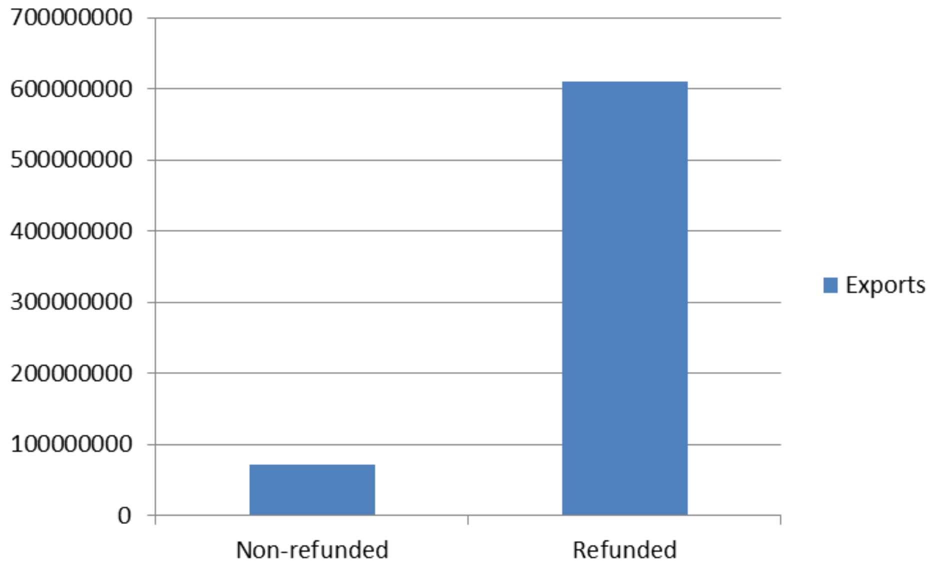
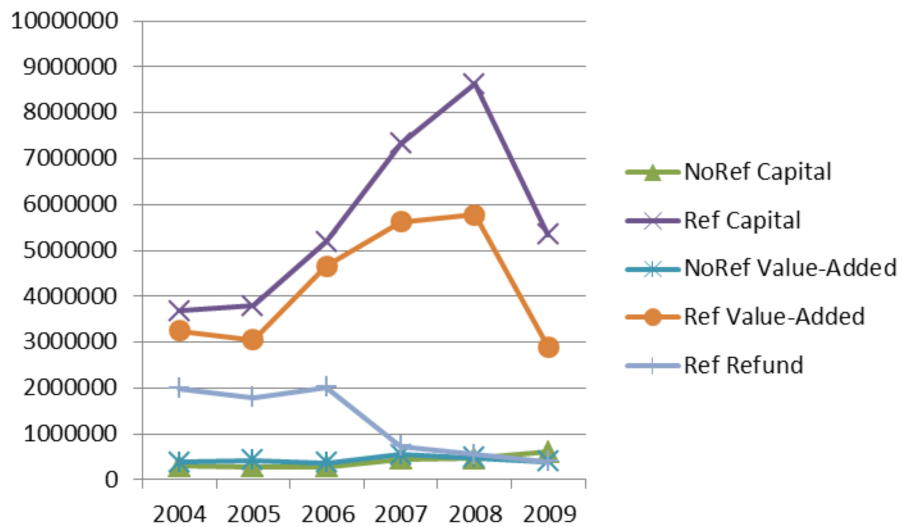


Figure 1. Average exports of refunded (Ref Exports) and non-refunded (NoRef Exports) firms 2004 – 2009.



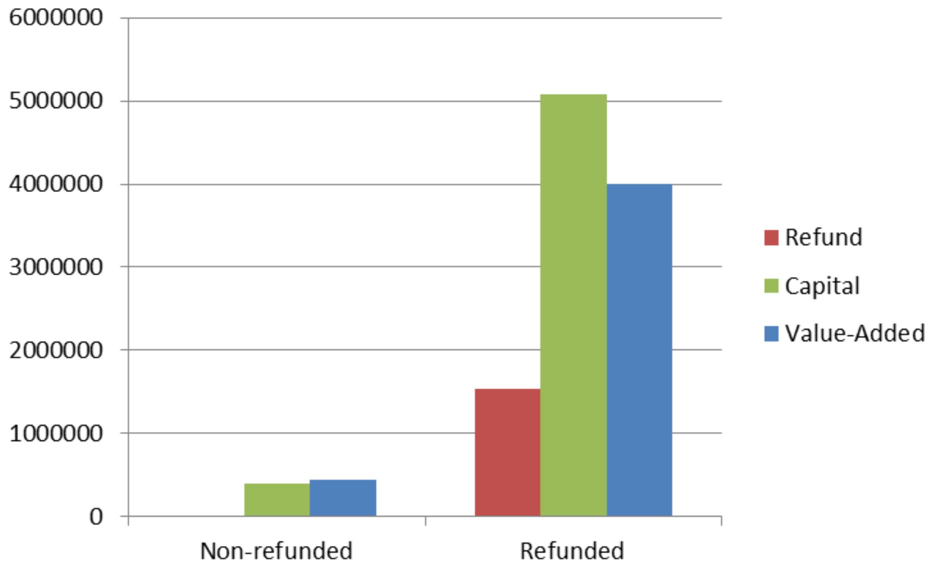
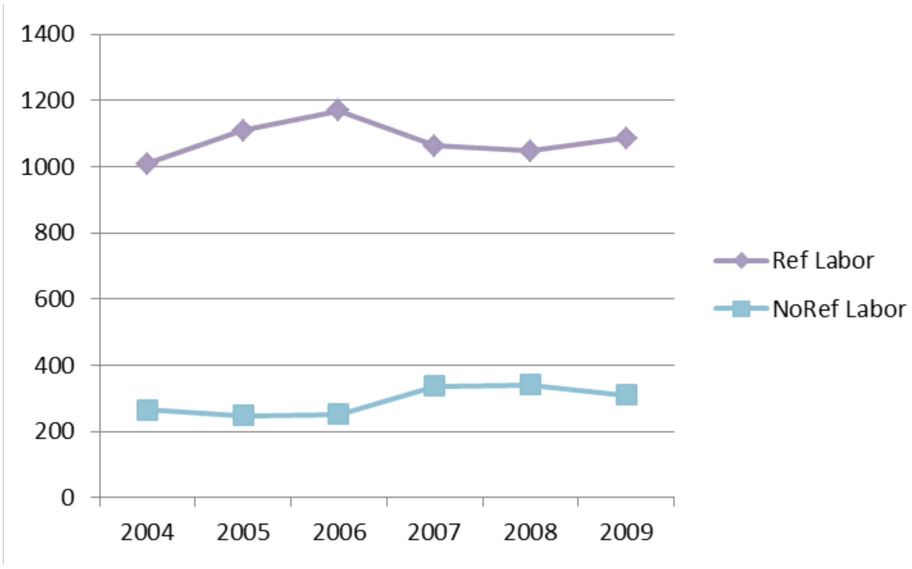


Figure 2. Average capital stock and value-added of refunded (Ref) and non-refunded (NoRef) firms 2004 – 2009.



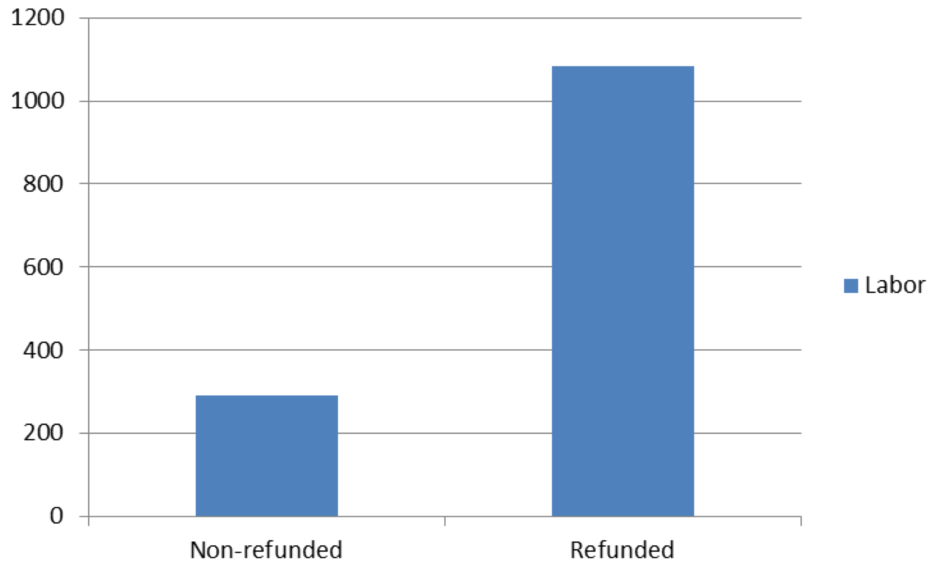
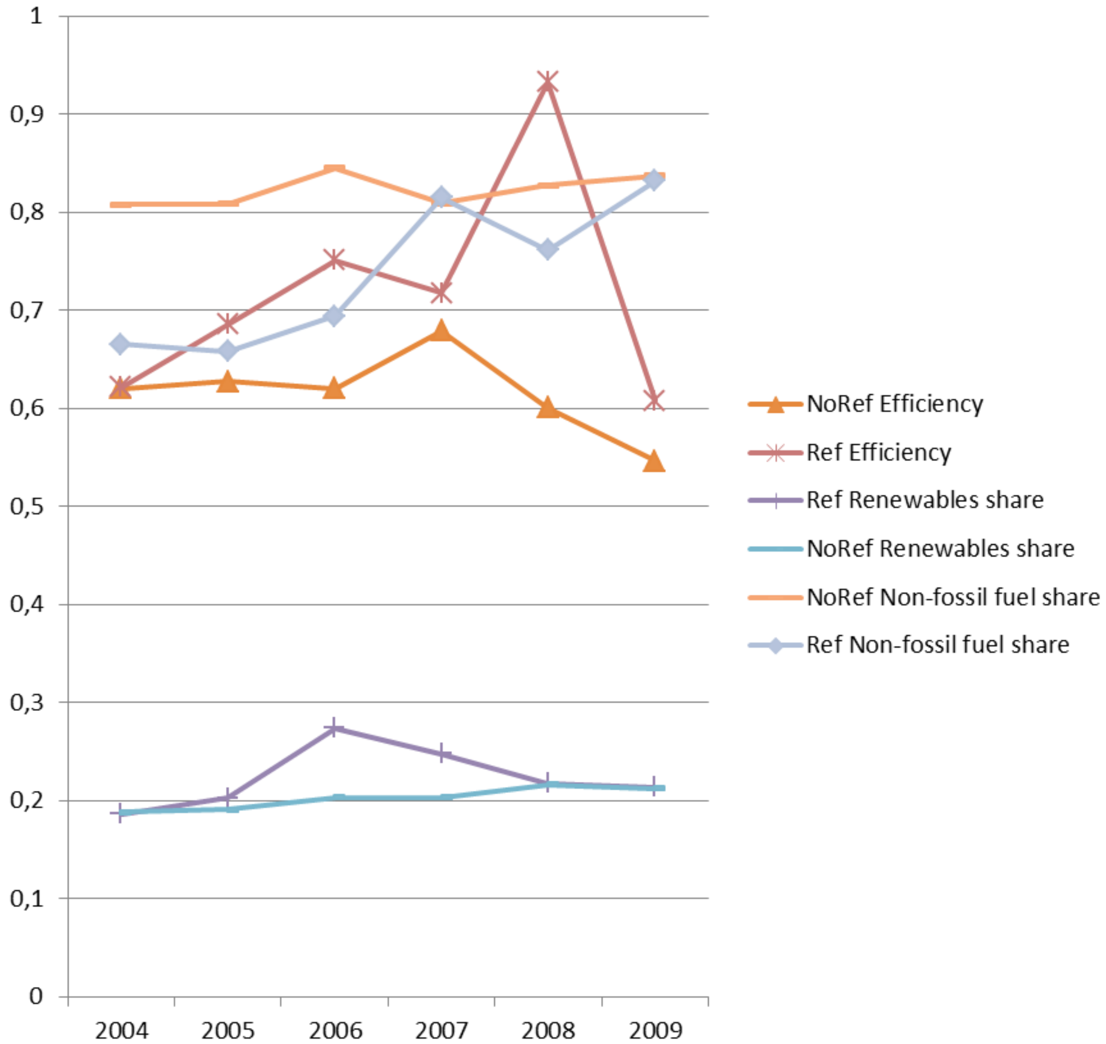


Figure 3. Average personnel refunded (Ref) and non-refunded (NoRef) firms 2004 – 2009.



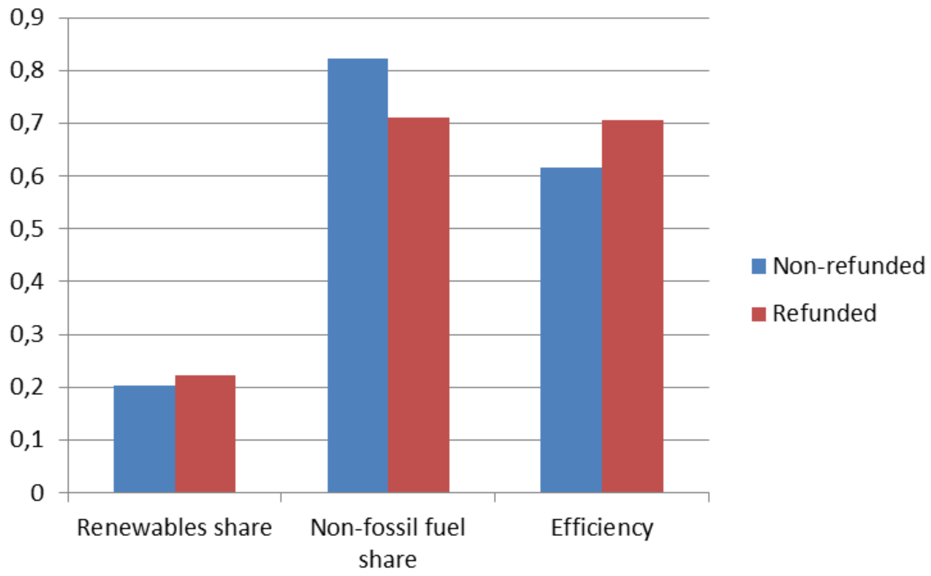


Figure 4. Average efficiency, renewables and non-fossil fuel shares in refunded (Ref) and non-refunded (NoRef) firms 2004 – 2009.

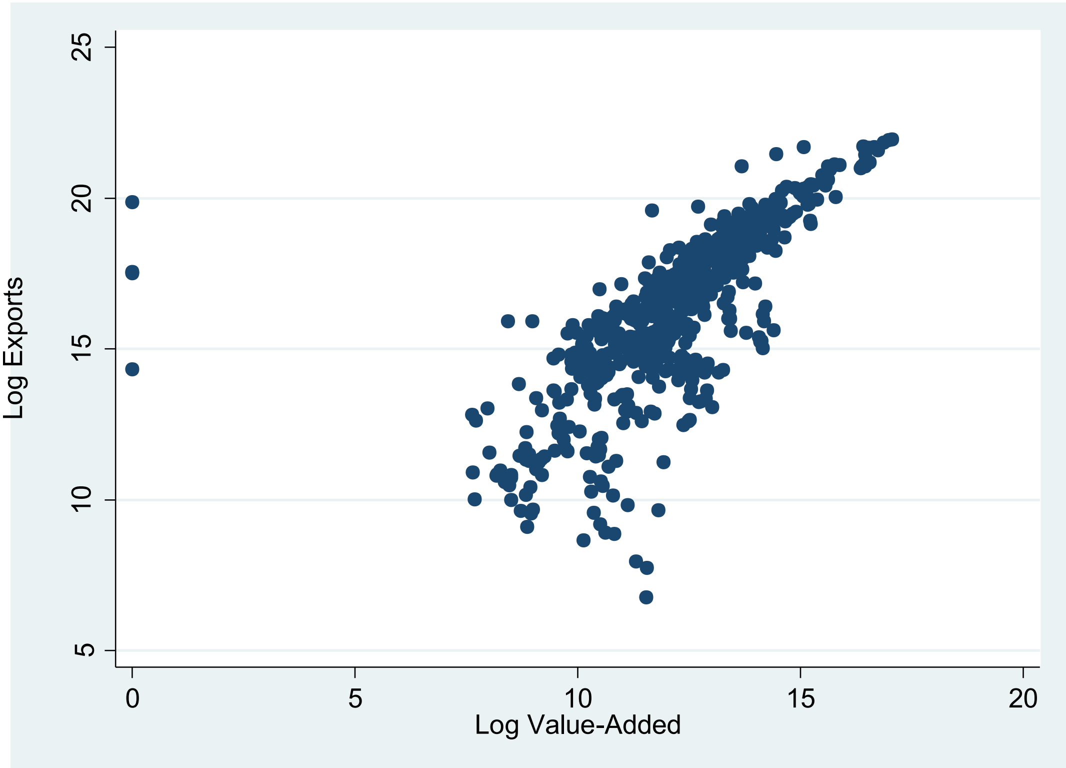


Figure 5. Log exports and log value-added.

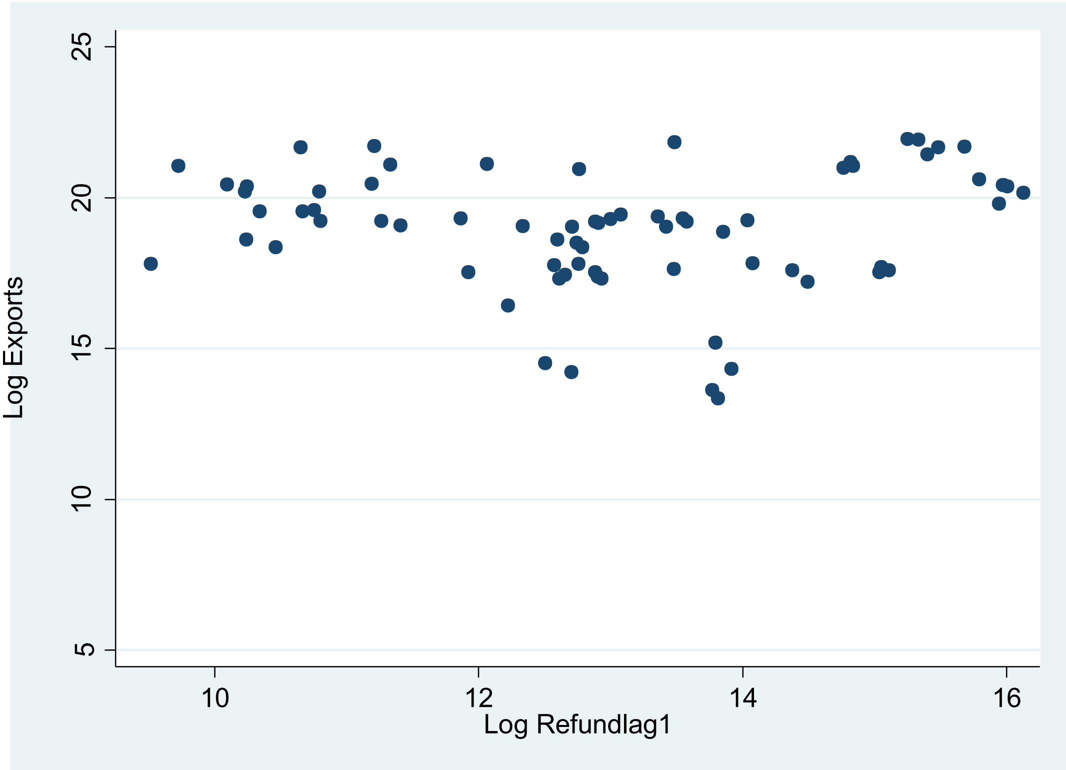


Figure 6. Log exports and the lag of log value-added.

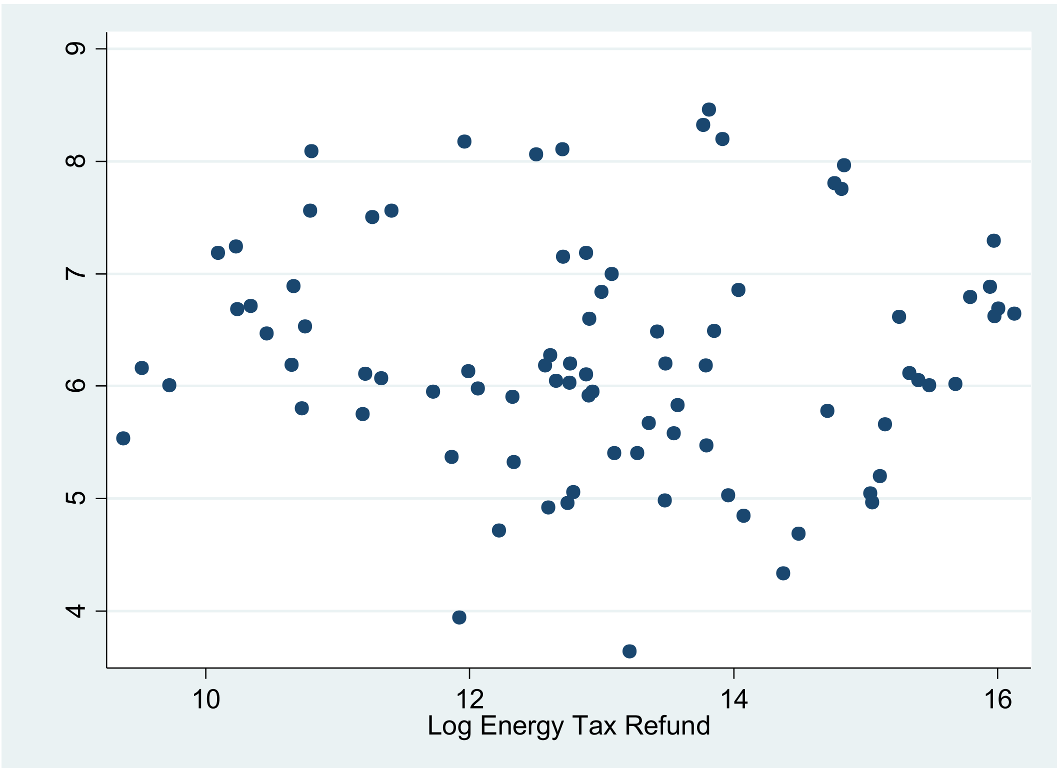


Figure 7. Log energy efficiency and log energy tax refund.

Methodology

As is characteristic of production data, the data suffers from multicollinearity and autocorrelation. Potential endogeneity issues loom at the outset. By design the refund increases with energy use, which increases with firm size in energy intensive export industries. That is, the positive correlation of the refund and exports may be due to firm size. Moreover, it is entirely possible that the positive correlation between the refund and exports represents in fact reverse causality, since an increase in exports may encourage firms to raise output in the hope of exporting more, resulting in more energy use and a higher refund of energy taxes. As is apparent in Table 2, lagged exports correlate with the current energy tax refund, the energy tax refund correlate with value-added, labor and efficiency. The methodology therefore needs to control for endogeneity.

In the absence of randomized experiments, most methodology for elaborate causal analysis requires large datasets and clear policy changes during the sample period. In smaller samples, provided that good instruments are available, the quasi-experimental instrumental variables (IV) method is applicable. In the absence of better options, I resort to the lagged values of the energy tax refund for an instrument.

As pointed out e.g. by Angrist and Pischke (2010), to be a valid as an instrument, the lagged refund needs to satisfy the relevance and the exclusion condition. The relevance condition refers to the correlation of the lagged refund and exports, which must be zero. Test results show that the coefficients on lags of the refund regressed on exports, are generally very small, close to zero, and hence this condition is satisfied. Hence, the lagged values satisfy instrument test results and the requirement for using an IV approach in linear models, i.e., the instrument is correlated with the endogenous explanatory variable (the refund), conditional on the other covariates.

The exclusion condition is more demanding, since it requires that the lagged refund (the instrument) influences current exports (the endogenous variable) only through its effect on current refunds. By applying several lags on the refund, the concern that the instrument has causal effect on the outcome, in ways other, than through the channel of interest, should be mitigated.

Various production related control variables, time and industry dummies are introduced to control for omitted variable bias. When growth and demand conditions were strong, the overall demand for energy and raw materials increased and raised their prices. During 2004 – 2009, energy and raw material prices rose particularly due to expanding Chinese production and needs, further fueled by China's current account surplus induced liquidity boom in the Western Hemisphere.[12] This boom was associated with increased demand for energy intensive Finnish exports, particularly basic metals. Time dummies are therefore necessary to capture business cycle effects, reflecting demand conditions on global markets, and industry dummies to (imperfectly) control for technological differences between industries.

[12] Source: http://www.vox.com/2014/12/16/7401705/oil-prices-falling.

Due to persistent autocorrelation, lags of the dependent variable and several lags of the instrument are included in the regression. As a robustness checks, various model forms are tested shifting dependent and independent variables.

Since the instrument is not randomized and internal validity cannot be guaranteed, I cannot prove causality. Nevertheless, while it is important not to dismiss correlation as not suggesting causation at all, correlation is necessary for causality in the first place. That is, significant correlation is necessary for the refund to have any causal effect at all. To begin with, I seek correlational evidence from several angles.

In the interests of replicability, and to reduce the scope for errors, I select a simple and transparent research design, i.e., identification strategy. Exports are considered a function of production function variables such as capital and labor, and productivity related variables. According to international trade models, see e.g. Melitz (2003) or Helpman, Melitz and Yeaple (2004), only the most productive firms engage in foreign activities, including exporting. Hence, several productivity-related, but little correlated variables are included as explanatory variables, i.e., technical efficiency, energy efficiency (energy intensity) and profitability. Value-added is excluded from estimates on exports, as it is directly related to capital and labor and would be similar to double-counting them as explanatory variables. In addition, I include energy related variables of interest, i.e., energy efficiency and renewables intensity. The model estimated with instrumental variables (IV) is presented in equation (4) below.

$$y_{it} = \alpha_1 y_{it-1} + \alpha_2 r_{it}(r_{it-1}, r_{it-2}) + \beta_1 x_{1it} + \beta_2 x_{2it} + \ldots + \beta_6 x_{6it} + d_t + d_j + e_{it} \quad (4)$$

The dependent variable, y_{it} stands for exports in year t by firm i. The explanatory variables include a lag of exports, as well as the energy tax refund, r_{it}, instrumented by its lags r_{it-1}, r_{it-2}. In addition, logs of capital, labor, efficiency, profitability, energy efficiency and renewable (or non-fossil-fuel-intensity) for firm i, in industry j in year t are included in $x_{1it}, \ldots, x_{6it}$. I include time dummies (d_t) for each year from 2004 to 2009 to capture business cycle effects and industry dummies (d_j) to capture industry characteristics. Lastly, e_{it} is the error term. Robust standard errors are computed to control for potential heteroscedasticity. Reduced forms of the model are estimated also with ordinary least squares (OLS) and fixed effects (FE).

The long-term equilibrium impact of the refund[13] is calculated by adjusting the coefficient to the impact of the lagged dependent variable in the model

$$\alpha_2 / (1 - \alpha_1) \quad (5),$$

where α_2 is the coefficient on lagged exports, and α_1 is the coefficient on the refund.

Results

Provided that the instrument is valid, the lagged refund is exogenous to the dependent variables. Tables 3 to 7 below present results from models including all variables satisfying most test results, with the exception of the endogeneity test, which generally failed to reject the H_0 of exogeneity. OLS and FE are more efficient than IV. Yet, fixed effects results tend to fail the F-test, while OLS results cannot be relied upon due to the size impact. Hence IV results are referred to in the following. The

[13] See e.g. Greene (2003).

differences between IV, OLS and FE results should stem from the inclusion of lagged control and exclusion of dummy variables in the IV estimations.

On average, the results show no significant correlation between the lagged refund and exports (Table 3) or between the refund and employment (Table 5). With respect to exports, the signs and small magnitudes of the coefficients in various robustness checks are fairly consistent, i.e., the refund has no impact on exports. In some models, the relationship is negative. As a further robustness check a simplified model is estimated, i.e., excluding value-added, labor, capital, energy related variables and profitability. This is to check the potential impact of double counting of the variables in exports. Profitability is excluded as the refund may directly contribute to profits. If firm size is controlled for by the number of employees, while the capital stock and industry dummies control for the technology, it appears that technical efficiency is significantly associated with exports, consistent with Helpman et. al (2004) finding that more productive firms export. Indeed, in several other forms of the model, exports appear to be linked to efficiency as trade theory suggests.

In contrast, value-added is significantly and positively related to the refund (Table 4). The insignificant impact of the refund on exports suggests that the positive link between value-added and the refund is not due to exports. Hence, it is possible that the refund crowds out smaller producers, not eligible to the refund. Alternatively, since the domestic market is small, it may also substitute imports of intermediates with domestic produce. That is, the refund may be able to maintain value creating production in Finland through import substitution. The relationship between value-added and the refund is endogenous, since they are linked by design. Current refund increases with the decline of current value-added, i.e., the link is inverse. Yet the correlation of the refund, including its lag, is positive with value-added. This positive significant correlation between the refund and value-added may emerge from autocorrelation. That is, the lagged refund influences current value-added through the current refund or the lagged value-added.

By design the energy tax refund is also related to energy use. The negative association of the refund with energy efficiency is as one would expect. The failure of the endogeneity test, suggests that there may be causality from the refund to energy inefficiency. In any case, the recipients are more energy intensive or inefficient in their energy consumption than non-recipients even after controlling for time and industry effects. This contrasts with the energy efficiency argument that industry proponents have put forward.

Table 3. Instrumental variables estimates of the refund's impact on exports[14]

Model Explanatory variables	Exports with 1 lag, refund 3 lags	Exports with time and industry dummies, refund 3 lags	Exports with 1 lag, refund 2 lags	Exports with time and industry dummies, refund 2 lags	FE cluster (id)	OLS	OLS
Log energy tax refund	.000038	-.0137934	-.0030009	-.0069513	.0153864*	.0152166	.0147036
Lag log energy tax refund					-.0022753	-.0134645	-.0112937
Lag2 log energy tax refund					.0060069	-.0009845	-.0040157
Lag log exports	.8189***		.7443203***		.1120361	.7576543***	.7638246
Log capital	.0206947	.3313339***	.0999509**	.4978928***	-.0093365	.1135976**	.1172132
Log labor	.244597***	1.018216***	.2656024**	.84334***	.780291**	.0551548	.2325463
Efficiency (m700output)	.3723143***	1.106536***	.3554223**	1.001428***	.5646483***	.233704**	.3573152
Profitability	.0861565**	.0082802	.0530219	-.0696948	.0753354	.3204607**	
Log energy efficiency	-.0098705	-.1249506	-.0028747	-.0639667	.1454453	-.0003029	
Renewables intensity	.1982381	.777454***	.278812*	1.007253***	-.1335679	.2870547*	
y2005	0	0	0	0		0	0
y2006	0	0	.23934***	.0848445		.263615***	.1314499
y2007	.137638	.118313	.089729	.092931		.149466	.021724

[14] *** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

	2*	7	8	4		5*	9
y2008	.1236052	.0985735	.1043411	.0641862		.1311639*	0
y2009	0	0	0	0		0	-.1383848
tala17	.3337889***	1.071521***	.2378541**	.8914167***		.2281321**	.1425066
tala20	.2810326**	.6969112***	.1784335	.6407669***		.17228	.088043
tala24	.0967573	-.3351308	-.1633682	-.2756675		-.1356623	-.2519049
Constant	.9431674*	6.799017***	1.193771*	5.339552***	9.374788**	.9442895	1.049513
Observations	255	258	380	387	393	393	383
F-test	409.97	88.74	477.67	107.43	3.26	403.46	467.38
Kleibergen-Paap p-val	0.0000	0.0000	0.0000	0.0000			
Hansen J p-val	0.3625	0.7540	0.7883	0.5751			
Endogeneity test of log refund, p-val[15]	0.8761	0.8959	0.2843	0.6616			
R2 overall					0.6629	0.9376	0.9367
No. of groups/ clusters					132	132	132
Eq. impact[16]	0.00021		-0.01174		0.017328	0.062789	0.062257

[15] H_0: The specified endogenous regressors can be treated as exogenous.

[16] Long-term equilibrium impact from equation (4).

Table 4. Instrumental variables estimates of the refund's impact on value-added[17]

Model Explanatory variables	Value-added with 1 lag, refund 3 lags	Value-added with time and industry dummies, refund 3 lags	Value-added with 1 lag, refund 2 lags	Value-added with time and industry dummies, refund 2 lags	FE cluster (id)	OLS
Log energy tax refund	.01446**	.0221975***	.0148056***	.0252657***	.0058135	.0100385
Lag log energy tax refund					.0187424**	.0066188
Lag2 log energy tax refund					.0147204*	-.0028425
Lag log of value-added	.2888226***		.3985867***		-.002534	.4481666***
Log of exports	.0421156**	.0665452***	.0439704***	.0767365***		.0469341**
Log capital	.2648659***	.3837667***	.2239137***	.3980999***	.1363051**	.2228922***
Log labor	.4360131***	.5610984***	.3302142***	.5026795***	.7129651***	.1291165***
Efficiency (m700output)	.7668597***	.9562707***	.7174801***	1.005323***	.8793068***	.2686902***
Profitability	.1472851***	.1652683***	.1340857***	.1591492***	.0091377***	.6685181***
Log energy efficiency	.0719179***	.0798037***	.0416099**	.0537624**	.1424682	.0457608**
Renewables intensity	-.0364588	-.0418817	-.0365526	-.0854309	-.4891801**	-.0449744
y2005	0	0	0	0		0
y2006	0	0	.0878308**	.0374063		.1151186***
y2007	.0209814	.001138	.0797446**	.0573617		.11801***
y2008	-.0556755	-.0285632	-.0229686	.0219125		0
y2009	0	0	0	0		.0173763
tala17	.0846762	.0992236	.0030023	-.0134264		-.0195096
tala20	.0536125	.0939231	.0174879	.0405454		-.01667
tala24	-.036742	-.0522072	-.0815651	-.0841459		-.0979427

[17] *** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

Constant	1.567727 ***	2.461125	1.488197 ***	2.629739 ***	5.457198***	1.157353 ***
Observations	258	258	387	387	422	400
F-test	724.32	552.03	1041.23	525.10	6127.51	550.38
Kleibergen-Paap p-val	0.0000	0.0000	0.0000	0.0000		
Hansen J p-val	0.2418	0.2396	0.7970	0.3424		
Endogeneity test of log refund, p-val	0.9298	0.6357	0.4853	0.1545		
R2 overall					0.8639	0.9677
No. of groups/ clusters					142	134
Eq. impact[18]	0.020332		0.024618		0.005799	0.018191

*** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

[18] Long-term equilibrium impact from equation (4).

Table 5. Instrumental variables estimates of the refund's impact on employment[19]

Model Explanatory variables	Labor with 1 lag, refund 3 lags	Labor with time and industry dummies, refund 3 lags	Labor with 1 lag, refund 2 lags	Labor with time and industry dummies, refund 2 lags	OLS
Log energy tax refund	-.0121336	-.0069573	-.0167665	-.0047987	.0021898
Lag log energy tax refund					-.0225329
Lag2 log energy tax refund					.0163733
Lag log of labor		.7118043***		.8346947***	.8607748***
Log of exports	.258807***	.0804934**	.2360397***	.0430718*	.0331607
Log capital	.3902284***	.1242729***	.3562332***	.0692184**	.0608515**
Efficiency (m700output)	-.7509991***	-.281376**	-.6409823***	-.1187899	-.1167501
Profitability	.0132223	.0204643	.0513442	.0177968	.0228173
Log energy efficiency	.1790586***	.0885977***	.1109831***	.0351383**	.0337158**
Renewables intensity	-.1069564	.0405469	-.1557123	-.0187987	.019359
y2005	0	0	0	0	0
y2006	0	0	.1471519	.1584881***	-.0959738*
y2007	.204134**	.2401568***	.2597516***	.255572***	0
y2008	.2099447**	.124888***	.1682344*	.1096554***	-.1455657***
y2009	0	0	0	0	-.2477216***
tala17	-.7210007***	-.2828869*	-.6860535***	-.2350102**	-.1932533*
tala20	-.6085025***	-.2392132*	-.5560283***	-.1714339*	-.1314425
tala24	-.1258803	-.1031402	-.0880513	-.077542	-.0575838

[19] *** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

Constant	-4.288944***	-1.753915***	-3.101106***	-.8664748***	-.5166813*
Observations	258	258	387	387	400
F-test	64.39	545.57	63.93	931.56	752.59
Kleibergen-Paap p-val	0.0000	0.0000	0.0000	0.0000	
Hansen J p-val	0.9745	0.4993	0.7750	0.2317	
Endogeneity test of log refund, p-val	0.7537	0.6595	0.8084	0.2669	
R2 overall					0.9476
No. of groups/ clusters					134
Eq. impact[20]		-0.02414		-0.02903	0.015728

*** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

[20] Long-term equilibrium impact from equation (4).

Table 6. Instrumental variables estimates of the refund's impact on energy efficiency[21]

Model Explanatory variables	Energy efficiency with 1 lag, refund 3 lags	Energy efficiency with time and industry dummies, refund 3 lags	Energy efficiency with 1 lag, refund 2 lags	Energy efficiency with time and industry dummies, refund 2 lags	OLS
Log energy tax refund	-.0173068	-.051736**	-.0171456**	-.061773***	-.0108991
Lag log energy tax refund					.0230149*
Lag2 log energy tax refund					-.0279016**
Lag log energy efficiency	.5767545***		.6934496***		.7266445***
Log of exports	-.0228421	-.0979489*	.0070017	-.0607723	.0039049
Log capital	-.2117921***	-.4102329***	-.1181161**	-.2609714***	-.0936278**
Log of labor	.254454***	.5365661***	.1169588**	.3543449***	.1354766***
Efficiency (m700output)	.8100176***	1.344851***	.4696552***	.9944198***	.1013434*
Profitability	.0999756***	.1310401***	.1405679***	.2052413***	.4489777***
Renewables intensity	-.4865582***	-1.167432***	-.4660026***	-1.392337***	-.4158714**
y2005	0	0	0	0	0
y2006	0	0	.1617906	.1104722	.1781442
y2007	-.0909553	-.0523696	-.058833	-.1676045	0
y2008	-.1430756*	-.1801102	-.0965297	-.1631887	-.0429504
y2009	0	0	0	0	.0345183
tala17	-.1579982	-.370439	-.2231614*	-.5266884**	-.1787838
tala20	.0530418	.5094789	.0200668	.4238119	.0198299

21 *** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

		***		**	
tala24	.0678408	.1005012	-.0365942	.0472366	-.0173923
Constant	4.348066 ***	10.86***	2.807878**	9.417735 ***	2.354657 ***
Observations	258	258	387	387	400
F-test	110.95	27.3	120.19	22.48	100.22
Kleibergen-Paap p-val	0.0000	0.0000	0.0000	0.0000	
Hansen J p-val	0.2437	0.6124	0.0776	0.6500	
Endogeneity test of log refund, p-val	0.5696	0.6583	0.3610	0.2556	
R2 overall					0.7831
No. of groups					134
Eq. impact[22]	-0.04089		-0.05593		-0.03987

*** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

[22] Long-term equilibrium impact from equation (4).

Table 7. Instrumental variables estimates of the refund's other impacts[23]

Explanatory variables	Exports with 3 lags	Exports with 2 lags	Exports with 2 lags	Value-Added with 2 lags	Value-Added with 3 lags	Employment with 2 lags	Energy efficiency with 2 lags
Log energy tax refund	-.040905*	-.037841*	.0139688*	.02639***	.02286***	-.0335***	-.0631***
Lag log exports			.91931***				
Log exports				.07479***	.06633***	.05197***	-.1409***
Log value added	.816154**	.88692***				.932977***	.611927***
Log labor	.513522***	.3438225**		.506418***	.560805***		.0789937
Log capital	.0034253	.1297293		.395141***	.382980***	-.178357***	-527622***
Efficiency (M700)	.3571191	.1308637	.1920999	1.00079***	.954595***	-1.27907***	.3098739
Profitability	-.1323874*	-.2191473**		.161366***	.166612***	-.123196***	.1441841*
Log energy efficiency	-.2342***	-.1484797**		.0561587**	.081282***	.0106242	
Non fossil fuel intensity	-.4185709	-.4872759**		.0504119	.0484695	-.0424323	.697881***
y2005	0	0	0	0	0	0	0
y2006	0	.0222391	.27156***	.0375005	0	.0458985	.0965759
y2007	.0687307	.0095312	.1553113**	.0593846	.0042162	.0814426	-.160047
y2008	.0399707	-.0199165	.1546183*	.0231805	-.026415	.0704817	-.1476585
y2009	0	0	0	0	0	0	0
tala17	.556201	.410580	.092568	.027362	.124714	-	.081479

[23] *** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

	***	5**		4	**	.365107 ***	7
tala20	.297916 1	.216313 5	.009417 1	.073332 1	.112264 8**	- .338783 ***	.880760 3
tala24	- .769611 ***	- .758334 ***	- .196172 8	- .035312 1	- .020837 2	.023878	.829807 3
Constant	5.49802 ***	3.63481 ***	1.05528 1	2.57081 ***	2.39666 ***	- 4.09112 ***	6.91521
Observations	258	387	380	387	258	387	387
F-test	108.99	27.70	462.15	534.39	557.86	176.10	18.50
Kleibergen-Paap p-val	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hansen J p-val	0.7540	0.6556	0.3599	0.2766	0.2361	0.7303	0.8385
Endogeneity	0.8959	0.4990	0.7282	0.1134	0.5169	0.2730	0.4909
Eq. impact[24]			-0.0409				

*** Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level; * Correlation is significant at the 0.1 level.

Omitted variable bias is controlled for by including dummies for year, industry, and various firm variables. Once the interactions of year and industry dummies are included, FE test results are no longer satisfied suggesting that the number of variables is too small. Since significant results could be obtained in other model forms, the insignificance of the refund is not deemed to be due to small sample size. In sum, while causality cannot be established, the absence of significant correlation between the energy tax refund and exports strongly points towards the absence of a competitiveness enhancing effect.

Discussion

The endogeneity test showing exogeneity of the refund is sufficient to allow for causal interpretation of the results provided that the lagged refund is a valid instrument, i.e., as good as random. This is constrained by the fact that lagged variable effects may be biased by omitted variables. Hence, various control variables, as well as dummies for year, industry, and firm fixed effects were included. Their interactions reduced the number of variables excessively and results did not pass test results in FE estimations. Meanwhile in IV the overall impact was insignificant. Significant results could be obtained with respect to other variables and models. The refund reduces costs, which should be reflected in improved export performance, but the near zero negative coefficients indicate the absence of a competitiveness enhancing effect.

[24] Long-term equilibrium impact from equation (4).

Cost competition, related to wages and/or exchange rate manipulation, is intense in mature industries, such as the paper industry or the steel industry. The refund aims to reduce energy costs of the producers and raise cost competitiveness, and therefore acts as a form of fiscal devaluation[25]. Why this does not show up in exports can be due to several reasons: pass-through to inefficiencies, demand conditions or the shape of the demand curve. The steel industry, a key recipient of the refund, has been feared to shift production overseas particularly to China. The 2000's witnessed an extraordinary economic boom related to rising competition and off-shoring to emerging economies. The inflationary growth accelerating liquidity boom raised prices of raw materials (Plumer 2015), including Finnish steel prices already in 2002 before the energy tax refund was introduced. The demand for Finnish steel collapsed only in 2007, China's production lead to overcapacity. Also the paper industry suffered from overcapacity induced by technological change and structural shifts in market demand. That is, the subsidy may have maintained excess capacity, where hindsight suggests that it should have been reduced. In sum, the cost reducing impact of the refund may be insignificant compared to exogenous market and/or technological developments.

The refund may not be as effective as currency depreciation since it is indirect, affecting only part of energy costs. In the long run, the refund may be diverted into higher wages or profits distributed as dividends to shareholders, or structural inefficiencies. If significant at all, the refund can be expected to reallocate resources towards the subsidized input, energy. Hence, the refund may not work due to inefficiencies, a misallocation of resources and structural effects on energy consumption and imports that subsidies tend to generate. The reduced pressure from environmental regulation may also generate dynamic effects as the incentives to seek more energy efficient means of production or innovate are reduced. In the long term, this may result in lost competitiveness relative to firms in countries with stricter regulations, as the Porter hypothesis postulates. Indeed, energy intensity proved to be positively associated with the subsidy, while exports are strongly associated with technical efficiency consistent with the Helpman et al. (2004).

Investments are too large scale and infrequent to be studied for the location of production for pollution haven considerations, while the lack of data on imports of respective intermediates rules out the possibility of studying the impacts of the refund on net exports. Nevertheless, the significant positive impact of the refund on value-added suggests that the refund may help to maintain production in Finland. The refund is directly linked to value-added, but inversely. Hence, an increase in value-added reduces the current refund, but cannot influence the lagged refund. Reverse causality is therefore ruled out. The lagged refund appears to raise value-added, i.e., the use of domestic labor and capital. This may represent a crowding out effect of domestic competition, since the impact does not appear to be due to increased exports. But it can also represent a crowding in effect of domestic production through reduced imports of intermediates. Given exogenous demand, a marginal cost factor such as the refund, may have an effect on the cost competitiveness of domestic intermediates relative to imported intermediate goods. What can be established is that the refund

[25] In the absence of nominal exchange rate devaluations, misalignments in the euro can be readjusted by changing the relative tax burden on exports and imports or internal devaluations (see e.g. IMF 2011).

does not promote exports. Since import substitution policies are vulnerable to inefficiencies and a misallocation of resources, the refund is likely to represent suboptimal policy.

Conclusion

The energy tax refund does not appear to raise competitiveness in terms of export performance. The positive correlation of the refund with exports appears to emerge from the large size of the recipients. At best, the refund may have an import substitution effect by reducing imports of intermediate goods, but the analysis is constrained by endogeneity issues and lack of data on imports. Consistent with the Helpman et al. (2004), exports are strongly associated with technical efficiency. As for pollution haven effects, energy intensity increased with the refund.

Since the instrument is not randomized, I cannot prove a causal relationship despite the various controls. Nevertheless, significant results could be obtained, suggesting that insignificance is not due merely to small sample size. The small magnitudes of the coefficients strongly suggest the absence of an export performance enhancing effect. As such results are fairly consistent with recent literature on the impact of environmental taxes on competitiveness. I contribute to the accumulation of such evidence, enjoying broader relevance to countries combatting overvaluation with indirect fiscal devaluation.

References

Albrizio, S., Kozluk, T., Zipperer, V. (2014): Empirical Evidence on the Effects of Environmental Policy Stringency on Productivity Growth, OECD Economics Department Working Papers No. 1179, OECD Publishing.

Angrist, J., Pischke, J-S. (2010): The Credibility Revolution in Empirical Economics: How Better Research Design is Taking the Con out of Econometrics. NBER Working Paper No. 15794. March 2010

Arlinghaus, J. (2015): Impacts on Carbon Prices on Indicators of Competitiveness – A Review of Empirical Findings, OECD Environment Working Papers No. 87, OECD Publishing, Paris.

Baum, C. F. (2013): Dynamic Panel Data Estimators. EC 823: Applied Econometrics. Boston College, Spring 2013.

Berghäll, E. (2014): Has Finland advanced from an investment to an innovation-driven stage? The Finnish Journal of Business Economics (LTA) 1/2014: 11–32.

Brunnermeier, S., Levinson, A. (2004): Examining the evidence on environmental regulations and industry location. Journal of Environment & Development 13, 6–41.

Cazals, C., Florens, J-P., Simar, L. (2002): Nonparametric frontier estimation: A robust approach. Journal of Econometrics 106, 1–25.

Condon, M., Ignaciuk, A. (2013): Border Carbon Adjustment and International Trade: A Literature Review, OECD Trade and Environment Working Papers, 2013/6, OECD Publishing.

Copeland, BR. (2010): Handbook on Trade and the Environment.

Copeland, B., Taylor, M. (2004): Trade, growth, and the environment. Journal of Economic Literature 42, 7–71.

Dechezleprêtre, A., Sato, M. (2014): The impacts of environmental regulation on competitiveness, Policy Brief, Grantham Research Institute on Climate Change and the Environment and the Environment, London School of Economics and Political Science.

Flues, F., Lutz, B. (2015): forthcoming, Competitiveness of Effects of the German Electricity Tax, OECD Environment Working Paper, OECD Publishing, Paris.
Greene, W. (2003): Econometric Analysis.

Grossman, G. M., Krueger, A. B. (1995): Economic Growth and the Environment, The Quarterly Journal of Economics, MIT Press, vol. 110(2), pages 353–77, May.

Harris, M.N., Kónya, L., Mátyás, L. (2002): Modelling the Impact of Environmental Regulations on Bilateral Trade Flows: OECD, 1990–1996. The World Economy,25(3), 387–405.

Helpman, E., Melitz, M. J., Yeaple, S. R. (2004): Export versus FDI with Heterogeneous Firms. *The American Economic Review*, Vol. 94, No. 1 (Mar., 2004), pp. 300-316, http://www.jstor.org/stable/3592780.

IMF (2011): Addressing Fiscal Challenges to Reduce Economic Risks. FISCAL MONITOR. September 2011.

Jaffe, A.B., Peterson, S.R., Portney, P.R., Stavins, R.N. (1995): Environmental Regulations and the Competitiveness of US Manufacturing Industries: What Does the Evidence Tell Us? Journal of Economic Literature 33, 132–1410.

Keynes, J. M. (1931): Addendum I to: Great Britain. Committee on Finance and Industry. Report (Macmillan Report) (London: His Majesty's Stationery Office, 1931), 190 – 209. Reprinted in Donald Moggridge, The Collected Writings of J. M. Keynes, Vol. XX (London: Macmillan, and Cambridge: Cambridge University Press, for the Royal Economic Society, 1981), 283–309.

Krugman, P. (2006): International Economics Theory and Policy. Addison Wesley.

Lehtilä, A., Savolainen, I., Tuhkanen, S. (1997): Indicators of CO_2 emissions and energy efficiency. Comparison of Finland with other countries. [VTT Energy, Espoo (Finland). Energy Systems] Research Org:Technical Research Centre of Finland, Espoo (Finland). Report Number(s):VTT-PUB—328.

Levinson A., Taylor, M. S. (2008): Unmasking The Pollution Haven Effect, International Economic Review, 49(1), pages 223–254, 02

Lund, P.D. (2007): The link between political decision-making and energy options: Assessing future role of renewable energy and energyefficiency in Finland. Energy. Volume 32, Issue 12, 2271–2281.

Martin, R., dePreux, L., Wagner, U. (2014): The impacts if a carbon tax on manufacturing: Evidence from microdata. Journal of Public Economics 117, 1–14.

Martin, R., Muûls, M., Wagner U. (2013): Impact of the EU ETS on Regulated Firms: What is the Evidence after Eight Years? Draft prepared for the symposium issue of the Review of Environmental Economics and Policy.

Melitz, M. J. (2003) "The Impact of Trade on Aggregate Industry Productivity and Intra-Industry Reallocations." Econometrica, November 2003, 71(6), pp. 1695–725.

Plumer, B. (2015): Why oil prices keep falling — and throwing the world into turmoil. VOX January 23, 2015. http://www.vox.com/2014/12/16/7401705/oil-prices-falling

Porter, M. E., van der Linde, C. (1995), Toward a New Conception of the Environment-Competitiveness Relationship, Journal of Economic Perspectives, Vol. 9, No. 4, 97–118.

Tamminen, S., Ollikka, K., Laukkanen, M. (2016): Suomen energiaverotus suosii energiaintensiivisiä suuryrityksiä, VATT Policy Brief 2-2016.

Teknologiateollisuus, (2012): Teknologia ilmastonmuutoksen torjunnassa. Teknologiateollisuus ry, Helsinki 2012.

TEM (2012): Yritystukiselvitys, (TEM-julkaisu nro 7/2012), http://www.tem.fi/files/32573/TEMjul_7_2012_web.pdf.

TEM (2013): Toimialojen tuottavuuden kasvu, sen yritystason mekanismit ja yritystuet" (TEM-julkaisu nro 14/2013) http://www.tem.fi/files/36824/TEMjul_14_2013_web_03062013.pdf.

Tobey, J. A. (1990): The Effects of Domestic Environmental Policies on Patterns of World Trade: An Empirical Test. Kyklos 43(2), 191–209.

Van Beers, C., Van den Bergh, J.C.J.M (1997): An Empirical Multi-Country Analysis of the Impact of Environmental Regulations on Foreign Trade Flows, Kyklos 50(1), 29–46

VTT (2012): Low carbon Finland 2050. VTT clean energy technology strategies for society. VTT Visions 2. VTT Technical Research Centre of Finland. Main editors and project coordination: Koljonen, T., Similä, L. Main authors of section: Lehtilä, A., Koljonen, T.

WTO: Anti-dumping, subsidies, safeguards: contingencies, etc, Understanding the WTO: The Agreements , at https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm8_e.htm