Comparing the use of ODEX indicators with Divisia decomposition analysis to measure true energy efficiency achievements: case study Irish industry

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Abstract

The European Union Directive for Energy Efficiency and Energy Services (ESD) sets out clear energy efficiency targets for all EU member states for the period up to 2016. The directive states that a harmonised model, combining top-down and bottom-up calculations, shall be used to measure energy efficiency improvements achieved by member states. The ESD mentions that the ODEX energy efficiency indicator is an example of an appropriate top-down calculation method.

Using Irish industry as a case study, this paper examines the effectiveness of ODEX in measuring true energy efficiency improvements in the sector. ODEX is compared to an alternative proxy for energy efficiency, namely an index of energy intensity at constant structure calculated using the Divisia approach. Both methods are subjected to a series of tests to determine their accuracy. The extent to which each can capture energy efficiency improvements achieved in the earlier part of a period under examination is investigated.

The Divisia calculation performs better than ODEX when subjected to the tests. Consequently Divisia gives a better view of energy efficiency improvements in Irish industry. The findings challenge the validity of the method of using an ODEX value to calculate energy savings in terms of energy units.

Introduction

ENERGY END-USE EFFICIENCY AND ENERGY SERVICES DIRECTIVE

The Energy End-use Efficiency and Energy Services Directive (ESD) 2006/32/EC [European Union (2006)] seeks a 9% improvement in energy efficiency to be achieved by each member state over the nine year period 2008-2016. The Directive defines energy efficiency as, *"…a ratio between an output of performance, service, goods or energy, and an input of energy"*. The 9% target is quantified in terms energy savings, i.e. a reduction in energy demand relative to a counterfactual, that can attributed to energy efficiency improvement measures.

Annex 1 of Directive 2006/32/EC defines the methodology to be utilised in quantifying the target based on the preceding five-year annual average final energy demand. This demand is converted to a primary energy equivalent by multiplying the final electricity demand by a factor of 2.5 and adding this to the final non-electricity demand. The target is thus quantifiable, fixed and is independent of future energy demand growth. In addition, the Directive 2006/32/EC target excludes those participating in the EU Emissions Trading Scheme. It allows the impact of measures introduced since 1995 (and in certain cases since 1991) that have a lasting effect to be included. The focus of Directive 2006/32/EC is on quantified national measures.

The directive states that a *"harmonised calculation model which uses a combination of top-down and bottom-up calculation methods"* . In Ireland, the ODEX indicator is the prevalent top-down methodology for measuring energy efficiency improvements in all sectors of the economy. In this paper, the appropriateness of using ODEX to measure Ireland's progress towards targets defined in the ESD is examined.

ODEX AND OTHER TOP-DOWN METHODS

The use of ODEX indicators, or energy efficiency indices, is an approach to measuring energy efficiency that has recently been developed within the ODYSSEE project [ADEME (2007)]. These indices aggregate trends in unit consumption by sub-sector or end-use into one index by sector based on the weight of each sub-sector/end use in the total energy consumption of the sector. According to Bosseboeuf et al (2005), ODEX *"provides a good "proxy" of the energy efficiency progress from a policy evaluation viewpoint"*. ODEX relates energy use of manufacturing branches, or subsectors, to their physical output given by a production index for most branches, rather than to their value-added, to calculate their changes in energy efficiency. The calculated values for all sub-sectors are weighted and aggregated to give an overall result for the sector. The ODEX thereby removes the distorting effects of changes in value-added that are unrelated to production output. By disaggregating the sector into a number of distinct defined branches, the index attempts to remove changes in energy consumption patterns brought about by changes in the industrial production mix.

There are many more-established top-down decomposition methods in existence that are used to measure the energy performance of an economic sector or to assess the effectiveness of energy policies. Ang and Zhang (2000) provide a comprehensive survey of studies undertaken on the subject up to 2000. These methods typically calculate a sub-sector energy intensity, i.e. the ratio of energy use to industrial output, and thereby endeavour to account for and remove the impact of changes in industrial production mix from the calculated overall energy performance result. Greening et al. (1997) have undertaken a comparison of six of the more common decomposition methods using data sets for ten OECD countries and conclude that methods using the Divisia decomposition approach yielded the smallest residual term, or error. When comparing various methods based on the Laspeyres index and the Divisia index, Ang (2004) generally recommends the use of the Log Mean Divisia method (LMDI) due to its "*theoretical foundation, adaptability, ease of use and result interpretation, and some other desirable properties in the context of decomposition analysis.*" No academic studies could be identified where the ODEX energy efficiency indicator is tested with scientific rigour or compared to existing decomposition methods.

CASE STUDY: IRISH INDUSTRY

In this paper, the effectiveness of the ODEX in capturing energy efficiency achievements achieved by Irish industry is examined by comparing the results of the ODEX methodology with an index of energy intensity at constant structure calculated using the aforementioned LMDI approach. A number of tests are devised to examine and compare the behaviour of the two and to determine which method is the most appropriate for the Irish scenario.

Ireland is an interesting case study for a number of reasons; not least its significant growth in energy demand since 1995 coupled with relatively low and reducing energy intensity, [Howley et al (2008)]. Ireland also has experienced poor performance in limiting greenhouse gas emissions and faces significant challenges in the future, with greenhouse gas emissions already 25% above 1990 levels in 2007. The industry sector in Ireland is particularly interesting due to the gradual disappearance of energy-intensive manufacturing industry, brought about by economic policies targeting inward investment from companies in large value-added sub-sectors, including pharmaceuticals and information technologies.

Measuring the energy efficiency achievements of Irish industry

Trends in energy consumption in all sectors of the Irish economy are analysed and published regularly by Sustainable Energy Ireland, Ireland's national energy agency. The most recent publication for the Industry sector includes an ODEX energy efficiency indicator and an index of energy intensity at constant structure [O'Leary et al (2007)]. In the work detailed in this document, the ODEX and energy intensity at constant structure are calculated anew using the methods outlined below.

CALCULATING ODEX: AN ENERGY EFFICIENCY INDEX

To calculate ODEX for industry, the sector is broken down into a number of sub-sectors or branches for which both final energy consumption data and production output data is available. A unit consumption index is first calculated for each sub sector, by dividing energy consumption by production output and the result is adjusted such that the value for the base year is 100. So, for any given year *Baseyear+n*, the unit consumption index *I* for a sub-sector *s* can be calculated according to the formula:

$$I_{sBaseyear+n} = 100 * \frac{EC_{sBaseyear+n} * PI_{sBaseyear}}{EC_{sBaseyear} * PI_{sBaseyear+n}}$$

(Equation 1)

where:

$EC_{sBaseyear}$ and $EC_{sBaseyear+n}$ are the energy consumption values for a sub-sector *s* in the years *Baseyear* and *Baseyear+n*,

$PI_{sBaseyear}$ and $PI_{sBaseyear+n}$ are the corresponding production indices for the same years.

The unit consumption index is calculated for each sub-sector for each year. The overall industry ODEX is calculated as a weighted average of unit consumption indices by sub-sector in accordance with the ODYSSEE definition [Enerdata (2008)]. Each sub-sector is weighted on the basis of its share of total energy consumption of the sector. For each sub-sector *s*, the variation of the overall ODEX between consecutive years *t-1* and *t* is calculated according to the following formula:

$$\frac{I_t}{I_{t-1}} = \frac{1}{\sum_s F_{st} * \left(I_{st-1}/I_{st}\right)}$$

(Equation 2)

where:

F_{st} is the fraction the total energy consumption attributed to the sector *s* in year *t*;

I_{st-1} and I_{st} are the unit consumption indices for sub-sector *s* in years *t-1* and *t* respectively;

and I_{t-1} and I_t are the ODEX values for all industry in years *t-1* and *t* respectively.

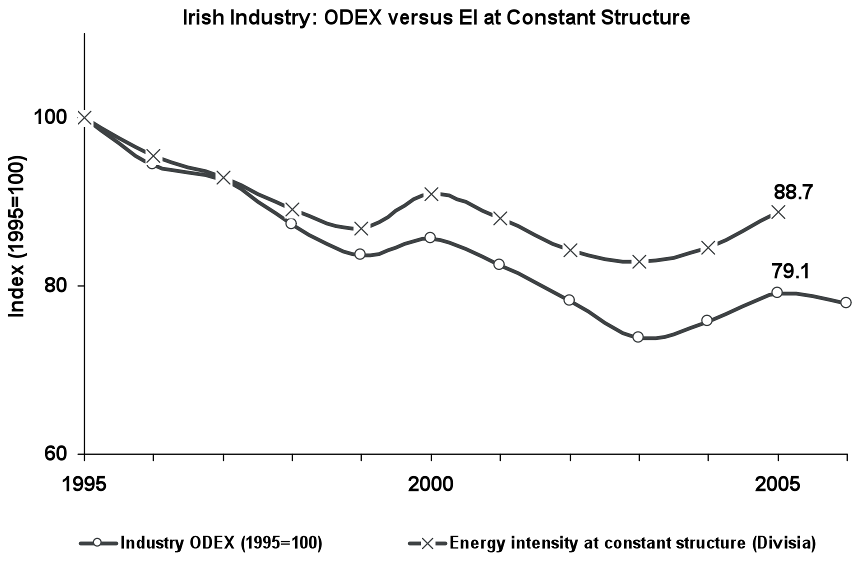

Figure 1 Irish Industry: ODEX versus Energy intensity at Constant Structure

CALCULATING LMDI: AN INDEX OF ENERGY INTENSITY AT CONSTANT STRUCTURE

To calculate an index of energy intensity at constant structure for Ireland. the LDMI, or Divisia, approach mentioned above, will be used. The Divisia index is a weighted sum of logarithmic growth rates, where the weights are the components' shares in total value, given in the form of a line integral. The ratio of change in energy consumption due to changes in energy intensity is given by Ang (2005) as:

$$D_{\text{int}} = \exp\left(\sum_i \frac{\left(E_i^T - E_i^0\right)/\left(\ln E_i^T - \ln E_i^0\right)}{\left(E^T - E^0\right)/\left(\ln E^T - \ln E^0\right)} \ln\left(\frac{I_i^T}{I_i^0}\right)\right)$$

(Equation 3)

where:

E_i^T and E_i^0 are the total energy consumption attributed to the sub-sector *i* in years *T* and *0* respectively;

E^T and E^0 are the total energy consumption for the whole sector in years *T* and *0* respectively;

I_i^T and I_i^0 are the energy intensity values for sub-sector *i* years *T* and *0* respectively, given by dividing sub-sector's energy consumption by its gross value added.

INDEX RESULTS FOR IRELAND

Using production output data and gross value added (GVA) data for Ireland published by the Central Statistics Office (2006) (CSO) and energy consumption data provided by Sustainable Energy Ireland, both ODEX and energy intensity at constant structure (Divisia) have been calculated for the years from 1995 onwards and are presented in Figure 1.

It can be seen that the two approaches yield very different results. ODEX shows a 20.9% improvement in energy performance over 10 years, while Divisia gives a figure of 11.3% improvement over the same period. The ODEX represents energy performance of thirteen NACE-coded sub-sectors that make up Irish industry. The Divisia index, on the other hand, represents just twelve of these sub-sectors. This is because GVA data for sub-sector *NACE 13-14 Non-energy Mining,* used for calculating the Divisia index, is not published. While this could distort the Divisia result somewhat, it does little to account for the large difference, as the sub-sector is responsible for just 5% of total final consumption of the sector.

The two methods use different sets of data. While the energy data is common to both, the ODEX uses production output data, whereas GVA figures are used for the Divisia calculation. In some economies, production output figures for many of the defined energy-intensive branches can be relatively easily be quantified, in terms of tonnes of steel or cement produced for instance, and used directly in the ODEX calculation. In the Irish case however, these energy-intensive branches either don't exist or production figures are not available for them. Consequently the Irish approach to calculating industry ODEX is to use production output data compiled by the CSO and aggregated at a two-digit NACE level. The Irish production output data is derived from a national Census of Industrial Production. As the each of the thirteen sub-sectors includes a range of different products, it is necessary to apply a weighting to each product based on its value added, in order to derive an aggregate unitless production output figure for the sub-sector. As the relative values of these products change over time, the sub-sector's production output figure is adjusted every few years using GVA data, to account for these changes. The effect of this correction is that the trend for the unitless production output for a particular sub-sector is very similar to the trend for GVA in Euro for that sub-sector. Therefore, the differing results cannot be attributed to differences between GVA and production output data alone. Much of the difference between the two results must therefore be due to differences in the calculation methodologies.

O'Leary et al (2007) use the Irish industry ODEX value to calculate total energy savings brought about by improved energy efficiency in the sector, according to the formula:

$$Savings = EC * \left(\frac{100}{ODEX} - 1 \right) \quad \textit{(Equation 4)}$$

where:

EC represents the sector's energy consumption for any particular year after the base year;
ODEX is the calculated index value for that year.

Obviously, if the ODEX value in *Equation 4* is replaced with the Divisia value for Irish industry, the calculated savings will be considerably lower. In order to determine which result best reflects the energy efficiency achievements of Irish industry, both will be subjected to a series of tests appropriate to the Irish data set.

Tests to determine the most appropriate indicator for Irish industry

Three tests have been devised to compare the behaviour of the two indices. The tests are used to help determine which of the two indices shown in the previous section provides the most accurate view of energy consumption trends in Irish industry, and to examine the appropriateness of using either index value to calculate real energy savings. The tests have been developed specifically to try to research issues observed when examining Irish industry data in detail.

TEST 1: INDEX BEHAVIOUR WITH FLUCTUATING SUB-SECTOR VALUES

Theoretical test

The first test examines the response of each indicator to fluctuating sub-sector data values. In the test scenario, Industry comprises two sub-sectors, A and B. Each sub-sector has an equal share of the sector's energy consumption. To test the index of energy intensity at constant structure, the GVA value for each subsector is set to fluctuate by 10% in a two-year cycle, with each returning to its base-year value every two years. In this scenario, the two GVA values fluctuate in opposite directions, i.e. the GVA of sub-sector A increases by 10% and GVA of sub-sector B decreases by 10% in year 1. The result in Figure 2 shows the energy intensity of the two-sub-sectors and the Divisia index for the whole sector. The calculated index returns to its base year value every two years. This is the expected behaviour as there has been no net change in energy intensity.

To apply the same test to the ODEX, the production output of each of the two sub-sectors is set to fluctuate by 10% in a similar manner. Every two years, the production output, and consequently the unit consumption for each sub-subsector, returns to its base year value. Figure 3 shows the unit consumption index for each sub-sector and the ODEX for the whole sector. The calculated ODEX shows a drop from 100 to 94.1 over the 12-year period analysed, indicating a 5.9% improvement in energy efficiency during that time. However, it is clear from the unit consumption values and the unchanging energy consumption that no energy efficiency improvement has been achieved over that time.

Relevance of test to Irish industry

To determine if this theoretical test has any relevance to a real data set, the pattern of fluctuating unit consumption values shown here needs to be compared to actual data. *Figure 4* shows the trend for unit consumption indices for the thirteen sub-sectors of Irish industry used to calculate ODEX. The energy intensity trends for the sub-sectors are very similar to these unit consumption trends. Most sub-sectors in Irish industry exhibit some degree of fluctuation. For some sub-sectors at least, the amplitudes of the fluctuations are considerable. The extent to which the these fluctuations will influence the value of the ODEX will depend on the size of the fluctuations and on how the sub-sector values change relative to each other from year to year.

Quantifying the magnitude of the fluctuating effect

A method is proposed here that helps quantify the magnitude of the change in ODEX values that is attributable to the fluctuations in unit consumption indices alone. The method involves removing fluctuations from all unit consumption indices. This is done by performing a linear interpolation between the unit consumption value for year n and the base year value. The method assumes that energy was consumed by the sub-sectors in all previous years such that the unit consumption indices up to the year *Baseyear+n* followed a straight line path. The unit consumption values for all sub-sectors *s* for all years between *Baseyear* and *Baseyear+n* are then given by the following equation:

$$I_{sx} = 100 + \left(\frac{x}{n} \right) * \left(I_{sBaseyear} - I_{sBaseyear+n} \right) \quad \textit{for } 0<x<n \qquad \textit{(Equation 5)}$$

This method requires that each year ODEX be recalculated for all preceding years. Furthermore, the energy consumption values, *EC*, all sub-sectors *s* for all preceding years is similarly calculated to remove fluctuations as follows:

$$EC_{sx} = 100 + \left(\frac{x}{n} \right) * \left(EC_{sBaseyear} - EC_{sBaseyear+n} \right) \quad \textit{for } 0<x<n \qquad \textit{(Equation 6)}$$

The production output figures can be recalculated also to ensure consistency, by multiplying the unit consumption value by the energy consumption value. However, this calculation will not affect the ODEX result. When this straight-line method is used to calculate ODEX in our hypothetical example with two sub-sectors, in contrast to the conventional method, the index value is always equal to the base year value when both unit consumption indices are at their base year values. Thereby, the drift due to fluctuating unit consumption values, shown in *Figure 3* has been removed.

To quantify the effect of the fluctuations on the index values for Irish industry, both indices are recalculated using the straight line method explained above. The value for each year is recorded. For energy intensity at constant structure, the straight line interpolation is used to remove fluctuations from the sub-sector energy intensity values, and these in turn are used to calculate energy consumption values for years between *Baseyear* and *Baseyear +n*. For ODEX, straight line interpola-

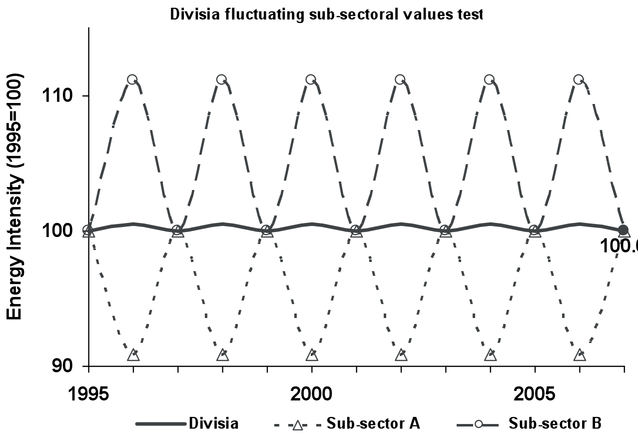

Figure 2 Test 1 Fluctuating Sub-sector Values Test – Divisia

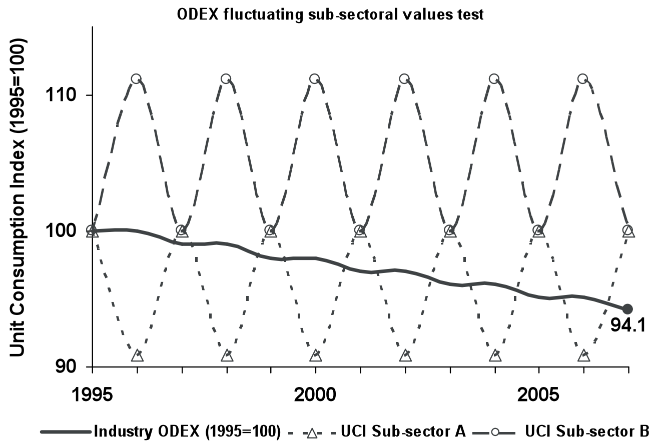

Figure 3 Test 1 Fluctuating Sub-sector Values Test – ODEX

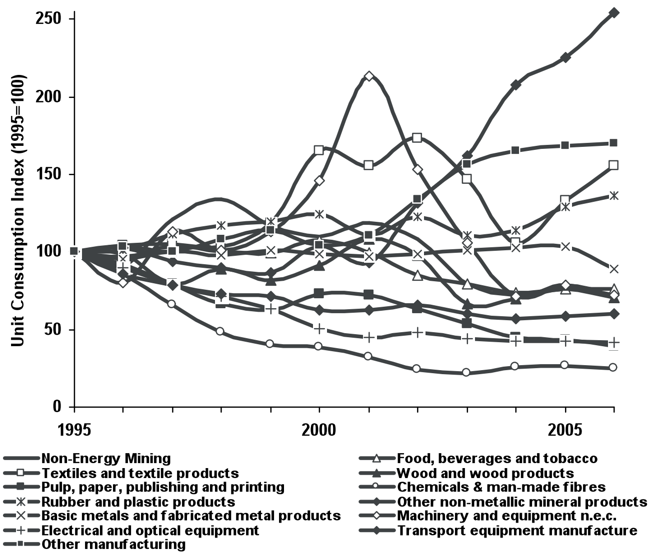

Figure 4 Unit Consumption Indices for 13 sub-sectors used to calculate ODEX

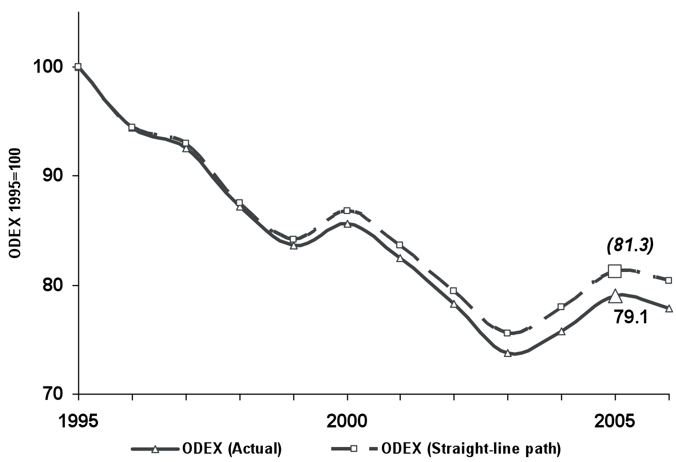

Figure 5 Irish industry ODEX: Actual versus straight line path

tions remove fluctuations from unit consumption indices, and the energy consumption figures for the years between for years between *Baseyear* and *Baseyear +n* are derived.

The recalculated index of energy intensity exactly matches the original index, indicating that fluctuations in recorded values at sub-sector level have no effect on the result. The recalculated ODEX, on the other hand, diverges from the original index with time, see *Figure 5*. The original index records a value of 79.1 in 2005, while the value obtained using the straight-line method is 81.3. It indicates that 2.2 percentage points of the energy efficiency improvement recorded by the Irish Industry ODEX indicator (or 10.5% of the total improvement) can be attributed to the effect of fluctuating unit consumption indices and energy consumption shares.

This test shows that the ODEX value yielded for any data set is path-dependent while the energy intensity value yielded by the Divisia approach is not. ODEX therefore reflects not only the energy efficiency achievement of a sector, but also the route that was followed. The same level of energy efficiency improvement achieved by following a different route will yield a different ODEX value.

TEST 2: TIME REVERSAL TEST FROM INDEX NUMBER THEORY

Formal tests for index numbers are well documented in academic papers that examine the performance of indices. Diewert (1993) lists the most common tests in index number theory. Some tests will be passed by both ODEX and energy intensity at constant structure, while other tests are less applicable to the ODEX methodology. The time reversal test shall be used here to examine the behaviour of each indicator. This test states that if the time sequence between first and last years being analysed is reversed, the new index should be the reciprocal of the original. Again, the data set for Irish industry is used to perform the test. For each index, the most recent index value is taken as the base year value, and the index is calculated for each year in reverse chronological order. To pass the test each index must return to its original value of 100 in 1995. Taking 88.7, the 2005 value, as the base year value for the index of energy intensity, and working backwards, it can be seen in *Figure 6* that the Divisia index closely adheres to its original path and yields a value of 100 in 1995.

For ODEX, the base year value is taken as 77.8, the 2006 value. When the index value for preceding years is calculated, the

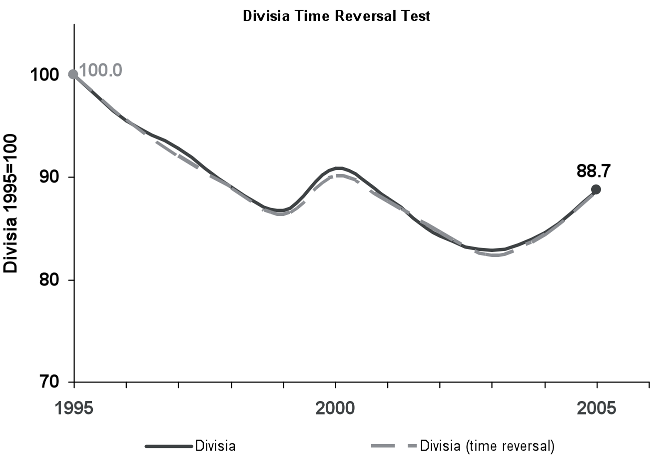

Figure 6 Time Reversal Test – Divisia

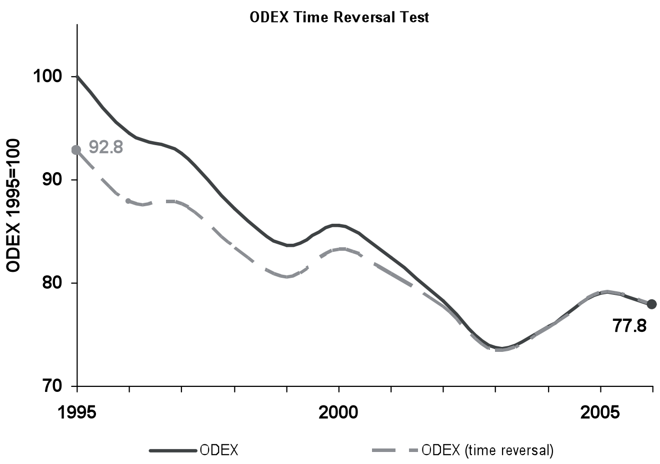

Figure 7 Time Reversal Test – ODEX

path diverges from the original until a value of 92.7 is reached in 1995, see *Figure 7*. This is considerably lower than the expected value.

It has already been shown that the ODEX value is path-dependent in Test 1. As the forward and reverse paths are different, the path-dependency issue provides at least one explanation for why ODEX does not pass the time reversal test.

TEST 3: EFFECTIVENESS OF INDEX IN CAPTURING EARLY ENERGY EFFICIENCY IMPROVEMENTS

The ESD states that "*energy savings … that result from energy efficiency improvement measures initiated in a previous year not earlier than 1995 and that have a lasting effect may be taken into account in the calculation of the annual energy savings*" and that "*in certain cases… measures initiated before 1995 but not earlier than 1991 may be taken into account*". Therefore, both top-down and bottom-up methods applied by the EU member state must be capable of adequately representing these early savings.

Using Irish industry data, this test examines the effects of energy efficiency/ intensity changes at a sub-sector level on the index values in subsequent years. For each year analysed, each sub-sector's contribution to that year's change in index value is quantified and the lasting effect of that contribution in subsequent years is measured.

To calculate the effect of one sub-sector's contribution in one year to the Divisia index for all subsequent years, its contribution for that year is set to zero, the index is recalculated, and is compared to the recorded index. This is done by holding the energy intensity value for the sub-sector for the year under examination equal to the previous year's value, and recalculating the energy consumption using the recorded GVA value. For subsequent years, the sub-sector data is adjusted such that the annual fractional changes in energy intensity remain the same as they were, and annual energy consumption figures are recalculated accordingly. In other words the fractional change in intensity for that year is removed from the overall calculation.

In a similar manner, the effect of one sub-sector's contribution in one year to the ODEX for all subsequent years can be calculated by adjusting the unit consumption index such that there is no change in that year, and the fractional changes in subsequent years correspond to the recorded fractional changes. Again, energy consumption is recalculated for all years for which unit consumption is adjusted.

Using the Irish data set, each sub-sector's contribution to the index values has been examined for each year. In this section, the result of the test for one sub-sector, *NACE 24 Manufacture of Chemicals and Pharmaceuticals*, for one year, 1996, is presented. The sub-sector is the one with the highest level of growth in recent years, showing an increase in production output by a factor of five in the period analysed. The sub-sector contributed 1.8 points of the total 4.5% improvement in the Divisia index in 1996. By 2005, this 1996 contribution amounted to a 0.7 percentage point improvement in the overall index, see *Figure 8*.

ODEX shows that the sub-sector NACE 24 contributed 1.8 points of the total 5.5% improvement, or drop, in the index in 1996, see *Figure 9*. However, by 2002, the 1996 contribution had turned into a 0.2 point *increase* in the ODEX. In other words, if the sub-sector had achieved no improvement in energy efficiency in 1996, the Irish Industry ODEX value would be more favourable (i.e. lower) even though energy consumption would be higher and production output would be unchanged. The energy efficiency improvement achieved by the sub-sector in 1996 had a negative impact on the calculated ODEX for all years from 2002 onwards.

Discussion

It has been shown that ODEX is influenced by fluctuations in unit consumption indices, whereas the Divisia or LMDI index is not affected by similar sub-sector data changes. Given the level of fluctuations in the Irish data, it has been necessary to attempt to measure the extent of the distortion for the Irish industry data set. It has been calculated in this paper that the fluctuations alone are bringing about an average drop in ODEX of 0.22 percentage points per annum.

ODEX fails the time reversal test from index number theory, while the index of energy intensity at constant structure, calculated according to the LMDI method, passes. This test highlights the path-dependency of ODEX. The final ODEX result given will depend on the productivity and energy consumption paths followed by the sub-sectors between the base year and the

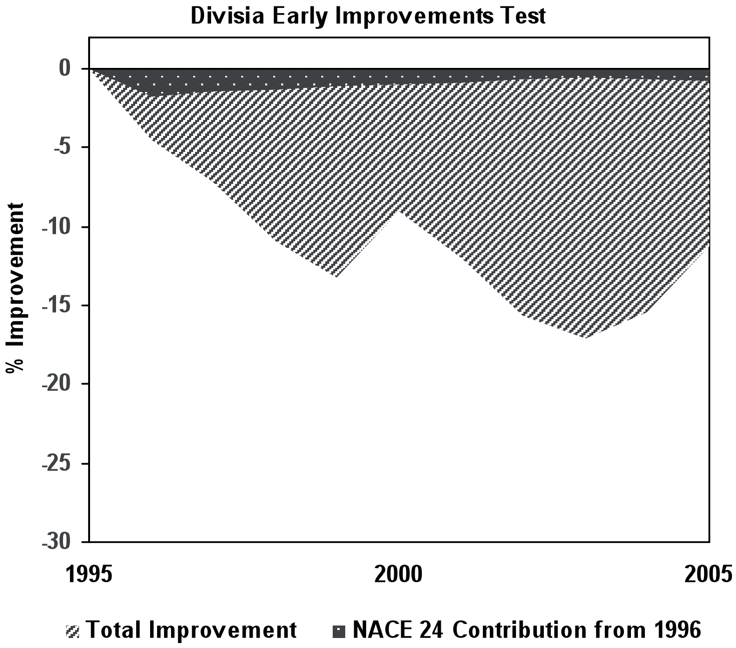

Figure 8 Early Improvements Test – Divisia

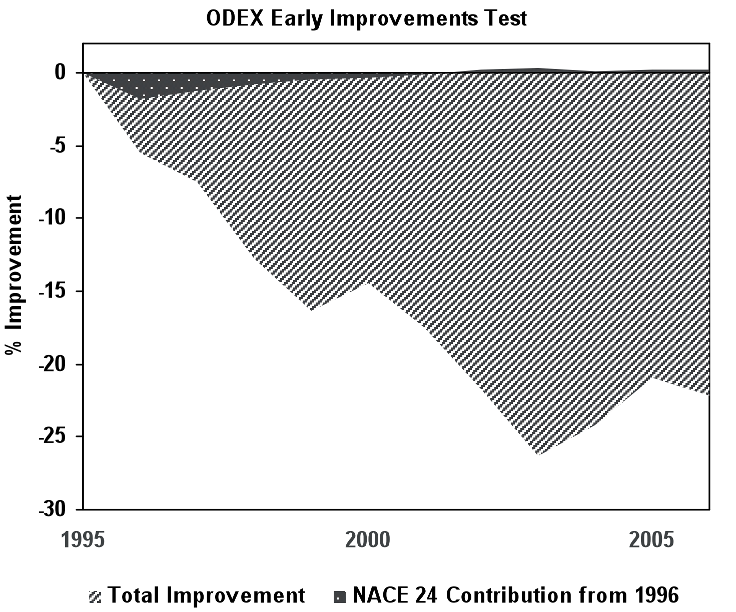

Figure 9 Early Improvements Test – ODEX

final year. The ODEX result will change if the unit consumption values for any previous years are adjusted.

The two indices behave very differently when measuring the effects of early energy efficiency improvements, with ODEX showing a positive sub-sector contribution reverting to a negative impact over time, in the case study shown. An improvement in energy efficiency in any year should not cause deterioration in an energy efficiency index in any subsequent year. The ability of the index to accurately measure longer-term energy efficiency improvements in Irish industry is questionable. Given that the ESD, for example, relates to a period of potentially 26 years (1991-2016), this effect undermines the ability of the indicator to reflect improvements brought about by policies implemented earlier in the period, as allowed for by the directive.

ODEX attempts to provide a better indication of true energy efficiency achievements by using physical output as a driving variable, rather than value-added. In the Irish case, this potential advantage is lost due to the relatively small amount of energy-intensive commodities produced and due to the aggregation of data available at a sub-sector level. In the Irish data set, GVA figures and production output figures for the sub-sectors used are very similar.

The ease with which ODEX can be calculated gives the indicator a considerable advantage over other methods. Also, unlike the LMDI index, ODEX is a universal indicator that can be applied to all sectors of the economy and to the economy as a whole. Therefore it is worth considering adapting the ODEX calculation methodology such that the issues highlighted in this paper are addressed.

An ODEX indicator can be calculated for each sector of an economy where the trends in different end-uses are weighted on the basis of their share of total consumption for the sector. Furthermore, the ODEX methodology allows all sector-level ODEX indicators to be aggregated into one economy-wide ODEX, where again each sector's contribution is based on its share of total final consumption. If it is acknowledged that an ODEX result contains an error factor, then consideration must be given to the additive effect of combining several sector-level errors into the economy-wide ODEX, as well as to the additional error associated with the calculation of the economy-wide ODEX itself.

Conclusion

Clearly, the Divisia approach performs better than ODEX when subjected to the documented tests. Given that the tests were applied to Irish industry data, it can be concluded that Divisia provides a more robust and reliable indication of the historical energy efficiency achievements of Irish industry. Given the large difference between the results for the two, shown in Figure 1, the use of an ODEX value in combination with *Equation 4* to calculate annual energy savings is not reliable.

The ESD requires that member states use a combination of top-down and bottom-up calculation methods in a harmonised model, to measure progress towards defined energy efficiency targets. Each member state should identify the top-down method that provides the most reliable and most accurate measurement of the true energy efficiency improvements in its economy. If a member state wishes to apply the ODEX top-down method, then the accuracy of the method should be determined using the historical data set for that member state. Tests such as those documented here could be applied. However, it is worth noting that if the index is proven to be accurate for a particular set of historical data, this does not guarantee that the calculation will remain accurate for all potential future energy data patterns.

The tests have been performed on an Irish data set only. Further work on the topic shall include an analysis of the industry data for other EU member countries to ascertain if the effects documented in this paper can be observed.

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Glossary

CSO Central Statistics Office

ESD Energy End-use Efficiency and Energy Services Directive 2006/32/EC

EU European Union

GVA Gross value added

LMDI Log Mean Divisia Index

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