Statistisk sentralbyrå
Statistics Norway

Decomposing real GDI growth in the Norwegian market economy

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TALL SOM FORTELLER
NOTATER / DOCUMENTS
2020/ 40

In the series Documents, documentation, method descriptions, model descriptions and standards are published.

Published 11 October 2020

ISBN 978-82-587-1219-7 (electronic)
ISSN 2535-7271 (elektronisk)

Symbols in tables	**Symbol**
Category not applicable	.
Data not available	..
Data not yet available	…
Not for publication	:
Nil	-
Less than 0.5 of unit employed	0
Less than 0.05 of unit employed	0.0
Provisional or preliminary figure	*
Break in the homogeneity of a vertical series	—
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Preface

The methodology as currently applied at Statistics Norway for decomposing the total trading gains in the Norwegian economy into those due to petroleum products and those to all other products has a conceptual flaw. Therefore, an alternative methodology is proposed in this paper for decomposing the real gross domestic income (GDI) growth in the Norwegian market economy into the growth of the multifactor productivity (MFP), the capital and labor inputs, and the trading gains.

The estimated MFP growth from this methodology can be compared with that from the current productivity accounts at Statistics Norway, and thus, serving as a quality control for data and methodologies applied. The trading gains as defined in this paper can be further decomposed into the terms of trade effect and the real exchange rate effect, and more importantly, by individual traded products, such as petroleum products.

The author wishes to thank Pål Sletten, Thomas Von Brasch, and Nini Barth for valuable comments.

Statistisk sentralbyrå, 28 October 2020

Lasse Sandberg

Abstract

A decomposition of the contributions to growth in real national disposable income (NDI) has been published in Statistics Norway's annual survey of the Norwegian economy. The methodology for decomposing the trading gains into those due to petroleum products and those to non-petroleum products when decomposing the real NDI growth is however, conceptually not correct. An alternative methodology is therefore proposed in this paper for decomposing the real gross domestic income (GDI) growth in the Norwegian market economy into the growth of the multifactor productivity (MFP), the capital and labor inputs, and the trading gains.

The estimated MFP from this methodology can be compared with that from the current productivity accounts at Statistics Norway, and thus, serving as a quality control for data and methodologies applied. The trading gains as defined in this paper can be further decomposed into the terms of trade effect and the real exchange rate effect, and more importantly, by individual traded product.

The estimated results show that the real GDI in 2018 in the Norwegian market economy was more than 4.6 times of that in 1972, and of the total increase in the real GDI over the period, about 47% was due to the capital input, 27% to the MFP, 17% to the trading gains, and only 7% to the labor input.

Over the sample period 1972-2018, the trading gains from 'Goods' contributed 0.39 per cent per year, while those from 'Services' contributed -0.19 per cent per year to the annual growth of the total trading gains in the Norwegian market economy (0.19 per cent per year). Despite the terms of trade effect outweighing the real exchange rate effect for both 'Goods' and 'Services', the opposite was true for 'Crude oil and natural gas', which, as one of the three main categories of 'Goods', contributed mostly to the trading gains from 'Goods'.

In fact, it was the change of international price of raw oil and natural gas relative to the price of domestic outputs (0.26 per cent per year), together with the large surplus from the oil and gas trade account (accounting for 18% in average of the nominal GDI), i.e. the real exchange rate effect, rather than the relative price of export and import of raw oil and natural gas (0.04 per cent per year), i.e. the terms of trade effect, that contributed mostly to the growth of the trading gains from 'Crude oil and natural gas' (0.30 per cent per year) in the Norwegian market economy over the period 1972-2018.

Given the sound theoretical reasoning behind the proposed methodology, as well as the comprehensive results that can be derived from it, the proposed methodology should be considered as a good candidate for better measuring Norwegian economic performance, including the decomposition of the total trading gains into those due to petroleum products and those to others.

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1. Introduction

Decomposing the real national disposable income (NDI) for Norway into various components including trading gains has been undertaken for many years, with some of the estimated results being published regularly at the online data bank (StatBank) at Statistics Norway.[1] In addition, a more detailed decomposition has been discussed and published in the series of annual *Economic Survey* for the years 2015-2018 (e.g. Statistics Norway, 2019).

The decomposition methodology presented in the *Economic Survey* applied is well documented in Barth and Brasch (2016a, 2016b), in which a trading gains index (TGI) for the total economy, representing the terms of trade effects, is decomposed into contributions from petroleum and non-petroleum products. To this end, the TGI is defined as a weighted sum of the trading gains due to petroleum products and those due to all non-petroleum products. The weights applied are defined as value shares of the net national product of the two products in the Norwegian economy.

However, because the net national product, or value added if focusing on its fundamental constituents, can be allocated across production units such as establishments, firms, industries, and sectors, rather than across the products that are produced by these production units, the current methodology for decomposing the trading gains by products is, therefore, not conceptually right.

As well known, petroleum products are one of the most important exported goods and thus valuable income sources for the Norwegian economy (see Liu, 2016). For instance, in terms of the share in total export, raw oil and natural gas accounted for about 35% around the late 1990s, the share reached to more than 45% in the new century until 2015, and then kept roughly 35% up to date. Therefore, a good measurement about how, and to what extent, petroleum products have been contributing to the trading gains, and subsequently, to the real income growth in Norway is naturally of significant interest for many.

In this paper, an alternative methodology for decomposing the real gross domestic income (GDI) for the Norwegian market economy is proposed. The methodology follows Diewert and Yu (2012) and Kohli (2004) among others. One of the distinctive advantages by applying this methodology is that the effect on the real GDI growth due to the trading gains can be easily identified and attributed accordingly to the contributions by individual exported/imported products, such as petroleum products.

Furthermore, the trading gains as defined in the proposed methodology can capture the real GDI change resulting from two separate effects: the terms of trade effect and the real exchange rate effect between two periods of time. The terms of trade effect reflects the contribution of changes in the export-to-import price ratio to the real GDI growth, and the real exchange rate effect captures the contribution resulting from trade imbalance, as well as from deviation of the price of tradables from that of non-tradables.[2]

[1] See Table 12504: Contribution to growth in real disposable income for Norway (per cent) 1971 – 2019 at https://www.ssb.no/en/statbank/table/12504.

[2] Tradables can be regarded as intermediates because exported (imported) products flow through the foreign (domestic) production sector where they are subject to a number of transformations, such as transportation, insurance, repackaging, wholesaling, and retailing etc., while non-tradables can be viewed as all goods and services intended for domestic use/absorption (Burgess, 1974; Kohli, 1978, 1991, 2006; Woodland, 1982).

The proposed methodology is derived based on the standard production theory that is motivated by profit maximizing behavior in a competitive market, thus only the market sector rather than the entirety of the Norwegian economy is the focus in the analysis. Further, different from Barth and Brasch (2016a, 2016b), the real GDI instead of the national disposable income (NDI) is the departure point for decomposition in this paper, implying that only the position of the Norwegian trade account is relevant for our purpose.

However, starting from the GDI to generate the national disposable income (NDI) is quite straightforward within the System of National Accounts, because the latter, a 'National' measure, is equal to the former, a 'Domestic' measure, plus primary incomes and current transfers receivable by resident units from the rest of the world, less those payable to non-resident units in the rest of the world (United Nations, 2009; Eurostat, 2013).

In addition to generating the trading gains effect to the real GDI growth, another advantage by using the proposed methodology is that the growth of multifactor productivity (MFP)[3] can be simultaneously derived in an internally consistent way. Therefore, the estimated MFP growth, based on aggregate data and thus by following a top-down approach in this paper, can be compared with that from the current productivity database at Statistics Norway that is generated by using more disaggregate industry-level data and accordingly following a bottom-up approach.

Such a comparison can serve as one meaningful quality control for checking both the data and methodologies employed by the two approaches. In addition, some researchers pointed out that the discrepancies of the results between the use of top-down approach as shown in this paper and that of the bottom-up approach as currently applied by many national statistical institutes including Statistics Norway may be interpreted as an reallocation effect due either to inefficiencies in production and/or a measurement issue (Schreyer, 2012).

Therefore, the purpose of the paper is twofold. First, it will apply the proposed methodology for decomposing the real GDI growth in the Norwegian market economy into different contributing components over the sample period 1972-2018. In particular, the contributions of the trading gains, and the factored two effects (i.e. terms of trade and real exchange rate effects), to the real GDI growth will be derived, as well as a further decomposition of trading gains by individual products.

Second, the estimated MFP growth by following the top-down approach within the proposed methodology will be compared with that from the current productivity database at Statistics Norway estimated by the bottom-up approach, with the purpose of identifying probable data and/or methodological deficiencies that may be associated with the two approaches, and more optimistically, any potential feasibility for integrating the two approaches in the future.

The rest of the paper is structured as follows. Section 2 presents the decomposition methodology that is applied in this paper for decomposing the real GDI growth into various components. Section 3 discusses the data that are used as inputs for the decomposition. In Section 4, a variety of the empirically estimated results are presented and discussed. Section 5 concludes.

[3] The term of total factor productivity (TFP) is currently used at Statistics Norway. However, it refers *de facto* to the multifactor productivity (MFP).

2. Decomposition method

The decomposition method applied in this paper follows Diewert and Yu (2012) and Kohli (2004). This is an economic approach to price indexes, relying on the conventional assumption of *competitive optimizing behavior* on the part of economic agents (consumers or producers) in the market sector of an economy.

2.1. Production theory framework

First, a number of notations need to be defined. In period *t*, let $\boldsymbol{y}^t$ be the output vector of product y_i^t, $\boldsymbol{p}^t$ be the corresponding vector of output price p_i^t, *i = 1,2, …, I*, with the latter being the ratio of *I* output prices to a measure of the aggregate price level, such as the consumption price or the price of domestic outputs. Note that if the i^{th} product is an import (or other produced input) into the market sector of the economy, then the corresponding product y_i^t is indexed with a negative sign.

Similarly, let $\boldsymbol{x}^t$ be the input vector of primary input x_j^t, $\boldsymbol{w}^t$ be the corresponding vector of input price w_j^t, *j = 1,2, …, J*, with the latter being the ratio of *J* input prices to the same chosen aggregate price level.

Denote the period *t* production possibilities set by S^t, which is a feasible set of output vectors $\boldsymbol{y}$ that can be produced if the vector of inputs $\boldsymbol{x}$ is utilized by the market sector. Further assume that the technology represented by S^t is subject to constant returns to scale.

Now define the period *t* market sector real income function, $g^t(\boldsymbol{p},\boldsymbol{x})$, as follows.

(1) $$g^t(\boldsymbol{p},\boldsymbol{x}) \equiv \max_{\boldsymbol{y}}\{\boldsymbol{p}\cdot\boldsymbol{y}: (\boldsymbol{y},\boldsymbol{x}) \in S^t\}.$$

As shown, $g^t(\boldsymbol{p},\boldsymbol{x})$ depends on *t*, representing the technology set S^t, on the vector of output prices $\boldsymbol{p}$ that the market sector faces and on $\boldsymbol{x}$, the vector of inputs that is available to the market sector.

The real income function $g^t(\boldsymbol{p},\boldsymbol{x})$ is proved to be linearly homogeneous and convex in the components of $\boldsymbol{p}$ and linearly homogeneous and concave in the components of $\boldsymbol{x}$ (see Diewert, 1974). In addition, the period *t* market sector supply vector $\boldsymbol{y}^t$ can be obtained by differentiating the period *t* market sector real income function with respect to the components of the period *t* output price vector $\boldsymbol{p}^t$ (Hotelling, 1932):

(2) $$\boldsymbol{y}^t = \nabla_{\boldsymbol{p}} g^t(\boldsymbol{p}^t,\boldsymbol{x}^t).$$

The period *t* market sector input prices $\boldsymbol{w}^t$ paid to primary inputs can be obtained by differentiating the period *t* market sector real income function with respect to the components of the period *t* input quantity vector $\boldsymbol{x}^t$ (Samuelson, 1953; Diewert, 1974):

(3) $$\boldsymbol{w}^t = \nabla_{\boldsymbol{x}} g^t(\boldsymbol{p}^t,\boldsymbol{x}^t).$$

The constant returns to scale assumption on the technology set S^t implies the following relationship:

(4) $$g^t(\boldsymbol{p},\boldsymbol{x}) = \boldsymbol{p}^t\cdot\boldsymbol{y}^t = \boldsymbol{w}^t\cdot\boldsymbol{x}^t.$$

2.2. Decomposition of real income growth

As shown in Diewert and Yu (2012), the growth of real income $g^t(\boldsymbol{p}, \boldsymbol{x})$ can be decomposed into the contributions from three components: the MFP growth, the change of real output prices, and the growth of inputs.

MFP growth

The MFP growth component measures the change in the real income due to the shift in technology between two periods (*t* and *t*-1), while keeping both the real output prices $\boldsymbol{p}$ and input quantities $\boldsymbol{x}$ constant at a reference level *r*:

$$\gamma(\boldsymbol{p}^r, \boldsymbol{x}^r, t) \equiv g^t(\boldsymbol{p}^r, \boldsymbol{x}^r)/g^{t-1}(\boldsymbol{p}^r, \boldsymbol{x}^r). \tag{5}$$

Since inputs remain constant, such a change in output is often interpreted as a change in technology. However, it may also reflect other factors, for instance, imperfect competition.[4]

Because each choice of the reference $\boldsymbol{p}^r$ and $\boldsymbol{x}^r$ will generate a possibly different measure, it is natural to choose special reference vectors for the measure of technical progress defined by (5), such as the frequently applied *Laspeyres* and *Paasche* measures.

A *Laspeyres* type measure γ_L^t that chooses the period *t*-1 reference vectors $\boldsymbol{p}^{t-1}$ and $\boldsymbol{x}^{t-1}$ and a *Paasche* type measure γ_P^t that chooses the period *t* reference vectors $\boldsymbol{p}^t$ and $\boldsymbol{x}^t$ can be defined as follows:

$$\gamma_L^t \equiv \gamma(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1}, t) = g^t(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1})/g^{t-1}(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1}), \tag{6}$$

$$\gamma_P^t \equiv \gamma(\boldsymbol{p}^t, \boldsymbol{x}^t, t) = g^t(\boldsymbol{p}^t, \boldsymbol{x}^t)/g^{t-1}(\boldsymbol{p}^t, \boldsymbol{x}^t). \tag{7}$$

Since both the measures of technical progress γ_L^t and γ_P^t are equally valid, it is also natural to take the best simple average, i.e. the geometric mean of them to obtain an overall measure of technical change, because the geometric mean treats the two measures in a symmetric manner and the time reversal property according to index number theory is satisfied.[5] Thus the MFP growth component is formally defined as:

$$\gamma^t \equiv [\gamma_L^t \cdot \gamma_P^t]^{1/2}. \tag{8}$$

Change of real output prices

The change of real output prices component measures the change in the real income due to the change in real output prices between two periods (*t* and *t*-1), while keeping constant both the technology and input quantities $\boldsymbol{x}$ at a reference level *r*:

$$\alpha(\boldsymbol{p}^{t-1}, \boldsymbol{p}^t, \boldsymbol{x}^r, r) = g^r(\boldsymbol{p}^t, \boldsymbol{x}^r)/g^r(\boldsymbol{p}^{t-1}, \boldsymbol{x}^r). \tag{9}$$

By the same logic, the reference period *r* could be chosen as either time period *t* or *t*-1, then a *Laspeyres* type measure α_L^t that chooses the period *t*-1 technology and reference vector $\boldsymbol{x}^{t-1}$, and a *Paasche* type measure α_P^t that chooses the period *t* technology and reference vector $\boldsymbol{x}^t$ can be defined as:

$$\alpha_L^t \equiv \alpha(\boldsymbol{p}^{t-1}, \boldsymbol{p}^t, \boldsymbol{x}^{t-1}, t-1) = g^{t-1}(\boldsymbol{p}^t, \boldsymbol{x}^{t-1})/g^{t-1}(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1}), \tag{10}$$

[4] See Basu and Fernald (2002) for gaps between measured productivity and technology.

[5] The time reversal property from index number theory means that the index estimate going backwards is equal to the reciprocal of the estimate going forwards.

(11) $\alpha_P^t \equiv \alpha(\boldsymbol{p}^{t-1}, \boldsymbol{p}^t, \boldsymbol{x}^t, t) = g^t(\boldsymbol{p}^t, \boldsymbol{x}^t)/g^t(\boldsymbol{p}^{t-1}, \boldsymbol{x}^t)$.

Taking the geometric mean of (10) and (11) yields the measure of the effect on the real income growth of the change in real output prices:

(12) $\alpha^t \equiv [\alpha_L^t \cdot \alpha_P^t]^{1/2}$.

Growth of inputs

Finally, the growth of inputs component measures the change in the real income due to the change in input quantities $\boldsymbol{x}$ between two periods (*t* and *t*-1), while keeping constant the technology and real output prices $\boldsymbol{p}$ at a reference level *r*:

(13) $\beta(\boldsymbol{p}^r, \boldsymbol{x}^{t-1}, \boldsymbol{x}^t, r) = g^r(\boldsymbol{p}^r, \boldsymbol{x}^t)/g^r(\boldsymbol{p}^r, \boldsymbol{x}^{t-1})$.

Again, a *Laspeyres* type measure β_L^t that chooses the period *t*-1 technology and reference vector $\boldsymbol{p}^{t-1}$, and a *Paasche* type measure β_P^t that chooses the period *t* technology and reference vector $\boldsymbol{p}^t$ can be defined as:

(14) $\beta_L^t \equiv \beta(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1}, \boldsymbol{x}^t, t-1) = g^{t-1}(\boldsymbol{p}^{t-1}, \boldsymbol{x}^t)/g^{t-1}(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1})$,

(15) $\beta_P^t \equiv \beta(\boldsymbol{p}^t, \boldsymbol{x}^{t-1}, \boldsymbol{x}^t, t) = g^t(\boldsymbol{p}^t, \boldsymbol{x}^t)/g^t(\boldsymbol{p}^t, \boldsymbol{x}^{t-1})$.

Taking the geometric mean of (14) and (15) yields the measure of the effect on the real income growth of the change in input quantities:

(16) $\beta^t \equiv [\beta_L^t \cdot \beta_P^t]^{1/2}$.

With these definitions ready, it can be shown that the growth of the real income can be decomposed as follows (see Diewert and Fox, 2016):

(17) $g^t(\boldsymbol{p}^t, \boldsymbol{x}^t)/g^{t-1}(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1}) \approx \gamma^t \cdot \alpha^t \cdot \beta^t$.

2.3. Decomposition using exact index number approach

Note that the decomposition components of the real income growth as defined in (8), (12), and (16) contain a number of theoretical constructions, which renders special challenges for empirical estimation. For instance, when making estimate of the MFP growth, both $g^t(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1})$ and $g^{t-1}(\boldsymbol{p}^t, \boldsymbol{x}^t)$ as shown in (6) and (7) are theoretical constructions, and therefore, may not be observable.

A commonly applied approach to making empirical estimates of the MFP growth is to assume a functional form for the real income function $g^t(\boldsymbol{p}, \boldsymbol{x})$, then to collect time series data on both prices and volumes of output and input. Error terms are then added to (2) and (3) and econometric techniques are accordingly applied for estimating the unknown parameters in the assumed functional form.

However, different econometricians may make various stochastic specifications and choose different functional forms. Once new data is available, the estimated parameters based on historical time series may have to be updated. Moreover, as the number of outputs and inputs grows, it will soon be impossible to estimate a flexible functional form.

As a result, it is usually not a fashion for national statistical institutes including Statistics Norway to apply this approach for compiling and publishing official statistics on a regular basis, because one of the criteria for choosing methodology by national statistical institutes is to apply as much as possible those methodologies

that are comparatively candid and objective, and can generate estimates that are steady and easily interpretable.

Having this in mind, the index number approach as presented here seems to be more suitable than others. In particular, the exact index number techniques as shown in Diewert and Yu (2012) have demonstrated that, if the real income function $g^t(\boldsymbol{p},\boldsymbol{x})$ has the translog form, (17) will hold exactly, and the measures of the three factored components of the growth in real income as defined in (8), (12) and (16) can take the following forms:[6]

(18) $$\ln \alpha^t = \sum_{i=1}^{I} \frac{1}{2}\left(\frac{p_i^{t-1}y_i^{t-1}}{\boldsymbol{p}^{t-1}\cdot\boldsymbol{y}^{t-1}} + \frac{p_i^t y_i^t}{\boldsymbol{p}^t\cdot\boldsymbol{y}^t}\right)\ln\left(\frac{p_i^t}{p_i^{t-1}}\right).$$

(19) $$\ln \beta^t = \sum_{j=1}^{J} \frac{1}{2}\left(\frac{w_j^{t-1}x_j^{t-1}}{\boldsymbol{w}^{t-1}\cdot\boldsymbol{x}^{t-1}} + \frac{w_j^t x_j^t}{\boldsymbol{w}^t\cdot\boldsymbol{x}^t}\right)\ln\left(\frac{x_j^t}{x_j^{t-1}}\right).$$

Then γ^t can be exactly estimated as a residual:

(20) $$\gamma^t = \frac{g^t(\boldsymbol{p}^t,\boldsymbol{x}^t)/g^{t-1}(\boldsymbol{p}^{t-1},\boldsymbol{x}^{t-1})}{\alpha^t\cdot\beta^t}.$$

Note that α^t as shown in (18) is the Törnqvist index of the real output prices, and β^t is the Törnqvist index of input quantities. By this formulation, the real output price index can in fact be further decomposed as the product of Törnqvist price indexes of individual output components (see additional details on the methodology in Appendix A):

(21) $$\alpha^t = \alpha_1^t \cdot \alpha_2^t \cdots \alpha_I^t,$$

where

(22) $$\ln \alpha_i^t = \frac{1}{2}\left(\frac{p_i^{t-1}y_i^{t-1}}{\boldsymbol{p}^{t-1}\cdot\boldsymbol{y}^{t-1}} + \frac{p_i^t y_i^t}{\boldsymbol{p}^t\cdot\boldsymbol{y}^t}\right)\ln\left(\frac{p_i^t}{p_i^{t-1}}\right),\ i = 1,2,\ \ldots,\ I.$$

Likewise, the contribution from changes in quantities of all inputs has a similar exact decomposition:

(23) $$\beta^t = \beta_1^t \cdot \beta_2^t \cdots \beta_J^t,$$

where

(24) $$\ln \beta_j^t = \frac{1}{2}\left(\frac{w_j^{t-1}x_j^{t-1}}{\boldsymbol{w}^{t-1}\cdot\boldsymbol{x}^{t-1}} + \frac{w_j^t x_j^t}{\boldsymbol{w}^t\cdot\boldsymbol{x}^t}\right)\ln\left(\frac{x_j^t}{x_j^{t-1}}\right),\ j = 1,2,\ \ldots,\ J.$$

In our empirical application of the decomposition method as discussed so far, y_i^t is the output of the Norwegian market economy, where *i = 1,2, …, D, X, M*. Note that *D* is the number of domestic outputs, *X* represents that of export, and *M* represents that of import. p_i^t is the corresponding real price that is the ratio of nominal output prices to a chosen price deflator.

In this paper, the chosen price deflator is the price of domestic outputs, or in other words, the price of domestic expenditure used for these outputs. The domestic outputs in the Norwegian market economy consist of household consumption

[6] More details on the translog function approach are summarized in Appendix A.

(excluding housing services), investment, changes of inventories, and net sales of market producers to nonmarket producers.[7]

The price of domestic outputs, P_D^t, is defined by the following Törnqvist index:

(25) $$\ln \frac{P_D^t}{P_D^{t-1}} = \sum_{i=1}^{D} \frac{1}{2}\left(\frac{p_i^{t-1}y_i^{t-1}}{\sum_{i=1}^{D} p_i^{t-1}y_i^{t-1}} + \frac{p_i^t y_i^t}{\sum_{i=1}^{D} p_i^t y_i^t}\right) \ln\left(\frac{p_i^t}{p_i^{t-1}}\right).$$

Then the growth of the real income $g^t(\boldsymbol{p}, \boldsymbol{x})$ can be decomposed exactly into five components as follows:

(26) $$g^t(\boldsymbol{p}^t, \boldsymbol{x}^t)/g^{t-1}(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1}) = \gamma^t \cdot \alpha_X^t \cdot \alpha_M^t \cdot \beta_L^t \cdot \beta_K^t.$$

In (26), $g^t(\boldsymbol{p}^t, \boldsymbol{x}^t)$ is the real GDI which is the norminal GDI, being equal to the nominal GDP produced by the Norwegian market economy, deflated by the price index as defined by (25), α_X^t (α_M^t) is the growth factor in the real export (import) price.

If $\alpha_X^t > 1$, the export price grows faster than the price of domestic outputs, thus, α_X^t measures the contribution of rising export price to the real GDI growth generated by the Norwegian market economy. If $\alpha_M^t > 1$, it represents the contribution of falling real import price to the real GDI growth. The larger the value of α_M^t, the larger the decline in the real import price (relative to the price of domestic outputs).

Note that import makes a negative contribution to the nominal GDI. The greater the value of import, the lower the nominal GDI. As shown in equation (22), the term in the first parenthesis on the right side of the equation is negative if import is concerned. When the real import price falls, α_M^t rises, leading to growth in the real GDI.

The impact on the real GDI growth due to the change of the export and import prices can be pooled together to define the trading gains α_{XM}^t as follows:

(27) $$\alpha_{XM}^t = \alpha_X^t \cdot \alpha_M^t.$$

Finally, the last two terms on the right side of the equation (26) represent the contributions from the growth of quantities in labor inputs (β_L^t) and in capital services (β_K^t), respectively.

It is worth mentioning that there are alternative measures of the trading gains. Diewert and Yu (2012) use the consumption price to deflate the nominal GDI, Kohli (2004, 2006) measures the trading gains as the ratio between the GDP price deflator and the domestic outputs price, because the latter does not contain the prices of export and import, while the former does. Reinsdorf (2010) decomposes the trading gains into a terms of trade effect and a relative price effect, but in the Fisher index framework.

Equation (26) is the decomposition in the form of the growth factors. It is possible to obtain its counterpart in the level forms for each term. By denoting the period *t* levels of MFP, real export price, real import price, labor input, and capital services as Γ^t, A_X^t, A_M^t, B_L^t, and B_K^t, respectively, and using the growth factors γ^t, α_X^t, α_M^t, β_L^t, and β_K^t, the corresponding levels can be defined as follows:

(28) $$\Gamma^0 \equiv 1, \Gamma^t \equiv \Gamma^{t-1} \cdot \gamma^t, t = 1, 2, \ldots$$

[7] More on data sources in Section 3.

(29) $A_X^0 \equiv 1, A_X^t \equiv A_X^{t-1} \cdot \alpha_X^t$, $t = 1, 2, \ldots$

(30) $A_M^0 \equiv 1, A_M^t \equiv A_M^{t-1} \cdot \alpha_M^t$, $t = 1, 2, \ldots$

(31) $B_L^0 \equiv 1, B_L^t \equiv B_L^{t-1} \cdot \beta_L^t$, $t = 1, 2, \ldots$

(32) $B_K^0 \equiv 1, B_K^t \equiv B_K^{t-1} \cdot \beta_K^t$, $t = 1, 2, \ldots$

Using the above definitions and equation (26), the following exactrelationship can be established for the level of the real GDI in period *t*, G^t, and the period *t* levels for MFP, real export and import prices, and input quantities:

(33) $G^t/G^0 = \Gamma^t \cdot A_X^t \cdot A_M^t \cdot B_L^t \cdot B_K^t$, $t = 1, 2, \ldots$

where G^0 is the level of real GDI in the Norwegian market economy in period 0, the latter being chosen as Year 1972 in this paper.

2.4. Decomposition of trading gains

As shown by Kohli (2004, 2006), the trading gains as defined by (27) can be further decomposed into two separate effects on the real GDI growth: the terms of trade effect and the real exchange rate effect.

Let S_X^t and S_M^t be the two-period (*t* and *t*-1) average value share of export and import in current prices in the nominal GDI, respectively. Note that S_M^t is negative, since import makes a negative contribution to the nominal GDI. Further, let P_X^t and P_M^t be the *nomina*l export and import price, respectively, and define $P_T^t = (P_X^t \cdot P_M^t)^{1/2}$ as the nominal price of tradables. Tradables are relative to non-tradables, of which the price index is defined in (25) as the price of domestic outputs.

Then the trading gains α_{XM}^t as defined in (27) can be reformulated as follows:

(34) $$\alpha_{XM}^t = \left(\frac{P_X^t}{P_D^t} \Big/ \frac{P_X^{t-1}}{P_D^{t-1}}\right)^{S_X^t} \cdot \left(\frac{P_M^t}{P_D^t} \Big/ \frac{P_M^{t-1}}{P_D^{t-1}}\right)^{S_M^t}$$

$$= \left(\frac{P_X^t}{P_M^t} \Big/ \frac{P_X^{t-1}}{P_M^{t-1}}\right)^{\frac{S_X^t - S_M^t}{2}} \cdot \left(\frac{P_T^t}{P_D^t} \Big/ \frac{P_T^{t-1}}{P_D^{t-1}}\right)^{S_X^t + S_M^t}.$$

The first term in the second line is called the terms of trade effect, reflecting the contribution of changes in the export-import price ratio to the real GDI growth. The second term is the real exchange rate effect, capturing the contribution resulting from trade imbalances, as well as from deviation in the price of tradables from that of non-tradables. It is clear that the real exchange rate effect is equal to one if either the trade is balanced (i.e., $S_X^t + S_M^t = 0$) or the price ratio of tradables to non-tradables does not change from one period to the next.

Finally, we can further decompose the trading gains for the total export/import into contributions from disaggregated individual traded products (goods or services). Suppose that the number of exported products and that of imported products are the same, i.e. $X = M$, which is the case in our empirical estimation in this paper, then the overall trading gains α_{XM}^t can be written as:

(35) $\alpha_{XM}^t = \prod_{i \in M} \alpha_{i,XM}^t = \prod_{i \in M} (\alpha_{i,X}^t \cdot \alpha_{i,M}^t)$,

where $\alpha_{i,XM}^t$ is the trading gains of the traded product *i*, and $i \in X(M)$.

Moreover, $\alpha_{i,XM}^t$ can be further decomposed into the terms of trade effect and the real exchange rate effect for the individual traded product *i* as follows:

$$\alpha_{i,XM}^t = \left(\frac{P_{i,X}^t}{P_D^t} \Big/ \frac{P_{i,X}^{t-1}}{P_D^{t-1}}\right)^{S_{i,X}^t} \cdot \left(\frac{P_{i,M}^t}{P_D^t} \Big/ \frac{P_{i,M}^{t-1}}{P_D^{t-1}}\right)^{S_{i,M}^t} \tag{36}$$

$$= \left(\frac{P_{i,X}^t}{P_{i,M}^t} \Big/ \frac{P_{i,X}^{t-1}}{P_{i,M}^{t-1}}\right)^{\frac{S_{i,X}^t - S_{i,M}^t}{2}} \cdot \left(\frac{P_{i,T}^t}{P_D^t} \Big/ \frac{P_{i,T}^{t-1}}{P_D^{t-1}}\right)^{S_{i,X}^t + S_{i,M}^t},$$

where $P_{i,X}^t$ ($P_{i,M}^t$) is the nominal export (import) price of product *i*; $S_{i,X}^t$ ($S_{i,M}^t$) is the two-period (*t* and *t*-1) average value share of the exported (imported) product *i* in current prices in the nominal GDI, and $P_{i,T}^t = \left(P_{i,X}^t \cdot P_{i,M}^t\right)^{1/2}$ is the nominal price of the tradable product *i*. Again, the first term in the second line is the terms of trade effect, and the second term is the real exchange rate effect of the traded product *i*.

3. Data

3.1. Norwegian market economy

The Norwegian market economy is defined in this paper by excluding from the total economy all nonmarket activities, the latter consisting of central and local government activities, such as education, health, defense, and public administration, and the activities of the Non-profit institutions serving households (NPISHs). Typically, for those dealing with nonmarket activities, the fundamental assumption of profit maximizing behavior does not hold true, as a result, including nonmarket activities will distort the estimated results within the methodological framework applied in this paper.

Moreover, independent measures of the output cannot be easily obtained for nonmarket activities because of the absence of market transactions, as a result, the output of nonmarket activities is assumed to be the sum of total inputs, therefore, leading to the estimated MFP growth being trivially zero. For instance, for owner occupied housing, the output is forced to be equal to the input and hence no productivity improvements can be generated for this sector according to the current national accounts conventions (United Nations, 2009).

Therefore, the entire residential housing stock is omitted and the consumption of residential housing services excluded from the household consumption in this paper. Formally, the industries that provide owner-occupied housing services (KNR2368), as well as private renting (KNR2369), are excluded from the Norwegian market economy. However, investment in the residential housing is included, since this investment is part of the output of the market production sector.

Finally, the Norwegian market economy comprises, technically speaking, all the industries with the code of KNR23xx, excluding KNR2368 and KNR2369.[8] For this definition of the market economy, unless stated otherwise, the methodology as applied in this paper uses in general the aggregate data, which are mostly drawn in March 2020 from the annual time series statistics for the period 1970-2018, published at the online databank (StatBank) at Statistics Norway.

[8] KNRxxxx is the industry code applied in the national accounts compilation system at Statistics Norway, see Amdal and Sagelvmo (2017).

3.2. Domestic output

The total output from the Norwegian market economy consists of domestic outputs, export and import.[9] The domestic outputs comprise household consumption (excluding housing services), investment, change of inventories, and net sales of market producers to nonmarket producers.

Data for the household consumption (excluding housing services) are drawn from Table 09172 (Final consumption expenditure of households, by expenditure, contents and year) published at the online StatBank. The investment by the market producers has two sources. Data for the investment are from Table 09181 (Gross fixed capital formation and capital stocks, by industry, contents and year); and data for the change of inventories are from Table 09189 (Final expenditure and gross domestic product, by macroeconomic indicator, contents and year) at the online StatBank.

Following the suggestions in Diewert and Yu (2012), the net sales of market producers to nonmarket producers are calculated as nonmarket producers' final demand minus nonmarket producers' value added. The former is drawn from Table 09181 and Table 09189, while the latter is from Table 09170 (Production account and income generation, by industry, contents and year), also at the online StatBank.

For each component of the domestic outputs, the nominal price is calculated as the value at current prices (NOK million) divided by the volume at constant 2015 prices (NOK million) published in the corresponding tables. Then, the real price of each domestic output is calculated as the nominal price of each domestic output divided by the domestic outputs Törnqvist price index as defined by (25).

For our purpose, the calculated nominal prices of each domestic output and the domestic outputs price are normalized with the price in 1972 being equal to 1. All the generated price indexes are presented in Table B1.1 in Appendix B. The normalized (with 1972 = 1) real prices of each domestic output are presented in Table B1.2 in Appendix B. In addition, annual (geometric) average growth rates (in percentage) for the entire period 1972-2018 and for a number of selected subperiods are calculated and reported in the tables.

3.3. Export and import

Data for export are drawn from Table 07336 (Exports of goods and services by product, contents and year) and those for import are from Table 07337 (Imports of goods and services, by product, contents and year) at the online StatBank. The number and type of the detailed category/group of goods and services covered by the two tables are the same.

Similarly, for each category/group at the lowest disaggregate level, the nominal price of the exported or imported goods/services is calculated as the value at current prices (NOK million) divided by the volume at constant 2015 prices (NOK million) published in the corresponding tables. The corresponding real price is then calculated as the nominal price of each category/group of the exported or imported goods/services divided by the domestic outputs Törnqvist price index as defined by (25).

After normalization (with 1972 = 1), the nominal prices of total export and import are reported in Table B1.1 and the corresponding real prices in Table B1.2 in Appendix B. Similarly, annual (geometric) average growth rates (in percentage) for

[9] Recall that import enters the total output with a negative sign to its quantity.

the entire period 1972-2018 and for a number of selected subperiods are calculated and reported in the tables.

3.4. Labor and capital inputs

Data for labor and capital inputs are drawn from the current productivity database at Statistics Norway, where the labor input at the KNR industry level[10] has not been quality-adjusted. In other words, due to data limitation, the labor input is currently measured as the sum of total hours worked within each KNR industry, regardless of the quality differences between the hours worked by people with high and those with low education or skills (see Liu, 2020).

When aggregating the labor input at KNR industry level up to higher level such as sector level or the whole economy level, the labor input at the KNR industry level (i.e. hours worked in the KNR industry in concern) is weighted by the labor compensation in each KNR industry. In this way, the labor quality is considered to be somehow taken into account in the aggregated labor input at higher aggregate level.

The capital services for each KNR industry are calculated by applying the *ex post* approach for estimating the nominal rate of return in each KNR industry (Timmer *et al*. 2007, 2010). The KNR industry capital services are then aggregated up to higher level by using as the weight the value share of the capital services in each KNR industry to the total capital services summed in the higher aggregate level (see Todsen, 2019).

4. Real GDI, productivity and trading gains

4.1. Real GDI and real GDP

The current price or nominal GDI is the sum of nominal labor compensation and nominal value of capital services, which equals the current price or nominal GDP. However, the real GDP may not necessarily equal to the real GDI. In a strict sense, the real GDP is in *volume* terms, while the real GDI is in *real* terms only, which measures the purchasing power of the total incomes generated by the GDP.

Technically speaking, the real GDI can be generated by deflating the nominal GDI with a price index. If the implicit price of the GDP is used as the deflator, the real GDI and the real GDP are the same. But if other deflators are used, the real GDI and the real GDP can be different. As a consequence, a divergence between the movements of the real GDP and the real GDI may appear. As is the case, the divergence may happen when a country's terms of trade change.

For instance, if a country's terms of trade improve, that is, its export price rises faster (or falls more slowly) than its import price, leading to an increase in the export to import price ratio, then fewer export is needed to pay for a given volume of import. As a result, a given level of domestic production goods and services can be reallocated from export to domestic absorption. Thus, an improvement in the terms of trade makes it possible for an increased volume of goods and services to be purchased by residents out of the incomes generated by a given level of domestic production (United Nations, 2009).

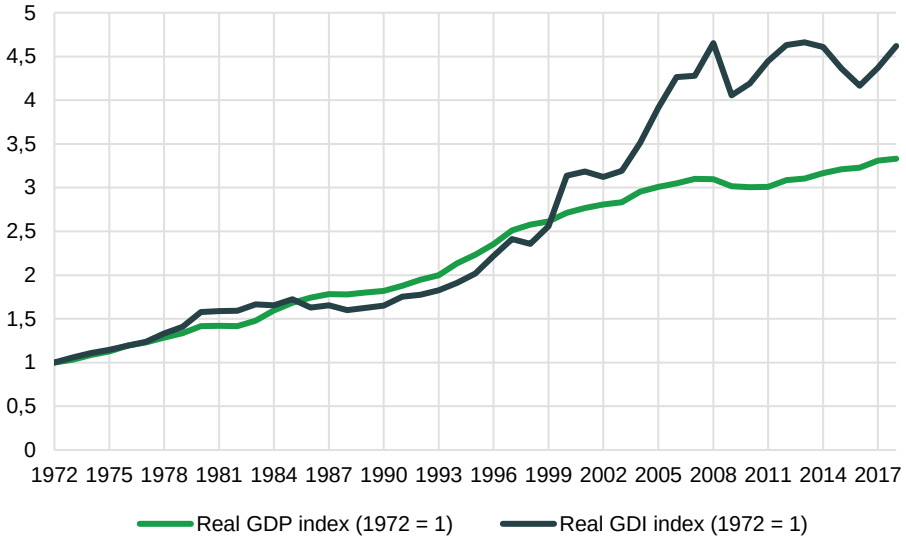
In this paper, the Törnqvist price index of domestic outputs as defined by (25) is used as the deflator to generate the real GDI for the Norwegian market economy.

[10] KNR industries are those applied in the Norwegian quarterly national accounts (*Kvartalsvis NasjonalRegnskap* in Norwegian), also see footnote 9.

The price of domestic outputs or domestic expenditures used for the outputs is intuitively simple and is regarded as a reasonable price measure of domestic absorption. In addition, the measures of the trading gains and of the real GDI are independent of the position of the trade account if this price index is used (Kohli, 2006).

In Figure 4.1, the indexes of both the real GDP and the real GDI are displayed, with their values in 1972 being set equal to 1. The real GDP is derived from the current productivity database at Statistics Norway.[11] As shown, over the entire period 1972-2018, both the real GDP and the real GDI increased substantially. For instance, in 2018, the real GDP and the real GDI was more than 3.3 and 4.6 times of their corresponding levels in 1972.

Figure 4.1 Indexes of real GDP and real GDI in the Norwegian market economy (1972 = 1)



Source: Author's own calculations.

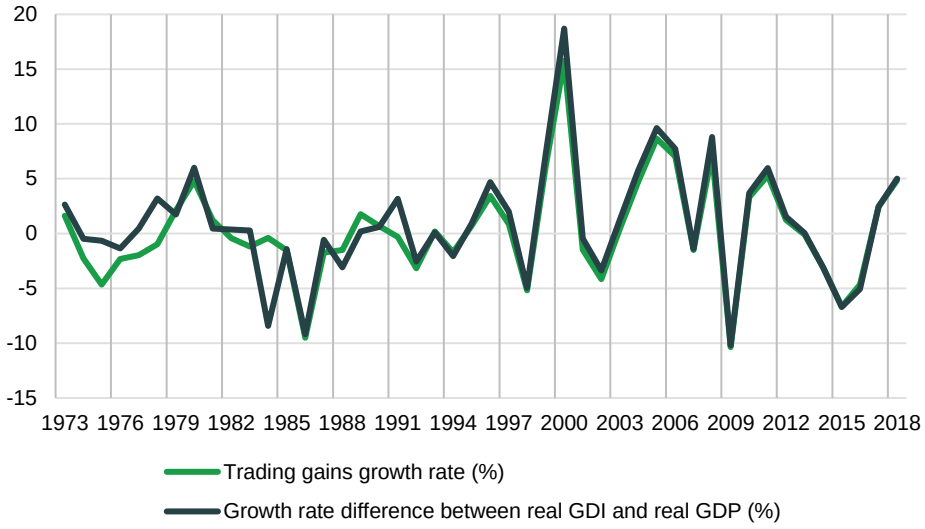
The real GDI was larger than the real GDP before 1985, while from 1986 to 1999 it was lower than the real GDP. Since the beginning of the 21st century, the growth of the real GDI outpaced significantly that of the real GDP, leading to a higher level of the real GDI than that of the real GDP, and the divergence between them had enlarged ever since, and only temporarily hampered in 2008 when global financial crisis occurred, and later in 2014 when international oil prices precipitated.

As shown in (26), if $\gamma^t \cdot \beta_L^t \cdot \beta_K^t$ is interpreted as the growth of the real GDP from the production perspective, the growth of the trading gains ($\alpha_{XM}^t = \alpha_X^t \cdot \alpha_M^t$), can be accounted for by the difference between the growth of the real GDI and that of the real GDP. In other words, the deviation of the real GDI from the real GDP is then possible to be attributed to the deviation of the prices of the export and import from the prices of domestic outputs.

In Figure 4.2, the annual percentage growth rate of the estimated trading gains is compared with the annual percentage growth rate difference between the real GDI and the real GDP. It is clear that except for a few years before 1985, they are in general very close, especially for the recent years.

[11] Accessed in January 2020.

Figure 4.2 Comparison of the trading gains growth with the growth difference between the real GDI and the real GDP in the Norwegian market economy, 1973-2018



Source: Author's own calculations.

What can be seen from Figure 4.1 and Figure 4.2 is that for the Norwegian market economy over the sample period 1972-2018, the real GDI had been growing differently from the real GDP, and the difference between them can be attributed to the changes of the trading gains. In particular, since around 1999, the trading gains had contributed positively and strongly to the real GDI growth, leading to an enlarging gap between the real GDI and the real GDP in the Norwegian market economy until the end of the observed period.

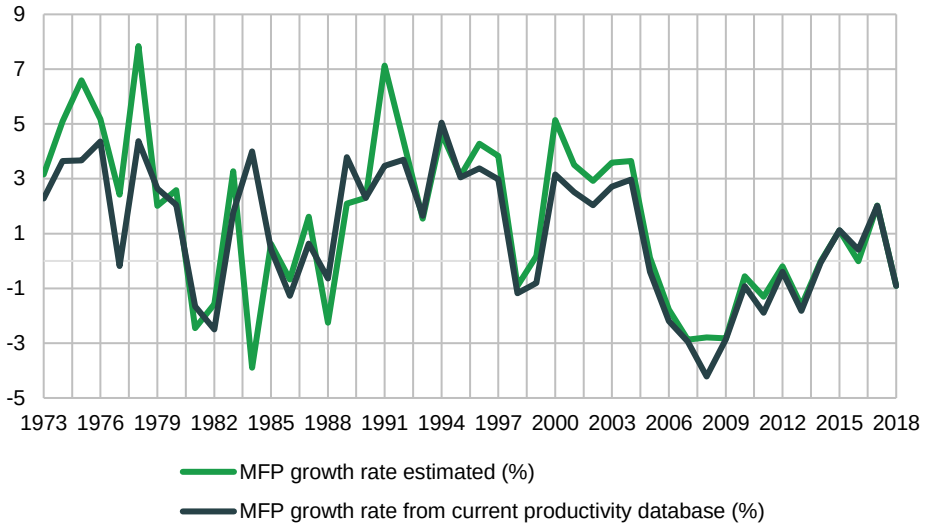
4.2. Estimated MFP growth

As outlined in Section 2, following the methodology as applied in this paper, the MFP growth for the Norwegian market economy can be derived simultaneously by using primarily aggregate data and following a top-down approach. The estimated MFP growth rate can be compared with that from the current productivity database at Statistics Norway, the latter is estimated by using detailed industry-level data and thus following a bottom-up approach. The comparison is depicted in Figure 4.3.

Broadly speaking, the estimated MFP growth rates by the top-down approach in this paper are higher than those by the bottom-up approach, with the arithmetic mean of the former being 1.51 and the latter 1.07 per cent per year over the entire period 1972-2018. For the recent years starting from 2012, the two measures appeared very close. However, there are also some exceptions. For example, for 1984 and 1988, the estimated MFP growth rates are actually lower than the corresponding measures from the current productivity database at Statistics Norway.

It is worth noting that the peak and trough of the two curves as displayed in Figure 4.3 took place following more or less the same tempo, except for Year 1984. The abnormality of 1984 is also reflected in Figure 4.2 for the estimated growth rate of the trading gains, which may signal a warning as regards to the input data quality.

Figure 4.3 Comparison of annual MFP growth rate in the Norwegian market economy, 1972-2018

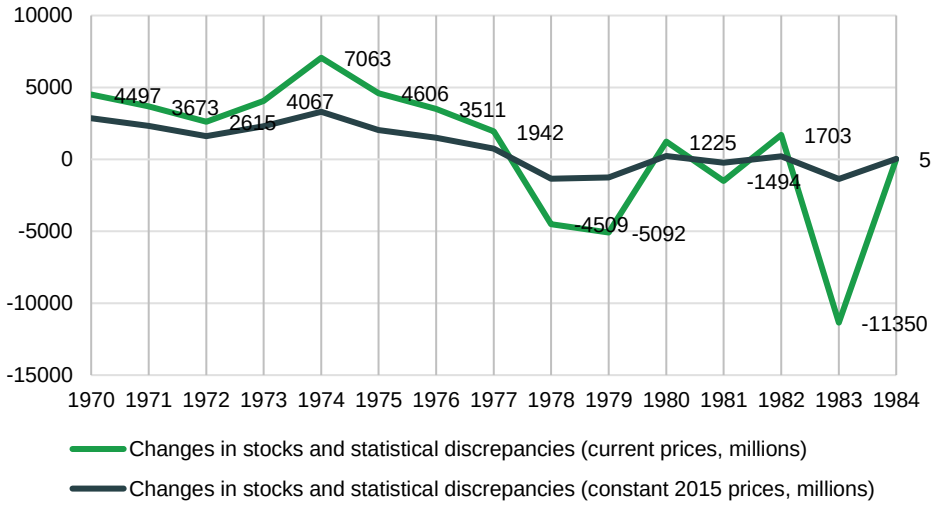


Source: Author's own calculations.

Recall that the input data for one of the domestic outputs, the change of inventories, are drawn from Table 09189 at the online StatBank, in which data are available only in the combined form of 'changes in stocks and statistical discrepancies'. Figure 4.4 reports the time series of 'changes in stocks and statistical discrepancies' over the period 1970-1984, both in current prices (NOK millions) and in constant 2015 prices (NOK, millions), with the former being labeled with the actual numbers.

As shown, there appeared a large jump from 1983 with the value of around minus 11 trillions to 1984 with the value of just 5 millions, which is quite impressive, if compared with data for other years as displayed in Figure 4.4.

Figure 4.4 Changes in stocks and statistical discrepancies, 1970-1984



Source: Table 09189 at the online StatBank at Statistics Norway.

Note that within the compilation system of Norwegian national accounts, a long time convention has been maintained that the changes of stocks include statistical discrepancies so that supply and use can be easily balanced by following the commodity flow approach. Therefore, the large jump in 1984 may merit some further investigation. Nonetheless, it does not mean that the jump by and in itself is

the reason, let alone the only reason, for explaining the abnormality of the estimated results in 1984 as shown in both Figure 4.2 and Figure 4.3.
When commenting on the difference between the estimated MFP growth by following a top-down approach (Diewert and Yu, 2012) and that compiled by Statistics Canada by following a bottom-up approach for the Canadian business sector over the period 1961-2011 (Gu, 2012), Schyreyer (2012) argued that the large difference of 0.8 per cent per year between the two estimates could be explained as an reallocation effect which quantifies the departure from the assumptions required for efficient input markets.

However, this argument may not be the only reason for the Norwegian case as discussed in this paper, although the difference found here is 0.4 per cent per year in average, only a half of that found in the Canadian case (0.8 per cent per year). At least in part, the difference has something to do with the current methodology as applied for compiling productivity accounts at Statistics Norway. As discussed in Liu (2020), the current methodology by following the bottom-up approach at Statistics Norway may need to be updated, because it is not up to the standard for a modern economic accounting framework.

The modern growth accounting has been applied by a number of leading national statistical institutes in the world, such as Bureau of Economic Analysis and Bureau of Labor Statistics (Eldridge *et al*., 2020), Statistics Canada (Baldwin *et al*., 2007), Australia Bureau of Statistics (Voskoboynikov *et al*. 2020), as well as by the EU-KLEMS project (Timmer *et al*., 2007, 2010), following the pioneering work of Jorgenson and his co-workers in developing growth accounts for the United States (Jorgensen *et al*., 1987, 2005).

There are a number of issues within the current methodology as applied at Statistics Norway for compiling productivity accounts. For instance, the aggregation made across different industry levels is not consistent with each other. Moreover, as mentioned in Section 3, labor input data in the current productivity database have not yet taken into consideration the quality differences across different types of labor. In other words, the so-called quality-adjusted labor input is still wanted (see Liu, 2020). All these issues should be explored, but they are clearly beyond the scope of this paper and therefore will be left for further investigation in future research.

4.3. Decomposing real GDI

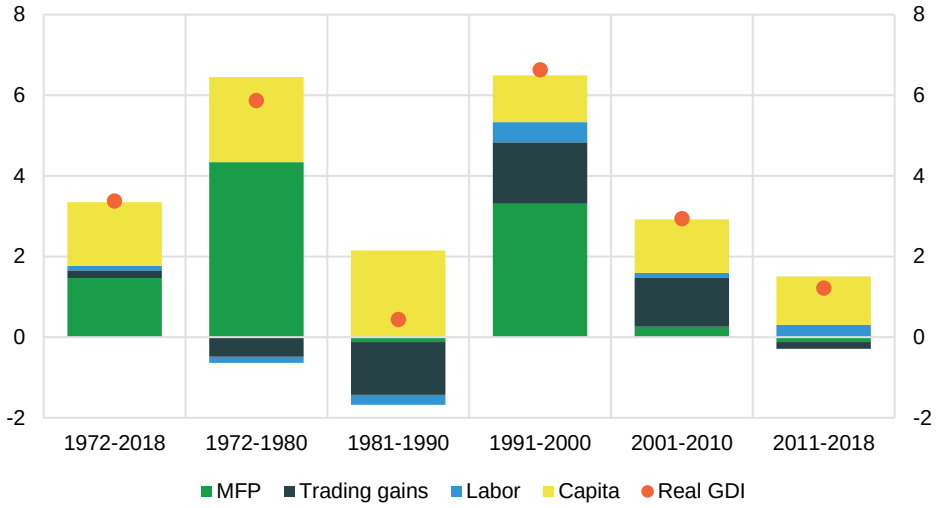
Using (26), the real GDI growth of the Norwegian market economy over the period 1972-2018 is decomposed into the following four components: the MFP growth contribution (γ^t), the trading gains contribution ($\alpha_{XM}^t = \alpha_X^t \cdot \alpha_M^t$), the labor input contribution (β_L^t), and the capital services contribution (β_K^t).

The annual decomposition results for the entire period 1972-2018, and the averaged results over the entire period and a number of subperiods are presented in Table B1.3 in Appendix B. In Figure 4.5, the averaged results for the entire period 1972-2018 and several selected subperiods (1972-1980, 1981-1990, 1991-2000, 2001-2010, and 2011-2018) are presented.

As shown, the average growth rate of the real GDI over the entire period 1972-2018 is 3.38 per cent per year, of which 1.58 per cent came from the capital input, 1.47 per cent from the MFP growth, 0.19 per cent from the trading gains, and 0.11 per cent from the labor input. Over the entire period and three of the five selected subperiods (1981-1990, 2001-2010, and 2011-2018), the growth rate of the capital input was the largest contribution factor to the real GDI growth in the Norwegian

market economy. In fact, the capital input was the only one among the total four contribution factors that had the positive average growth rate over both the entire and all subperiods.

Figure 4.5 Average annual growth rates of real GDI and its contribution factors in the Norwegian market economy (%)



Source: Author's own calculations.

During two subperiods, i.e. 1972-1980 and 1991-2000, the MFP growth was the largest contribution factor to the real GDI growth. Overall, labor input was a weaker and relatively stable contribution factor, if compared with other factors and if in terms of its absolute value of contribution. On the other hand, the contribution to the real GDI growth from the trading gains was quite volatile.

The contribution to the real GDI growth from the trading gains was the lowest in the first two subperiods (1972-1980 and 1981-1990), while it became the second largest in the subsequent two subperiods (1991-2000 and 2001-2010), and in the last subperiod (2001-2018), it went back to become the lowest again. However, the annual average contribution over the entire period ended up with a positive value.

Table 4.1 Annual average growth of real GDI and its contribution factors, over 1972-2018 and various business cycles (peak to peak) (%)

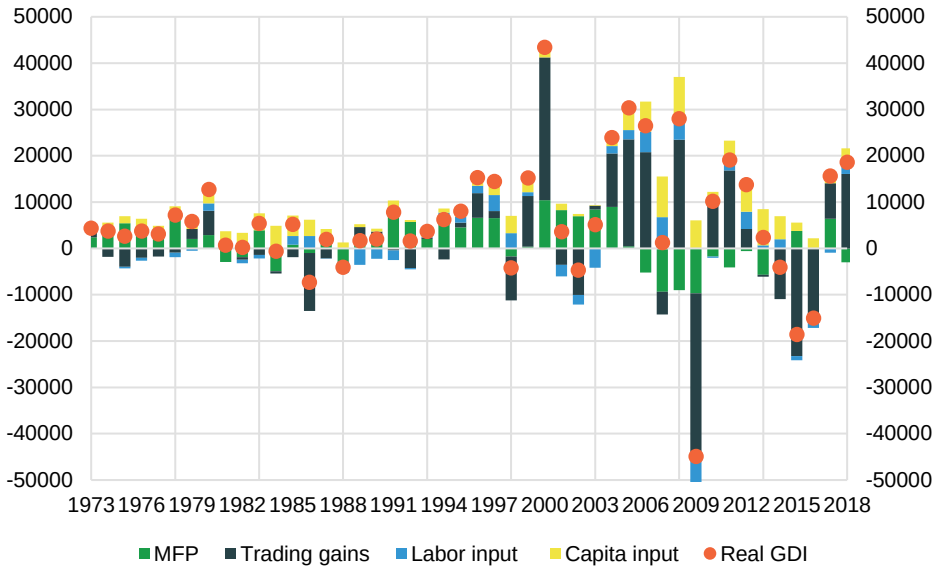
	Real GDI	MFP	Trading gains	Labor input	Capital services
1972-2018	3.38	1.47	0.19	0.11	1.58
	(100)	(43.4)	(5.7)	(3.2)	(46.7)
1972-1977	4.33	4.48	-1.93	-0.20	2.03
	(100)	(103.4)	(-44.6)	(-4.7)	(46.9)
1978-1986	3.11	0.81	-0.72	0.30	2.71
	(100)	(25.9)	(-23.3)	(9.6)	(87.3)
1987-1998	3.13	2.62	-0.52	-0.04	1.06
	(100)	(83.7)	(-16.6)	(-1.2)	(33.9)
1999-2007	6.86	1.57	3.78	0.15	1.22
	(100)	(22.9)	(55.1)	(2.2)	(17.8)
2008-2013	1.43	-1.56	0.95	0.33	1.73
	(100)	(-108.6)	(66.1)	(22.8)	(121.1)
2014-2018	-0.18	0.44	-1.52	0.08	0.83
	(100)	(-237.3)	(825.9)	(-44.5)	(-452.4)

Source: Author's own calculations.

Notes: Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors. Percentage share in parenthesis.

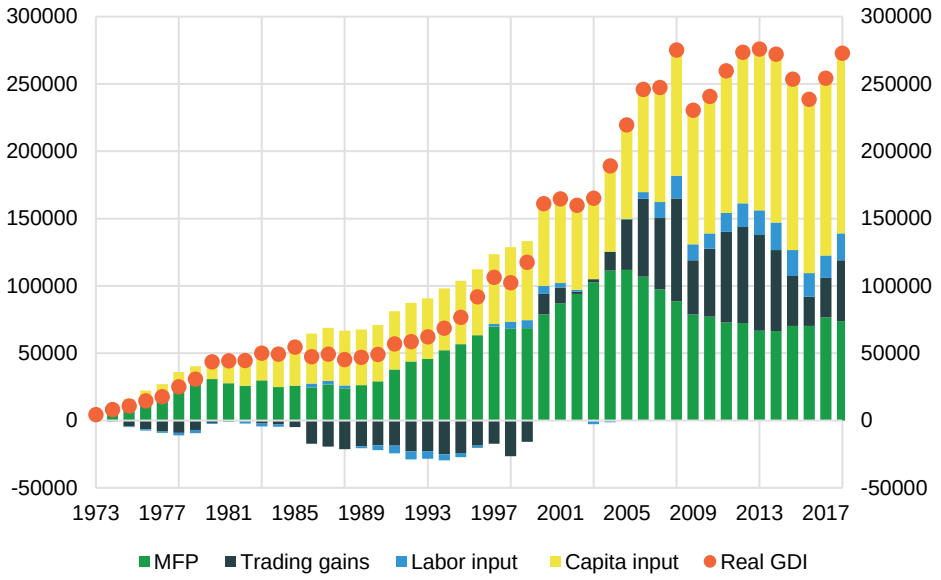
For some purposes, the decomposition results over different subperiods may be of particular interest. To give an example, the decomposition results for the Norwegian market economy across the business cycles (peak to peak) are reported in Table 4.1. In addition, the percentage shares of the four contribution factors to the real GDI growth are also reported in the parenthesis in the table.

Figure 4.6 Decomposition of annual change in real GDI, 1972-2018 (in 1972 NOK, millions)



Source: Author's own calculations.

Figure 4.7 Decomposition of accumulated change in real GDI, 1972-2018 (in 1972 NOK, millions)



Source: Author's own calculations.

The decomposition results of the annual change by using (26), and the accumulated change by using (28)-(33), in the real GDI in 1972 NOK (millions) for the Norwegian market economy over the entire period 1972-2018 are presented in Figure 4.6 and Figure 4.7, respectively. More information on the accumulated growth factor in the real GDI and in the four contribution factors in the Norwegian market economy over the period 1972-2018 are reported in Table B1.4 in Appendix B.

As shown, although the contribution from the capital input to the annual change of the real GDI was not very large on annual basis (see Figure 4.6), if compared to other contribution factors, the accumulated contribution by capital input was rather large because it was the only contribution factor that had the positive contribution in each year of the sample period 1972-2018. As a consequence, the accumulated contribution from capital input was the largest compared to the other factors,

reaching to 133,927 millions (in 1972 NOK) in the last observed year (2018), accounting for roughly half (49%) of the total accumulated change of the real GDI, which was 272,816 millions (in 1972 NOK) in 2018 (see Figure 4.7).

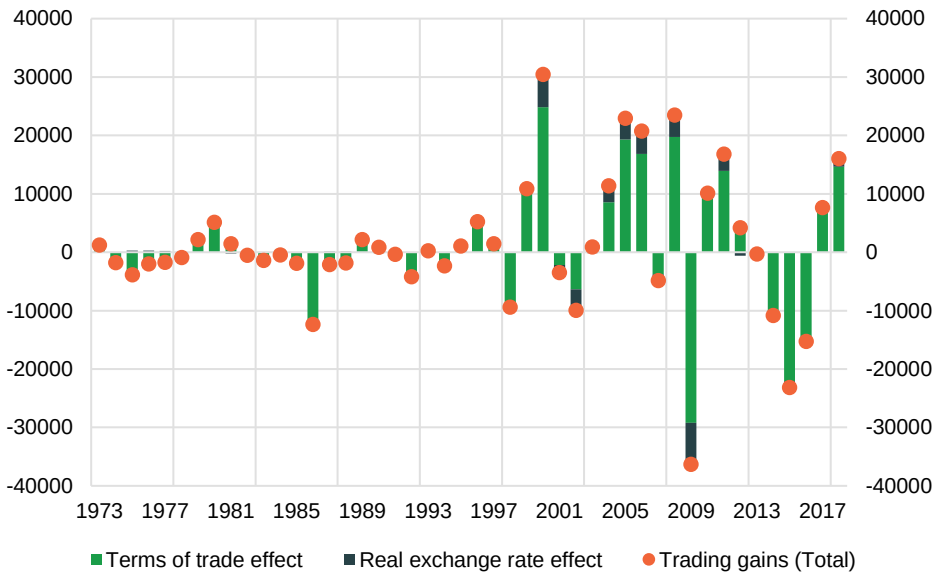
The contribution to the annual change of the real GDI from trading gains was quite volatile, and in a number of years, the contribution from this factor in terms of the absolute value was dominant, if compared to other factors (see Figure 4.6). In the end, the accumulated contribution by the trading gains reached to 45397 millions (in 1972 NOK) in 2018, accounting for around 17% of the accumulated real GDI change.

Also in 2018, the accumulated contribution by the MFP growth was 73719 millions (in 1972 NOK), accounting for 27% of the accumulated real GDI change, while that by the labor input was 19772 millions (in 1972 NOK), and 7% of the accumulated real GDI change.

4.4. Decomposing trading gains

As outlined in Section 2, by means of (34), the trading gains (hereafter TG) can be further decomposed into the terms of trade (hereafter TOT) effect and the real exchange rate (hereafter RER) effect. The decomposition of total TG in the Norwegian market economy into the TOT effect and the RER effect is carried out, and the results in terms of the growth factor by year, and in the average growth percentage rates over the entire period 1972-2018, and a number of subperiods, are reported in Table B1.5 in Appendix B.

Figure 4.8 Decomposition of annual total trading gains into TOT effect and RER effect, 1972-2018 (in 1972 NOK, millions)



Source: Author's own calculations.

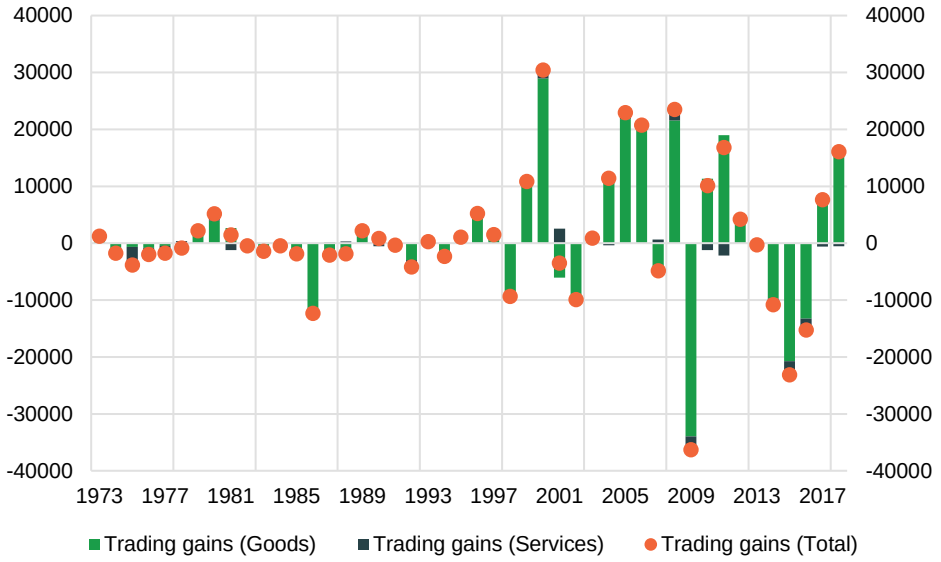
In Figure 4.8, the decomposition of the annual change of the total TG in the Norwegian market economy into the TOT effect and the RER effect in 1972 NOK (millions) is presented for the period 1973-2018. As shown, the TOT effect was much larger than the corresponding RER effect in terms of the absolute value for the most of the observed years.

By following (35) and (36), the total TG can also be decomposed into those for individual exported/imported products. The decomposition results of the total TG in the Norwegian market economy into those due to 'Goods' and those due to

'Services' in terms of the growth factor by year, and of the average annual growth percentage rates over the entire period 1972-2018 and a number of subperiods, are reported in Table B1.5 in Appendix B. Moreover, the decomposition results of 'Goods' and 'Services's TG into their respective TOT and RER effects are also reported in Table B1.5 in Appendix B.

In Figure 4.9, the decomposition results of the annual change of the total TG in the Norwegian market economy in 1972 NOK (millions) into those due to 'Goods' and those due to 'Services' are presented. As shown, in term of the absolute value, the TG due to 'Goods' were much larger than those due to 'Services' for the most years of the period 1972-2018.

Figure 4.9 Decomposition of annual total trading gains into those for Goods and those for Services, 1972-2018 (in 1972 NOK, millions)



Source: Author's own calculations.

In Table 4.2, the average annual percentage growth rates of the total TG for the Norwegian market economy, the decomposed TOT and RER effects, the decomposed TG for 'Goods' and 'Services', as well as the further decomposed TOT and RER effects respectively for 'Goods' and 'Services', for the entire period 1972-2018 and a number of subperiods, are presented.

Table 4.2 Average annual growth rates of trading gains (TG), terms of trade (TOT) effect and real exchange rate (RER) effect for the Norwegian market economy (%) *

	Total			Goods			Services		
	TG (1) = (2)+(3)	TOT (2)	RER (3)	TG (4) = (5)+(6)	TOT (5)	RER (6)	TG (7) = (8)+(9)	TOT (8)	RER (9)
1972-2018	0.19	0.14	0.06	0.39	0.37	0.01	-0.19	-0.21	0.02
1972-1980	-0.49	-0.64	0.15	0.09	0.24	-0.15	-0.58	-0.73	0.15
1981-1990	-1.31	-1.14	-0.17	-0.99	-0.90	-0.10	-0.32	-0.25	-0.07
1991-2000	1.52	1.29	0.23	1.48	1.26	0.22	0.04	0.02	0.02
2001-2010	1.22	1.19	0.03	1.12	1.15	-0.03	0.10	0.09	0.02
2011-2018	-0.16	-0.22	0.05	0.15	0.04	0.11	-0.31	-0.32	0.01

Source: Author's own calculations.
Note: Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

For the sample period 1972-2018, the average growth rate of the total TG for the Norwegian market economy was 0.19 per cent per year, of which 0.14 per cent originated from the TOT effect and only 0.06 per cent were from the RER effect. In terms of the absolute value, the TOT effect was larger than the corresponding RER effect, not only for the entire period 1972-2018, but also for all the subperiods

as listed in Table 4.2. Thus, the TOT effect was the dominating contribution factor to the total TG, no matter the latter was trading gains or losses, for the Norwegian market economy over the sample period 1972-2018.

As shown in Table 4.2, for the entire period, the average growth rate of the TG for 'Goods' was 0.39 per cent per year, which came almost all from the TOT effect (0.37 per cent per year), because the RER effect was very small (0.01 per cent per year). In terms of the absolute value, the TOT effect was larger than the RER effect for almost all subperiods, except for the last one, i.e. 2001-2018. Moreover, only for the subperiod 1981-1990 were both the TG and the corresponding TOT effect negative, for all the other subperiods, as well as for the entire period 1972-2018, both were positive.

As also shown in Table 4.2, the average growth rate of the TG for 'Services' was -0.19 per cent per year for the entire period 1972-2018. This was fully explained by the TOT effect (-0.21 per cent per year), which was offset with a small positive margin by the RER effect (0.02 per cent per year). In addition, in terms of the absolute value, the TOT effect was no less than the RER effect for all subperiods as listed in Table 4.2.

If focusing only on the subperiods as listed in Table 4.2, it seems that the real GDI growth in the Norwegian market economy had benefited substantially from the trading gains over the two 'golden age' subperiods, namely, 1991-2000, and 2001-2010. Except for the RER effect for 'Goods' in the subperiod 2001-2010, the TG, the TOT and RER effects were all positive for the 'Total (export/import)', 'Goods', and 'Services'. In particular, the TG and the TOT effect were the largest for the 'Total (export/import)' and 'Goods', if compared to those over the other subperiods. On the contrary, in terms of the absolute value, the TG and the TOT effect were, though positive, weaker for 'Services' in these two subperiods, if compared to those over the other subperiods, leading to the negative values for both the TG and the TOT effect for 'Services' over the entire period 1972-2018.

In the published export/import data at Statistics Norway, there are three main categories within the 'Goods', namely, (1) 'Crude oil and natural gas'; (2) 'Ships, oilplatforms, aircraft'; (3) 'Other goods'. For the main categories, the estimated annual growth factors of the TG and its decomposition into the TOT and RER effects are reported in Table B1.6 in Appendix B. In addition, the averaged annual percentage growth rates of TOT, RER and TG over the entire period 1972-2018 and a number of subperiods are also presented in the same table.

In Table 4.3, the average annual percentage growth rates of the TG for 'Goods', the decomposed TG for the three main categories, for the entire period 1972-2018 and a number of subperiods, are presented. In addition, the average annual percentage growth rates of the TG for each main category of 'Goods' are further decomposed into the TOT effect and the RER effect, respectively.

Over the sample period 1972-2018, the 0.39 per cent per year of the average annual growth rate of the TG for 'Goods' was explained combinedly by the 0.30 per cent per year from the average annual growth rate of the TG for 'Crude oil and natural gas', -0.10 per cent per year from that for 'Ships, oilplatforms, aircraft', and 0.19 per cent per year from that for 'Other goods'.

For two of the three main categories, i.e. 'Ships, oilplatforms, aircraft' and 'Other goods', the TG came primarily from the TOT effect (-0.09 and 0.13 per cent per year, respectively). On the contrary, for the main category of 'Crude oil and natural gas', the RER effect (0.26 per cent per year) was considerably larger than the TOT

effect (0.04 per cent). Such an observation for 'Crude oil and natural gas' was true not only for the entire period 1972-2018, but also for almost all the subperiods as listed in Table 4.3, except one, i.e. the subperiod 1981-1990. All the observations for 'Crude oil and natural gas' were in marked contrast to those observed for 'Goods' in its entirety (see Table 4.2).

Table 4.3 Average annual growth rates of trading gains (TG), terms of trade (TOT) effect, and real exchange rate (RER) effect in the Norwegian market economy, Goods in main categories (%) *

	Goods	Crude oil and natural gas			Ships, oilplatforms, aircraft			Other goods		
	TG = (1) + (4)+(7)	TG (1) = (2)+(3)	TOT (2)	RER (3)	TG (4) = (5)+(6)	TOT (5)	RER (6)	TG (7) = (8)+(9)	TOT (8)	RER (9)
1972-2018	0.39	0.30	0.04	0.26	-0.10	-0.09	-0.01	0.19	0.13	0.06
1972-1980	0.09	0.51	0.06	0.45	-0.23	-0.24	0.01	-0.19	0.03	-0.22
1981-1990	-0.99	-1.16	-0.18	-0.98	-0.25	-0.24	-0.02	0.41	0.03	0.38
1991-2000	1.48	1.17	0.22	0.95	-0.01	0.01	-0.02	0.33	0.28	0.05
2001-2010	1.12	0.83	0.14	0.69	0.00	0.00	0.00	0.29	0.19	0.10
2011-2018	0.15	0.18	-0.07	0.25	-0.01	0.01	-0.02	-0.01	0.09	-0.10

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

As shown in Table 4.3, during the subperiod 1981-1990, the growth rate of the TG for the main category of 'Crude oil and natural gas' was negative (-1.16 per cent per year), which means that the real GDI growth in the Norwegian market economy was negatively impacted by the trading losses instead of gains during this subperiod. The -1.16 per cent per year came to a large extent from the RER effect (-0.98 per cent per year) rather than the TOT effect (-0.18 per cent per year).

Apparently, in terms of the absolute value, it was the RER effect rather than the TOT effect that had contributed mostly to the TG, no matter whether it was the trading gains or losses, for the main category of 'Crude oil and natural gas' over the sample period 1972-2018, as well as during all the subperiods as listed in Table 4.3.

Because of the crucial importance of petroleum products[12] in the Norwegian economy, the above conclusion merits some discussions here. As outlined in Section 2, the TOT effect reflects the contribution of changes in the export-import price ratio to the real GDI growth. Since Norway is a price taker in the international market of raw oil and natural gas (see Liu, 2016), it is understandable that the TOT effect could not play a significant role in terms of the contribution to the growth of the TG in the Norwegian market economy.

On the other hand, the RER effect captures the contribution resulting from trade imbalances, as well as from deviation in the price of tradables from that of non-tradables, as shown by (34) and (36). As a matter of fact, except for the first three years (1972-1974) of our sample (1972-2018), the Norwegian market economy had been enjoying the surplus from the trade account of 'Crude oil and natural gas' over all the other years, and the trade imbalance from this account, i.e. the difference between the nominal value of export and that of import, accounted for a large share in the nominal GDI in the Norwegian market economy, with the average value being 18 per cent over the sample period 1972-2018.[13]

Recall that the RER effect for product *i*, $\left(\frac{P_{i,T}^{t}}{P_{D}^{t}} \Big/ \frac{P_{i,T}^{t-1}}{P_{D}^{t-1}}\right)^{S_{i,X}^{t}+S_{i,M}^{t}}$, as shown in (36), is a

[12] In this paper, the term of 'Crude oil and natural gas' is used interchangeably with that of 'petroleum products'.

[13] The average share was as high as 25 per cent since the beginning of the new century.

monotonically increasing (decreasing) function if the price index of tradables to non-tradables $\left(\frac{P_{i,T}^t}{P_D^t}\Big/\frac{P_{i,T}^{t-1}}{P_D^{t-1}}\right) > 1\ (< 1)$. It is true that the average annual price index was larger than 1 for the entire period 1972-2018, and for almost all subperiods as listed in Table 4.3, except for the subperiod 1981-1990, for which, the average annual price index was, indeed, less than 1.

Note that $S_{i,X}^t$ ($S_{i,M}^t$) is the two-period (*t* and *t*-1) average value share of exported (imported) product *i* in current prices in the nominal GDI. Since $S_{i,M}^t$ is negative, $S_{i,X}^t + S_{i,M}^t$ is just the share of the trade imbalance out of product *i*'s trade account in the nominal GDI. As mentioned above, this share was as high as 18 per cent on average over the sample period, and therefore, had significantly amplified the RER effect.

The main category of 'Other goods' can be further divided into the following subcategories: (1) 'Agriculture, forestry and fishing'; (2) 'Mining and quarrying'; (3) 'Manufacturing products'; (4) 'Electricity'. By following the same fashion, the similar information for 'Agriculture, forestry and fishing', and 'Mining and quarrying' are presented in Table B1.7, and those for 'Manufacturing products' and 'Electricity' in Table B1.8 in Appendix B.

Much interesting information can be drawn from these tables. For instance, the contribution of the TG from the subcategory of 'Manufacturing products' (0.18 per cent per year) was by far the largest, if compared to the other three subcategories, to the average annual percentage growth rate of the TG of the 'Other goods' (0.19 per cent per year as shown in Table 4.3) over the entire period 1972-2018. Further decomposition indicates that the 0.18 per cent per year of the TG from the subcategory of 'Manufacturing products' stemmed primarily from the TOT effect (0.12 per cent per year) rather than from the RER effect (0.06 per cent per year).

The subcategory of 'Manufacturing products' includes the following product groups: (1) 'Food products, beverages and tobacco'; (2) 'Textiles, wearing apparel, leather'; (3) 'Wood products'; (4) 'Pulp, paper and paper products & Printing and publishing';[14] (5) 'Refined petroleum products'; (6) 'Basic chemicals, chemical and mineral products'; (7) 'Basic metals'; (8) 'Machinery and other equipment n.e.c'; (9) 'Furniture and other manufacturing products & Transport equipment, non-competitive imports'.[15] The similar decomposition results for the nine product groups are reported in Table B1.9 (for product groups (1), (2) and (3)), Table B1.10 (for product groups (4), (5), and (6)), and Table B1.11 (for product groups (7), (8), and (9)) in Appendix B.

Again, information of interest can be drawn from the tables. For instance, the contribution of the TG from the product group of 'Machinery and other equipment n.e.c' (0.12 per cent per year) was the largest, compared to the other eight groups of products, to the average annual percentage growth rate of the TG for the subcategory of 'Manufacturing products' (0.18 per cent per year) over the entire period 1972-2018. In addition, the 0.12 per cent per year of the TG from the product group of 'Machinery and other equipment n.e.c' came primarily from the RER effect (0.09 per cent per year) rather than from the TOT effect (0.02 per cent per year).

Similar with 'Goods', there are three main categories within 'Services' in the

[14] Due to data limitation, two groups of products, 'Pulp, paper and paper products' and 'Printing and publishing', have been combined to form one joint group.

[15] Due to data limitation, two groups of products, 'Furniture and other manufacturing products' and 'Transport equipment, non-competitive imports', have been combined to form one joint group.

published export/import data at Statistics Norway: (1) 'Shipping and oil related';[16] (2) 'Travel'; (3) 'Other services'. The estimated annual growth factors of the TG and the decomposed TOT and RER effects for these main categories of 'Services' are reported in Table B1.12 in Appendix B. In addition, the averaged annual percentage growth rates over the entire period 1972-2018 and a number of subperiods are also reported in the same table.

In Table 4.4, the average annual percentage growth rates of the TG for 'Services', the decomposed TG for the three main categories of 'Services', and the further decomposed TOT and RER effects for each main category, for the entire period 1972-2018 and a number of subperiods, are presented.

Table 4.4 Average annual growth rates of trading gains (TG), terms of trade (TOT) effect, and real exchange rate (RER) effect in the Norwegian market economy, services in categories (%) *

	Services	Shipping and oil related			Travel			Other services		
	TG = (1) + (4)+(7)	TG (1) = (2)+(3)	TOT (2)	RER (3)	TG (4) = (5)+(6)	TOT (5)	RER (6)	TG (7) = (8)+(9)	TOT (8)	RER (9)
1972-2018	-0.19	-0.18	-0.23	0.05	0.00	0.01	-0.01	-0.01	-0.01	0.00
1972-1980	-0.58	-0.51	-0.88	0.38	-0.03	-0.01	-0.02	-0.03	-0.01	-0.02
1981-1990	-0.32	-0.37	-0.19	-0.18	0.05	0.05	0.01	0.00	-0.01	0.00
1991-2000	0.04	0.04	-0.05	0.09	-0.03	0.01	-0.03	0.03	0.03	0.00
2001-2010	0.10	0.08	0.03	0.05	0.04	0.03	0.02	-0.02	-0.03	0.00
2011-2018	-0.31	-0.20	-0.16	-0.04	-0.06	-0.03	-0.03	-0.05	-0.05	0.00

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Over the entire period 1972-2018, the -0.19 per cent per year of the average growth rate of the TG for 'Services' was almost fully explained by the -0.18 per cent per year of the average annual growth rate of the TG from 'Shipping and oil related services'. The average annual growth rate of the TG for 'Travel' was close to zero, while that for 'Other services' was -0.01 per cent per year.

For 'Shipping and oil related services', the annual average growth rate over the sample period 1972-2018 of the TG (-0.18 per cent per year) was fully explained by the TOT effect (-0.23 per cent per year) which was offset by the positive RER effect (0.05 per cent per year). However, the domination of the TOT effect for the entire period 1972-2018 does not necessarily hold for all the subperiods. For instance, in the 1990s and 2000s, the average annual growth rates of the TG (0.04 and 0.08 per cent per year, respectively) for 'Shipping and oil related services' were in large part determined by the RER effect (0.09 and 0.05 per cent per year, respectively) rather than by the TOT effect (-0.05 and 0.03 per cent per year, respectively).

The main category of 'Other services' contains the following subcategories: (1) 'Other transport'; (2) 'Financial and business services'; (3) 'Services n.e.c.'. By the same fashion, detailed results for these subcategories of services are reported in Table B1.13 in Appendix B. Because all the decomposition results for these subcategories were rather small, they will not be further discussed here in the main text.

[16] Due to data limitation, four categories of services, 'Gross receipts, shipping', 'Operating costs shipping, excl bunkers', 'Petroleum activities, various services', and 'Pipeline transport', have been combined to form one joint group.

5. Conclusions

The export of petroleum products accounts for a substantial share of the total export, and thus, is an important source of income for Norway. However, the current methodology as applied at Statistics Norway for decomposing the total trading gains in the Norwegian economy into those due to petroleum products and those to all other products is not conceptually right.

For the sake of good measurement, an alternative methodology following Diewert and Yu (2012) and Kohli (2004) is therefore proposed in this paper for decomposing the real GDI growth in the Norwegian market economy into various contribution factors: MFP, trading gains, as well as labor and capital inputs. Using this methodology, the trading gains can be decomposed into the terms of trade effect and the real exchange rate effect, as well as by individual traded product.

Moreover, the MFP growth derived from this methodology by using aggregate data and hence a top-down approach can be compared with that from the current productivity database at Statistics Norway by using disaggregate data and hence a bottom-up approach. This comparison can serve as a quality control for both data and methodologies as applied by the two approaches.

The estimated MFP growth is in general larger than that from the current productivity database, with the mean of the former being 1.51 and the latter 1.07 per cent per year over the period 1972-2018. But for the recent years starting from 2012, the two measures are very close. In general, the growth peaks and troughs took place following more or less the same tempo as reflected by the two measures in time-series. However, some exceptions may signal a warning of data quality, which merits further investigation.

The estimated results show that the real GDI in the Norwegian market economy in 2018 was more than 4.6 times of that in 1972, while over the same period, the real GDP had increased more than 3.3 times. The annual growth rate of 3.38 per cent in the real GDI originated first from the growth of the capital input (1.58 per cent per year), followed by the MFP growth (1.47 per cent per year), the trading gains (0.19 per cent per year), and the growth of labor input (0.11 per cent per year).

This finding is in line with many empirical evidences that the long term growth is mostly conditioned by increases in the capital stock and by gains in the MFP. However, the contribution by the trading gains found in this paper, though volatile across different subperiods, had played an important role in the real GDI growth in the Norwegian market economy, and therefore, should be taken into account when assessing Norwegian economic performance.

The further decomposition reveals that the total trading gains in the Norwegian market economy stemmed largely from the terms of trade effect (0.14 per cent per year) rather than the real exchange rate effect (0.06 per cent per year), and were mainly due to ‘Goods’ instead of ‘Services’. Indeed, the trading gains from ‘Goods’ contributed 0.39 per cent per year, while those from ‘Services’ contributed -0.19 per cent per year to the growth of the total trading gains (0.19 per cent per year) over the period 1972-2018.

Despite the terms of trade effect outweighing the real exchange rate effect for both ‘Goods’ and ‘Services’, as for ‘Crude oil and natural gas’, the opposite was true, i.e. it was the change of international price of raw oil and natural gas relative to the price of domestic output price (0.26 per cent per year), together with the large surplus from the oil and gas trade account (accounting for 18% in average of the

nominal GDI), rather than the relative price of export and import of raw oil and natural gas (0.04 per cent per year), that contributed mostly to the growth of the trading gains from petroleum products (0.30 per cent per year) in the Norwegian market economy over the period 1972-2018.

Of the three main categories of 'Goods', 'Crude oil and natural gas' had contributed the most (0.30 per cent per year), followed by 'Other goods' (0.19 per cent per year) to the trading gains for 'Goods'. The contribution from 'Ships, oilplatforms, aircraft' was, however, negative (-0.10 per cent per year) over the period 1972-2018.

On the other hand, the trading gains for 'Services' (-0.19 per cent per year) could be almost fully explained by the contribution from the main category of 'Shipping and oil related services' (-0.18 per cent per year), because those from the other two main categories, 'Travel' and 'Other services', were very small over the period 1972-2018.

More information can be drawn from further decompositions.[17] For instance, the contribution by the subcategory of 'Manufacturing products' (0.18 per cent per year) was by far the largest to the trading gains for the main category of 'Other goods' (0.19 per cent per year), and this came primarily from the terms of trade effect (0.12 per cent per year) rather than from the real exchange rate effect (0.06 per cent per year) over the period 1972-2018. Following the same fashion, it can be shown that the contribution by the product group of 'Machinery and other equipment n.e.c' (0.12 per cent per year) was the largest to the trading gains for the subcategory of 'Manufacturing products' (0.18 per cent per year) over the period 1972-2018.

By means of the methodology as proposed in this paper, besides the decomposition of the real GDI growth into the various components in term of the growth factors, the level of the real GDI can also be decomposed into those in terms of the levels. For instance, the increase of the real GDI over the period 1972-2018 was 272816 millions (in 1972 NOK), of which 133927 millions (accounted for about 49%) could be attributed to the capital input, 73719 millions (27%) to the MFP, 45397 million (17%) to the trading gains, and 19772 millions (7%) to the labor input.

Because of the sound theoretical reasoning behind the proposed methodology, as well as the rich results that can be derived from it, the proposed methodology should be considered a good candidate at Statistics Norway for better measurement of the Norwegian economic performance, including decomposing the total trading gains into those due to petroleum products and those to others.

On the other hand, the proposed methodology has the Norwegian market economy as its focus. To understand the whole picture behind the growth of disposable income for the entire Norwegian economy, however, the methodology should be extended to cover the Norwegian nonmarket economy as well. In addition, when considering the change of Norwegian disposable income in per capita terms, which is a more relevant indicator of living standard, the change of population should also be taken into account. All these issues are of crucial importance and therefore should be further investigated in the future.

[17] Much more estimated results are presented in the tables in Appendix B.

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Vedlegg A: Translog function approach

Following Diewert and Morrison (1986), assume that the log of the period *t* real income as defined in the paper, $g^t(\boldsymbol{p},\boldsymbol{x})$, has the following translog functional form:

(A.1) $\ln g^t(\boldsymbol{p},\boldsymbol{x}) \equiv a_0^t + \sum_{i=1}^{I} a_i^t \ln p_i^t + \frac{1}{2}\sum_{i=1}^{I}\sum_{k=1}^{I} a_{ik} \ln p_i^t \ln p_k^t$

$+ \sum_{j=1}^{J} b_j^t \ln x_j^t + \frac{1}{2}\sum_{j=1}^{J}\sum_{k=1}^{J} b_{jk} \ln x_j^t \ln x_k^t + \sum_{i=1}^{I}\sum_{j=1}^{J} c_{ij} \ln p_i^t \ln x_j^t,$

where

(A.2) $\sum_{i=1}^{I} a_i^t = 1$, for *t = 0, 1, 2, …*;

(A.3) $\sum_{j=1}^{J} b_j^t = 1$, for *t = 0, 1, 2, …*;

(A.4) $a_{ik} = a_{ki}$, for all *i, k*;

(A.5) $b_{jk} = b_{kj}$, for all *j, k*;

(A.6) $\sum_{k=1}^{I} a_{ik} = 0$, for *i = 1, 2, …, I*;

(A.7) $\sum_{k=1}^{J} b_{jk} = 0$, for *j = 1, 2, …, J*;

(A.8) $\sum_{j=1}^{J} c_{ij} = 0$, for *i = 1, 2, …, I*;

(A.9) $\sum_{i=1}^{I} c_{ij} = 0$, for *j = 1, 2, …, J*.

Note that the coefficients for the quadratic terms in (A.1) are assumed to be constant over time. In addition, Diewert (1974) shows that the income function is homogeneous of degree one in $\boldsymbol{p}^t$, if assumptions (A.2), (A.4), (A.6) and (A.9) hold. Similarly, the income function is homogeneous of degree one in $\boldsymbol{x}^t$, if assumptions (A.3), (A.5), (A.7) and (A.8) hold. These assumptions are necessary for the income function to be well-defined.

Diewert and Morrison (1986) showed that if $g^t(\boldsymbol{p},\boldsymbol{x})$ is defined by (A.1) - (A.9) above and there is competitive profit maximizing behavior on the part of all market sector producers for all periods *t*, then

(A.10) $g^t(\boldsymbol{p}^t,\boldsymbol{x}^t)/g^{t-1}(\boldsymbol{p}^{t-1},\boldsymbol{x}^{t-1}) = \gamma^t \cdot \alpha^t \cdot \beta^t,$

where γ^t, α^t, and β^t are defined by (8), (12) and (16), respectively.

Moreover, Diewert and Morrison (1986) showed that γ^t, α^t, and β^t could be calculated using empirically observable price and quantity data for periods *t*-1 and t as follows:

(A.11) $\ln \alpha^t = \sum_{i=1}^{I} \frac{1}{2}\left(\frac{p_i^{t-1}y_i^{t-1}}{\boldsymbol{p}^{t-1}\cdot\boldsymbol{y}^{t-1}} + \frac{p_i^t y_i^t}{\boldsymbol{p}^t\cdot\boldsymbol{y}^t}\right)\ln\left(\frac{p_i^t}{p_i^{t-1}}\right),$

(A.12) $\ln \beta^t = \sum_{j=1}^{J} \frac{1}{2}\left(\frac{w_j^{t-1}x_j^{t-1}}{\boldsymbol{w}^{t-1}\cdot\boldsymbol{x}^{t-1}} + \frac{w_j^t x_j^t}{\boldsymbol{w}^t\cdot\boldsymbol{x}^t}\right)\ln\left(\frac{x_j^t}{x_j^{t-1}}\right),$

(A.13) $$\gamma^t = \frac{g^t(\boldsymbol{p}^t,\boldsymbol{x}^t)/g^{t-1}(\boldsymbol{p}^{t-1},\boldsymbol{x}^{t-1})}{\alpha^t \cdot \beta^t}.$$

where α^t is the Törnqvist index of the output prices, and β^t is the Törnqvist index of input quantity.

Diewert and Yu (2012) show that the same assumptions made above can also be applied for decomposing the aggregate period *t* contribution factor due to changes in all deflated output prices α^t into separate effects for each change in each output price.

Suppose there is a change in a single real output price, p_i, going from period *t*-1 to *t*, then a Laspeyres type measure α_{Li}^t that chooses the period *t*-1 reference technology and holds constant other output prices at their period *t*-1 levels and holds inputs constant at their period *t*-1 levels $\boldsymbol{x}^{t-1}$, and a Paasche type measure α_{Pi}^t that chooses the period *t* reference technology and reference input vector $\boldsymbol{x}^t$ and holds constant other output prices at their period *t* levels are as follows:

(A.14) $$\alpha_{Li}^t \equiv g^{t-1}\left(p_1^{t-1}, \ldots p_{i-1}^{t-1}, p_i^t, p_{i+1}^{t-1}, \ldots p_I^{t-1}, \boldsymbol{x}^{t-1}\right)/g^{t-1}(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1}),$$

(A.15) $$\alpha_{Pi}^t \equiv g^t(\boldsymbol{p}^t, \boldsymbol{x}^t)/g^t\left(p_1^t, \ldots p_{i-1}^t, p_i^{t-1}, p_{i+1}^t, \ldots p_I^t, \boldsymbol{x}^t\right).$$

Since both measures of real output price change are equally valid, it is natural to average them to obtain an overall measure of the effects on real income of the change in the real price of output *i*:

(A.16) $$\alpha_i^t \equiv \left[\alpha_{Li}^t \cdot \alpha_{Pi}^t\right]^{1/2}.$$

Under the assumptions as defined by (A.1) – (A.9), one yields:

(A.17) $$\ln \alpha_i^t = \frac{1}{2}\left(\frac{p_i^{t-1}y_i^{t-1}}{\boldsymbol{p}^{t-1}\cdot\boldsymbol{y}^{t-1}} + \frac{p_i^t y_i^t}{\boldsymbol{p}^t\cdot\boldsymbol{y}^t}\right)\ln\left(\frac{p_i^t}{p_i^{t-1}}\right).$$

This implies that the aggregate real output price contribution in period *t*, α^t, can be exactly decomposed into the product of separate price contributions, as follows:

(A.18) $$\alpha^t = \alpha_1^t \cdot \alpha_2^t \cdots \alpha_I^t.$$

By the same reasoning, one can also decompose the aggregate period t contribution factor due to changes in all market sector primary input quantities β^t into separate effects for each change in each input quantity.

Suppose there is a change in a single input quantity, x_j, going from period *t*-1 to *t*, then a Laspeyres type measure β_{Lj}^t that chooses the period *t*-1 reference technology and holds constant other input quantities at their period *t*-1 levels and holds real output prices at their period *t*-1 levels $\boldsymbol{p}^{t-1}$, and a Paasche type measure β_{Pj}^t that chooses the period *t* reference technology and reference real output price vector $\boldsymbol{p}^t$ and holds constant other input quantities at their period *t* levels:

(A.19) $$\beta_{Lj}^t \equiv g^{t-1}\left(\boldsymbol{p}^{t-1}, x_1^{t-1}, \ldots x_{j-1}^{t-1}, x_j^t, x_{j+1}^{t-1}, \ldots x_J^{t-1}\right)/g^{t-1}(\boldsymbol{p}^{t-1}, \boldsymbol{x}^{t-1}),$$

(A.20) $$\beta_{Pj}^t \equiv g^t(\boldsymbol{p}^t, \boldsymbol{x}^t)/g^t\left(\boldsymbol{p}^t, x_1^t, \ldots x_{j-1}^t, x_j^{t-1}, x_{j+1}^t, \ldots x_J^t\right).$$

Taking geometric average of β_{Lj}^t and β_{Pj}^t to obtain an overall measure of the effects on real income of the change in the quantity of input *j*:

(A.21) $$\beta_j^t \equiv \left[\beta_{Lj}^t \cdot \beta_{Pj}^t\right]^{1/2}.$$

Under the assumptions as defined by (A.1) – (A.9), one yields:

(A.22) $$\ln \beta_j^t = \frac{1}{2}\left(\frac{w_j^{t-1}x_j^{t-1}}{\boldsymbol{w}^{t-1}\cdot\boldsymbol{x}^{t-1}} + \frac{w_j^t x_j^t}{\boldsymbol{w}^t\cdot\boldsymbol{x}^t}\right)\ln\left(\frac{x_j^t}{x_j^{t-1}}\right).$$

The contribution from changes in quantities of all inputs, β^t, has the following exact decomposition:

(A.23) $$\beta^t = \beta_1^t \cdot \beta_2^t \cdots \beta_J^t.$$

Vedlegg B: Estimated results in tables

Table B1.1 Price indexes for domestic outputs, export, and import, the Norwegian market economy, 1972-2018

	PC Household consumption excluding housing services	PI Market producers' investment	PCI Market producers' change of inventories	PNS Net sales of market producers to nonmarket producers	PD Domestic expenditure	PX Export	PM Import
Year			(Index, 1972 = 1.000)				
1972	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1973	1.073	1.048	1.094	1.121	1.075	1.129	1.090
1974	1.098	1.160	1.210	1.142	1.126	1.223	1.248
1975	1.116	1.156	1.058	0.925	1.094	0.998	1.080
1976	1.087	1.118	1.030	1.000	1.081	1.013	1.069
1977	1.089	1.105	1.111	0.997	1.080	1.047	1.080
1978	1.086	1.062	1.297	0.834	1.032	1.053	1.076
1979	1.057	1.033	1.213	1.104	1.054	1.176	1.133
1980	1.101	1.095	1.344	1.037	1.086	1.231	1.146
1981	1.139	1.109	1.209	1.145	1.132	1.128	1.094
1982	1.115	1.117	1.182	1.016	1.099	1.059	1.063
1983	1.083	1.087	1.064	0.953	1.063	1.047	1.069
1984	1.057	1.062	0.021	1.055	1.144	1.070	1.066
1985	1.053	1.095	1.006	1.013	1.058	1.029	1.058
1986	1.072	1.067	1.063	0.935	1.051	0.810	0.985
1987	1.088	1.094	1.084	1.020	1.079	1.020	1.071
1988	1.060	1.076	0.845	1.164	1.075	1.006	1.043
1989	1.047	1.055	0.969	1.115	1.059	1.106	1.070
1990	1.044	1.007	1.115	1.054	1.037	1.030	1.012
1991	1.032	1.010	0.923	0.732	0.979	0.988	0.996
1992	1.019	1.012	1.020	0.900	1.000	0.930	0.982
1993	1.023	1.024	1.010	1.006	1.021	1.021	1.016
1994	1.008	1.005	1.035	0.949	1.000	0.972	1.007
1995	1.023	1.026	1.000	0.990	1.019	1.018	1.006
1996	1.007	1.018	1.059	0.992	1.009	1.069	1.008
1997	1.022	1.017	0.945	0.951	1.009	1.020	1.003
1998	1.023	1.020	1.030	1.003	1.020	0.921	1.012
1999	1.016	1.007	1.194	0.991	1.014	1.107	0.989
2000	1.025	1.038	1.140	1.023	1.031	1.367	1.075
2001	1.017	1.026	1.031	0.989	1.015	0.978	0.999
2002	1.006	0.982	1.113	0.975	0.998	0.898	0.950
2003	1.026	0.997	1.310	1.012	1.021	1.020	1.014
2004	1.010	1.024	1.121	1.045	1.021	1.129	1.047
2005	1.008	1.021	1.255	1.044	1.025	1.174	1.015
2006	1.016	1.045	1.148	1.043	1.033	1.155	1.032
2007	1.009	1.059	1.212	1.084	1.044	1.015	1.039
2008	1.035	1.058	1.052	1.067	1.047	1.175	1.042
2009	1.023	1.034	0.915	1.018	1.020	0.830	0.997
2010	1.018	1.007	1.350	1.029	1.032	1.075	1.008
2011	1.008	1.033	1.091	1.046	1.026	1.128	1.033
2012	1.008	1.024	1.092	1.048	1.024	1.028	1.000
2013	1.018	1.021	1.017	1.039	1.023	1.016	1.016
2014	1.021	1.035	0.968	1.028	1.022	0.984	1.049
2015	1.022	1.023	0.886	1.032	1.015	0.920	1.050
2016	1.034	1.004	0.900	1.023	1.018	0.924	1.013
2017	1.019	0.995	1.178	1.031	1.024	1.072	1.024
2018	1.023	1.017	1.023	1.038	1.025	1.136	1.045
			Geometric average annual growth rates, per cent				
1972-2018	4.24	4.54	-0.86	1.35	4.19	4.38	4.07
1972-1980	8.82	9.62	16.48	1.52	7.83	10.54	11.40
1981-1990	7.53	7.63	-28.82	4.44	7.91	2.67	5.27
1991-2000	1.96	1.77	3.28	-5.03	1.00	3.50	0.90
2001-2010	1.66	2.50	14.34	3.01	2.54	3.85	1.40
2011-2018	1.89	1.89	1.50	3.57	2.21	2.32	2.88
1972-1977	9.24	11.67	9.88	3.38	9.12	7.89	11.16
1978-1986	8.44	8.03	-25.43	0.62	7.92	6.06	7.59
1987-1998	3.27	2.99	0.03	-1.62	2.51	0.72	1.84
1999-2007	1.45	2.20	16.67	2.23	2.22	8.63	1.72
2008-2013	1.82	2.93	7.85	4.12	2.86	3.60	1.61
2014-2018	2.36	1.46	-1.45	3.05	2.08	0.38	3.62

Source: Author's own calculations.

Table B1.2 Real GDI and real prices of domestic outputs, export and import, the Norwegian market economy, 1972-2018

	GDI/PD	PC/PD	PI/PD	PCI/PD	PNS/PD	PX/PD	PM/PD
	Real GDI (in 1972 NOK, millions)	Household consumption excluding housing services	Market producers' investment	Market producers' change of inventories	Net sales of market producers to nonmarket producers	Export	Import
Year				(Index, 1972 = 1.000)			
1972	75384	1.000	1.000	1.000	1.000	1.000	1.000
1973	79773	0.999	0.975	1.017	1.043	1.049	1.017
1974	83544	0.975	1.030	1.074	1.014	1.075	1.116
1975	86248	1.020	1.056	0.967	0.845	0.904	0.989
1976	90037	1.005	1.034	0.953	0.925	0.944	0.990
1977	93181	1.008	1.023	1.028	0.923	0.962	1.000
1978	100400	1.052	1.028	1.257	0.808	1.031	1.045
1979	106243	1.003	0.980	1.151	1.048	1.116	1.076
1980	119007	1.014	1.008	1.237	0.955	1.141	1.059
1981	119750	1.006	0.980	1.068	1.012	0.993	0.968
1982	119971	1.015	1.016	1.075	0.924	0.964	0.967
1983	125395	1.019	1.023	1.001	0.897	0.983	1.004
1984	124812	0.923	0.928	0.018	0.922	0.940	0.934
1985	130023	0.995	1.034	0.951	0.957	0.974	1.000
1986	122715	1.020	1.016	1.011	0.890	0.780	0.940
1987	124716	1.009	1.014	1.005	0.945	0.957	0.995
1988	120688	0.986	1.001	0.786	1.083	0.936	0.969
1989	122376	0.989	0.997	0.915	1.054	1.044	1.009
1990	124398	1.006	0.971	1.075	1.016	0.991	0.977
1991	132248	1.053	1.032	0.942	0.747	1.010	1.018
1992	133890	1.019	1.012	1.020	0.900	0.931	0.983
1993	137624	1.002	1.004	0.989	0.985	1.000	0.997
1994	143903	1.008	1.005	1.035	0.949	0.974	1.006
1995	151978	1.004	1.007	0.981	0.972	1.002	0.986
1996	167305	0.998	1.009	1.049	0.983	1.062	0.999
1997	181804	1.012	1.007	0.936	0.942	1.010	0.993
1998	177639	1.003	1.000	1.010	0.984	0.901	0.992
1999	192924	1.002	0.994	1.178	0.977	1.093	0.976
2000	236400	0.994	1.008	1.106	0.993	1.326	1.044
2001	240022	1.002	1.011	1.015	0.974	0.967	0.984
2002	235355	1.008	0.985	1.115	0.977	0.902	0.954
2003	240548	1.004	0.976	1.283	0.991	1.001	0.992
2004	264512	0.989	1.003	1.098	1.023	1.105	1.027
2005	294922	0.984	0.996	1.224	1.019	1.149	0.992
2006	321411	0.983	1.012	1.112	1.010	1.122	1.000
2007	322673	0.967	1.015	1.161	1.038	0.971	0.995
2008	350707	0.989	1.010	1.005	1.019	1.122	0.995
2009	305858	1.003	1.013	0.897	0.998	0.815	0.979
2010	316062	0.986	0.976	1.308	0.997	1.045	0.978
2011	335190	0.982	1.007	1.064	1.020	1.104	1.008
2012	348993	0.984	1.000	1.066	1.023	1.005	0.975
2013	351412	0.996	0.998	0.995	1.016	0.994	0.994
2014	347403	0.999	1.012	0.947	1.006	0.963	1.027
2015	328891	1.006	1.008	0.872	1.016	0.907	1.037
2016	313903	1.015	0.986	0.884	1.005	0.910	0.995
2017	329571	0.996	0.972	1.150	1.007	1.046	0.999
2018	348200	0.998	0.992	0.998	1.012	1.111	1.020
				Geometric average annual growth rates, per cent			
1972-2018	3.38	0.05	0.33	-4.85	-2.73	0.29	-0.05
1972-1980	5.87	0.91	1.66	8.02	-5.86	2.47	3.56
1981-1990	0.44	-0.34	-0.25	-34.04	-3.21	-4.62	-2.41
1991-2000	6.63	0.95	0.76	2.25	-5.97	2.54	-0.08
2001-2010	2.95	-0.86	-0.04	11.51	0.45	1.45	-1.05
2011-2018	1.22	-0.31	-0.32	-0.70	1.33	0.22	0.67
1972-1977	4.33	0.12	2.34	0.70	-5.26	-1.54	2.13
1978-1986	3.11	0.47	0.10	-30.90	-6.77	-1.38	-0.20
1987-1998	3.13	0.74	0.47	-2.42	-4.03	-1.61	-0.65
1999-2007	6.86	-0.75	-0.02	14.13	0.00	6.42	-0.43
2008-2013	1.43	-1.01	0.07	4.85	1.23	0.88	-1.18
2014-2018	-0.18	0.28	-0.61	-3.46	0.95	-1.58	1.55

Source: Author's own calculations.

Table B1.3 Sources of annual real GDI growth in the Norwegian market economy, 1972-2018

		Contributions to real GDI growth						
	g^t/g^{t-1}	γ^t	α_X^t	α_M^t	α_{XM}^t	β_L^t	β_K^t	β_{LK}^t
	Real GDI growth	MFP growth	Real export price growth	Real import price growth	Trading gains (TG)	Labor input growth	Capita input growth	Labor and Capital combined
	(Growth factors)							
Year	(1)=(2)*(5)*(8)	(2)	(3)	(4)	(5)=(3)*(4)	(6)	(7)	(8)=(6)*(7)
1973	1.058	1.032	1.025	0.992	1.016	0.999	1.010	1.009
1974	1.047	1.051	1.040	0.940	0.977	1.000	1.019	1.019
1975	1.032	1.066	0.948	1.006	0.954	0.997	1.019	1.016
1976	1.044	1.052	0.971	1.006	0.977	0.993	1.023	1.016
1977	1.035	1.024	0.980	1.000	0.980	1.001	1.030	1.031
1978	1.077	1.078	1.016	0.975	0.990	0.990	1.019	1.008
1979	1.058	1.020	1.061	0.963	1.021	0.995	1.021	1.016
1980	1.120	1.026	1.080	0.971	1.048	1.014	1.027	1.042
1981	1.006	0.975	0.996	1.016	1.012	1.001	1.018	1.019
1982	1.002	0.984	0.979	1.017	0.996	0.994	1.028	1.022
1983	1.045	1.033	0.990	0.998	0.988	0.994	1.030	1.024
1984	0.995	0.961	0.964	1.033	0.996	1.003	1.037	1.039
1985	1.042	1.006	0.985	1.000	0.985	1.015	1.035	1.051
1986	0.944	0.993	0.878	1.031	0.905	1.022	1.028	1.050
1987	1.016	1.016	0.980	1.003	0.983	1.000	1.018	1.018
1988	0.968	0.977	0.970	1.015	0.985	0.995	1.010	1.005
1989	1.014	1.021	1.022	0.996	1.018	0.971	1.005	0.976
1990	1.017	1.023	0.995	1.012	1.007	0.982	1.005	0.987
1991	1.063	1.071	1.006	0.991	0.997	0.983	1.012	0.995
1992	1.012	1.044	0.960	1.008	0.968	0.999	1.003	1.002
1993	1.028	1.015	1.000	1.002	1.002	1.001	1.009	1.010
1994	1.046	1.047	0.986	0.997	0.983	1.009	1.007	1.016
1995	1.056	1.031	1.001	1.006	1.007	1.009	1.008	1.017
1996	1.101	1.043	1.034	1.000	1.034	1.009	1.011	1.021
1997	1.087	1.038	1.006	1.003	1.009	1.020	1.017	1.038
1998	0.977	0.991	0.944	1.004	0.948	1.019	1.021	1.040
1999	1.086	1.002	1.049	1.012	1.061	1.004	1.017	1.022
2000	1.225	1.051	1.179	0.982	1.158	0.998	1.009	1.007
2001	1.015	1.035	0.979	1.006	0.985	0.990	1.006	0.996
2002	0.981	1.029	0.941	1.018	0.959	0.991	1.002	0.994
2003	1.022	1.036	1.001	1.003	1.004	0.983	1.001	0.983
2004	1.100	1.036	1.058	0.990	1.047	1.006	1.007	1.013
2005	1.115	1.001	1.083	1.003	1.087	1.007	1.018	1.025
2006	1.090	0.982	1.070	1.000	1.070	1.015	1.022	1.037
2007	1.004	0.971	0.983	1.002	0.985	1.021	1.028	1.049
2008	1.087	0.972	1.071	1.002	1.073	1.016	1.026	1.042
2009	0.872	0.972	0.889	1.008	0.896	0.985	1.017	1.001
2010	1.033	0.994	1.024	1.009	1.033	0.999	1.007	1.006
2011	1.061	0.987	1.056	0.997	1.053	1.007	1.013	1.020
2012	1.041	0.998	1.003	1.010	1.012	1.011	1.019	1.030
2013	1.007	0.984	0.997	1.002	0.999	1.002	1.023	1.025
2014	0.989	1.000	0.980	0.989	0.969	1.006	1.014	1.020
2015	0.947	1.011	0.948	0.984	0.933	0.998	1.005	1.003
2016	0.954	1.000	0.951	1.002	0.954	0.994	1.007	1.001
2017	1.050	1.020	1.024	1.001	1.024	0.997	1.008	1.005
2018	1.057	0.991	1.058	0.991	1.049	1.009	1.007	1.017
	Geometric average annual growth rates, per cent*							
	(1) =(2)+(5)+(8)	(2)	(3)	(4)	(5) =(3)+(4)	(6)	(7)	(8) = (6)+(7)
1972-2018	3.38	1.47	0.21	-0.02	0.19	0.11	1.58	1.69
1972-1980	5.87	4.34	1.40	-1.87	-0.49	-0.14	2.11	1.96
1981-1990	0.44	-0.12	-2.48	1.20	-1.31	-0.25	2.15	1.90
1991-2000	6.63	3.31	1.47	0.05	1.52	0.50	1.16	1.67
2001-2010	2.95	0.26	0.81	0.41	1.22	0.11	1.32	1.44
2011-2018	1.22	-0.12	0.14	-0.30	-0.16	0.30	1.20	1.51
1972-1977	4.33	4.48	-0.79	-1.15	-1.93	-0.20	2.03	1.82
1978-1986	3.11	0.81	-0.73	0.01	-0.72	0.30	2.71	3.02
1987-1998	3.13	2.62	-0.82	0.31	-0.52	-0.04	1.06	1.02
1999-2007	6.86	1.57	3.60	0.18	3.78	0.15	1.22	1.37
2008-2013	1.43	-1.56	0.49	0.46	0.95	0.33	1.73	2.07
2014-2018	-0.18	0.44	-0.86	-0.66	-1.52	0.08	0.83	0.91

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.4 Cumulated growth in real GDI and contribution factors in the Norwegian market economy, 1972-2018

		Cumulative contributions to real GDI growth						
	G^t/G^{1972}	Γ^t	A_X^t	A_M^t	A_{XM}^t	B_L^t	B_K^t	B_{LK}^t
	Cumulative real GDI growth	MFP growth	Real export price growth	Real import price growth	Trading gains (TG)	Labor input growth	Capita input growth	Labor and Capital combined
								(Index, 1972 = 1.000)
Year	(1)=(2)*(5)*(8)	(2)	(3)	(4)	(5)=(3)*(4)	(6)	(7)	(8)=(6)*(7)
1972	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1973	1.058	1.032	1.025	0.992	1.016	0.999	1.010	1.009
1974	1.108	1.084	1.066	0.932	0.993	0.999	1.030	1.029
1975	1.144	1.156	1.010	0.938	0.947	0.996	1.049	1.045
1976	1.194	1.215	0.980	0.944	0.925	0.989	1.074	1.062
1977	1.236	1.245	0.961	0.944	0.907	0.990	1.106	1.095
1978	1.332	1.343	0.976	0.920	0.898	0.980	1.127	1.104
1979	1.409	1.370	1.036	0.886	0.917	0.975	1.150	1.121
1980	1.579	1.405	1.118	0.860	0.961	0.988	1.182	1.168
1981	1.589	1.370	1.113	0.874	0.973	0.989	1.203	1.191
1982	1.591	1.349	1.090	0.889	0.969	0.983	1.238	1.217
1983	1.663	1.393	1.079	0.887	0.957	0.977	1.275	1.246
1984	1.656	1.339	1.041	0.916	0.954	0.980	1.322	1.296
1985	1.725	1.347	1.025	0.916	0.939	0.995	1.369	1.362
1986	1.628	1.338	0.899	0.945	0.850	1.017	1.407	1.430
1987	1.654	1.360	0.881	0.947	0.835	1.017	1.432	1.456
1988	1.601	1.329	0.855	0.962	0.822	1.011	1.447	1.463
1989	1.623	1.357	0.874	0.957	0.837	0.982	1.454	1.428
1990	1.650	1.388	0.870	0.969	0.843	0.964	1.462	1.409
1991	1.754	1.487	0.875	0.960	0.840	0.948	1.479	1.403
1992	1.776	1.552	0.840	0.968	0.813	0.947	1.484	1.406
1993	1.826	1.576	0.840	0.970	0.815	0.948	1.498	1.420
1994	1.909	1.650	0.829	0.967	0.801	0.957	1.508	1.443
1995	2.016	1.701	0.829	0.973	0.807	0.965	1.521	1.468
1996	2.219	1.774	0.857	0.973	0.834	0.974	1.538	1.498
1997	2.412	1.842	0.862	0.976	0.842	0.994	1.564	1.554
1998	2.356	1.825	0.814	0.980	0.798	1.012	1.597	1.616
1999	2.559	1.828	0.854	0.992	0.847	1.016	1.625	1.651
2000	3.136	1.922	1.007	0.974	0.980	1.014	1.640	1.663
2001	3.184	1.990	0.986	0.980	0.966	1.004	1.650	1.655
2002	3.122	2.048	0.928	0.998	0.926	0.995	1.654	1.645
2003	3.191	2.121	0.928	1.001	0.929	0.978	1.655	1.618
2004	3.509	2.199	0.982	0.991	0.973	0.983	1.666	1.639
2005	3.912	2.201	1.064	0.994	1.057	0.990	1.696	1.679
2006	4.264	2.162	1.139	0.994	1.132	1.005	1.733	1.741
2007	4.280	2.100	1.119	0.996	1.115	1.026	1.781	1.827
2008	4.652	2.041	1.199	0.998	1.196	1.042	1.827	1.904
2009	4.057	1.984	1.066	1.006	1.072	1.026	1.857	1.907
2010	4.193	1.973	1.091	1.015	1.107	1.025	1.870	1.918
2011	4.446	1.947	1.153	1.011	1.166	1.033	1.894	1.957
2012	4.630	1.943	1.156	1.021	1.181	1.044	1.931	2.016
2013	4.662	1.911	1.152	1.023	1.180	1.046	1.974	2.066
2014	4.608	1.911	1.129	1.012	1.143	1.052	2.002	2.107
2015	4.363	1.932	1.071	0.997	1.067	1.050	2.013	2.114
2016	4.164	1.932	1.019	0.999	1.017	1.044	2.027	2.116
2017	4.372	1.971	1.043	0.999	1.042	1.041	2.043	2.126
2018	4.619	1.953	1.104	0.990	1.093	1.051	2.058	2.162
	Geometric average contributions to real GDI growth, per cent*							
	(1) = (2)+(5)+(8)	(2)	(3)	(4)	(5) = (3)+(4)	(6)	(7)	(8) = (6)+(7)
1972-2018	100.00	43.35	6.34	-0.63	5.71	3.18	46.74	49.97
1972-1980	100.00	73.92	23.90	-31.79	-8.34	-2.46	35.91	33.40
1981-1990	100.00	-27.00	-558.0	269.68	-294.98	-55.78	483.73	426.76
1991-2000	100.00	49.89	22.17	0.81	22.99	7.59	17.45	25.14
2001-2010	100.00	8.77	27.58	13.87	41.56	3.82	44.93	48.81
2011-2018	100.00	-10.01	11.40	-24.84	-13.47	24.96	98.53	123.79
1972-1977	100.00	103.43	-18.30	-26.52	-44.61	-4.72	46.94	42.12
1978-1986	100.00	25.93	-23.66	0.38	-23.28	9.63	87.26	97.15
1987-1998	100.00	83.67	-26.32	9.79	-16.61	-1.21	33.93	32.70
1999-2007	100.00	22.93	52.49	2.56	55.14	2.21	17.75	19.99
2008-2013	100.00	-108.6	34.00	31.97	66.13	22.83	121.14	144.36
2014-2018	100.00	-237.3	470.08	358.86	825.85	-44.53	-452.4	-497.28

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.5 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018

	Total			Goods			Services		
	TG	TOT	RER	TG	TOT	RER	TG	TOT	RER
								(Growth factors)	
Year	(1) = (2)*(3)	(2)	(3)	(4) = (5)*(6)	(5)	(6)	(7) = (8)*(9)	(8)	(9)
1973	1.016	1.016	1.000	1.011	1.014	0.997	1.005	1.000	1.005
1974	0.977	0.979	0.998	0.983	1.000	0.983	0.994	0.992	1.002
1975	0.954	0.950	1.003	0.992	0.984	1.008	0.962	0.965	0.997
1976	0.977	0.973	1.003	0.991	0.987	1.004	0.986	0.988	0.997
1977	0.980	0.978	1.002	0.995	0.994	1.001	0.986	0.987	0.998
1978	0.990	0.993	0.998	0.987	0.988	0.999	1.004	1.001	1.003
1979	1.021	1.020	1.002	1.014	1.016	0.998	1.007	1.003	1.005
1980	1.048	1.042	1.006	1.037	1.037	1.000	1.011	1.006	1.004
1981	1.012	1.014	0.998	1.022	1.023	1.000	0.990	0.992	0.997
1982	0.996	0.999	0.997	1.003	1.004	0.999	0.993	0.994	0.999
1983	0.988	0.989	0.999	0.991	0.992	0.999	0.997	0.997	1.000
1984	0.996	1.004	0.992	0.998	1.004	0.995	0.998	0.999	0.998
1985	0.985	0.986	0.999	0.991	0.993	0.998	0.993	0.993	1.000
1986	0.905	0.909	0.996	0.910	0.912	0.997	0.994	0.995	0.999
1987	0.983	0.982	1.001	0.982	0.980	1.002	1.001	1.001	1.000
1988	0.985	0.984	1.001	0.983	0.982	1.001	1.003	1.002	1.000
1989	1.018	1.017	1.001	1.014	1.014	1.000	1.004	1.004	1.000
1990	1.007	1.008	0.999	1.011	1.012	0.999	0.996	0.996	1.000
1991	0.997	0.995	1.001	0.993	0.993	1.000	1.004	1.003	1.001
1992	0.968	0.973	0.995	0.977	0.982	0.995	0.991	0.991	1.000
1993	1.002	1.002	1.000	0.996	0.997	0.999	1.006	1.005	1.000
1994	0.983	0.984	0.999	0.987	0.988	0.999	0.996	0.996	1.000
1995	1.007	1.008	0.999	1.007	1.008	1.000	1.000	1.000	1.000
1996	1.034	1.031	1.003	1.035	1.032	1.003	0.999	0.999	1.000
1997	1.009	1.009	1.000	1.004	1.005	0.999	1.004	1.004	1.000
1998	0.948	0.952	0.996	0.952	0.957	0.995	0.996	0.996	1.000
1999	1.061	1.059	1.002	1.059	1.057	1.002	1.002	1.002	1.000
2000	1.158	1.127	1.027	1.149	1.116	1.030	1.007	1.007	1.001
2001	0.985	0.991	0.994	0.975	0.984	0.990	1.011	1.010	1.001
2002	0.959	0.973	0.985	0.961	0.979	0.982	0.997	0.997	1.000
2003	1.004	1.004	0.999	1.003	1.006	0.997	1.000	1.000	1.000
2004	1.047	1.035	1.011	1.049	1.037	1.012	0.998	0.998	1.000
2005	1.087	1.073	1.013	1.082	1.067	1.015	1.004	1.004	1.000
2006	1.070	1.057	1.013	1.068	1.050	1.017	1.002	1.003	1.000
2007	0.985	0.988	0.997	0.983	0.987	0.996	1.002	1.002	1.000
2008	1.073	1.061	1.011	1.067	1.052	1.014	1.006	1.006	1.000
2009	0.896	0.916	0.979	0.903	0.927	0.974	0.993	0.993	1.000
2010	1.033	1.031	1.002	1.037	1.034	1.003	0.996	0.996	1.000
2011	1.053	1.044	1.009	1.060	1.046	1.014	0.993	0.993	1.000
2012	1.012	1.014	0.998	1.011	1.012	0.999	1.001	1.001	1.000
2013	0.999	1.000	0.999	0.998	1.000	0.999	1.001	1.001	1.000
2014	0.969	0.970	0.999	0.972	0.975	0.997	0.997	0.997	1.000
2015	0.933	0.936	0.997	0.940	0.946	0.994	0.993	0.993	1.000
2016	0.954	0.956	0.997	0.960	0.963	0.996	0.994	0.993	1.000
2017	1.024	1.023	1.001	1.026	1.023	1.003	0.998	0.997	1.001
2018	1.049	1.044	1.004	1.050	1.042	1.008	0.998	0.999	1.000
	Geometric average annual growth rates, per cent*								
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)	(7) = (8)+(9)	(8)	(9)
1972-2018	0.19	0.14	0.06	0.39	0.37	0.01	-0.19	-0.21	0.02
1972-1980	-0.49	-0.64	0.15	0.09	0.24	-0.15	-0.58	-0.73	0.15
1981-1990	-1.31	-1.14	-0.17	-0.99	-0.90	-0.10	-0.32	-0.25	-0.07
1991-2000	1.52	1.29	0.23	1.48	1.26	0.22	0.04	0.02	0.02
2001-2010	1.22	1.19	0.03	1.12	1.15	-0.03	0.10	0.09	0.02
2011-2018	-0.16	-0.22	0.05	0.15	0.04	0.11	-0.31	-0.32	0.01
1972-1977	-1.93	-2.08	0.15	-0.58	-0.43	-0.16	-1.36	-1.36	0.00
1978-1986	-0.72	-0.57	-0.15	-0.58	-0.40	-0.17	-0.15	-0.21	0.06
1987-1998	-0.52	-0.49	-0.03	-0.51	-0.44	-0.06	-0.01	-0.02	0.01
1999-2007	3.78	3.31	0.45	3.50	3.05	0.44	0.27	0.25	0.03
2008-2013	0.95	0.99	-0.04	1.12	1.09	0.03	-0.17	-0.18	0.01
2014-2018	-1.52	-1.48	-0.03	-1.12	-1.06	-0.06	-0.40	-0.41	0.01

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.6 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018, in categories of Goods

		Crude oil and natural gas			Ships, oilplatforms, aircraft			Other goods	
	TG	TOT	RER	TG	TOT	RER	TG	TOT	RER
						(Growth factors)			
Year	(1) = (2)*(3)	(2)	(3)	(4) = (5)*(6)	(5)	(6)	(7) = (8)*(9)	(8)	(9)
1973	1.000	1.002	0.998	1.006	1.008	0.998	1.005	1.005	1.000
1974	0.988	1.001	0.986	0.996	0.996	1.000	0.999	1.010	0.989
1975	0.998	0.998	1.001	0.989	0.985	1.004	1.004	1.002	1.002
1976	0.999	0.999	1.000	0.994	0.994	1.000	0.998	0.994	1.005
1977	1.002	1.002	1.000	0.992	0.992	1.000	1.000	0.999	1.001
1978	1.000	1.001	0.999	1.003	1.003	1.000	0.983	0.985	0.999
1979	1.016	1.001	1.014	1.001	1.001	0.999	0.998	1.005	0.992
1980	1.039	1.001	1.038	1.000	1.001	1.000	0.998	1.002	0.996
1981	1.017	1.003	1.014	0.999	0.999	1.000	1.006	0.999	1.007
1982	1.003	1.003	1.000	0.994	0.993	1.001	1.005	0.999	1.007
1983	0.998	1.004	0.993	0.994	0.994	1.000	0.999	0.999	1.000
1984	0.989	1.002	0.987	0.998	0.996	1.001	1.012	1.007	1.005
1985	0.996	0.997	0.999	0.995	0.995	1.000	1.000	0.998	1.002
1986	0.905	0.986	0.918	1.000	1.000	1.000	1.003	0.994	1.009
1987	0.976	0.990	0.987	1.001	1.001	1.000	1.004	1.001	1.003
1988	0.968	0.993	0.975	0.998	0.999	0.999	1.017	1.017	1.000
1989	1.016	1.000	1.017	0.994	0.998	0.996	1.003	1.003	1.000
1990	1.020	1.003	1.017	1.001	1.000	1.001	0.991	0.987	1.004
1991	0.992	0.999	0.993	1.000	1.000	1.000	1.001	1.002	0.999
1992	0.982	1.004	0.979	1.000	1.000	1.000	0.995	0.991	1.004
1993	0.998	1.000	0.998	1.000	1.000	1.000	0.998	0.997	1.002
1994	0.984	0.994	0.989	1.001	1.001	1.000	1.002	1.004	0.999
1995	0.992	1.001	0.991	1.001	1.001	1.000	1.014	1.016	0.998
1996	1.037	1.004	1.033	1.000	1.000	1.000	0.998	0.996	1.002
1997	1.002	1.005	0.998	0.998	0.999	0.999	1.004	1.002	1.002
1998	0.948	0.988	0.960	1.001	1.001	1.000	1.003	1.003	1.001
1999	1.049	1.011	1.037	1.001	1.001	1.000	1.009	1.006	1.003
2000	1.145	1.017	1.126	0.998	0.999	0.999	1.007	1.011	0.996
2001	0.973	1.002	0.972	0.999	1.000	1.000	1.002	1.000	1.002
2002	0.960	0.993	0.967	1.000	1.000	1.000	1.001	0.995	1.005
2003	1.002	1.002	1.000	1.001	1.001	1.000	1.000	0.999	1.002
2004	1.043	1.012	1.031	1.000	1.000	1.000	1.006	1.009	0.997
2005	1.075	1.010	1.064	0.999	0.999	1.000	1.007	1.007	1.000
2006	1.057	1.013	1.043	1.000	1.000	1.000	1.011	1.014	0.997
2007	0.984	0.990	0.994	1.000	1.000	1.000	0.999	0.998	1.001
2008	1.068	1.013	1.054	1.000	1.000	1.000	0.999	0.998	1.001
2009	0.907	0.977	0.928	1.001	1.002	0.999	0.994	0.990	1.004
2010	1.026	1.001	1.025	1.000	0.999	1.001	1.010	1.010	1.001
2011	1.058	1.004	1.054	1.000	1.000	1.000	1.001	1.003	0.998
2012	1.012	1.001	1.011	1.000	1.000	1.000	0.999	0.997	1.003
2013	0.996	1.007	0.990	1.000	1.000	1.000	1.003	1.002	1.000
2014	0.975	0.993	0.982	1.000	1.001	0.999	0.997	0.998	0.999
2015	0.947	0.999	0.948	0.999	1.000	0.999	0.994	0.996	0.998
2016	0.956	0.995	0.960	1.000	1.000	1.000	1.004	1.005	0.999
2017	1.025	0.995	1.030	1.000	1.000	1.000	1.001	1.003	0.998
2018	1.051	1.001	1.050	0.999	1.000	1.000	1.000	1.003	0.997
					Geometric average annual growth rates, per cent*				
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)	(7) = (8)+(9)	(8)	(9)
1972-2018	0.30	0.04	0.26	-0.10	-0.09	-0.01	0.19	0.13	0.06
1972-1980	0.51	0.06	0.45	-0.23	-0.24	0.01	-0.19	0.03	-0.22
1981-1990	-1.16	-0.18	-0.98	-0.25	-0.24	-0.02	0.41	0.03	0.38
1991-2000	1.17	0.22	0.95	-0.01	0.01	-0.02	0.33	0.28	0.05
2001-2010	0.83	0.14	0.69	0.00	0.00	0.00	0.29	0.19	0.10
2011-2018	0.18	-0.07	0.25	-0.01	0.01	-0.02	-0.01	0.09	-0.10
1972-1977	-0.26	0.04	-0.30	-0.45	-0.48	0.03	0.12	0.20	-0.08
1978-1986	-0.48	-0.01	-0.46	-0.16	-0.18	0.02	0.05	-0.13	0.19
1987-1998	-0.72	-0.17	-0.56	-0.05	-0.01	-0.04	0.27	0.15	0.12
1999-2007	3.05	0.56	2.48	-0.02	0.00	-0.01	0.47	0.43	0.03
2008-2013	0.99	0.04	0.94	0.01	0.02	-0.01	0.11	0.00	0.11
2014-2018	-1.01	-0.35	-0.66	-0.02	0.01	-0.03	-0.09	0.09	-0.18

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.7 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018, in categories of Other goods (1)

+	Agriculture, forestry and fishing			Mining and quarrying		
	TG	TOT	RER	TG	TOT	RER
						(Growth factors)
Year	(1) = (2) * (3)	(2)	(3)	(4) = (5) * (6)	(5)	(6)
1973	0.997	1.000	0.997	1.001	1.001	1.000
1974	0.994	0.996	0.998	0.998	0.998	1.000
1975	1.001	0.998	1.003	1.000	1.000	1.000
1976	1.003	1.003	1.000	1.000	1.000	1.000
1977	0.999	1.000	1.000	1.000	1.000	1.000
1978	1.001	1.001	1.000	1.000	1.000	1.000
1979	1.001	1.002	0.999	1.000	1.000	1.000
1980	0.999	0.999	1.000	1.000	1.000	1.000
1981	1.001	0.999	1.002	0.999	0.999	1.000
1982	1.001	1.000	1.001	1.000	1.000	1.000
1983	0.999	0.998	1.001	1.000	1.000	1.000
1984	1.000	1.000	1.000	1.000	1.000	1.000
1985	1.001	1.001	1.000	1.000	1.000	1.000
1986	0.999	0.998	1.001	1.001	1.000	1.000
1987	1.003	1.002	1.000	1.000	1.000	1.000
1988	1.000	1.000	1.000	1.000	1.000	1.000
1989	0.998	0.998	1.000	1.000	1.000	1.000
1990	1.000	1.000	1.000	1.000	1.000	1.000
1991	0.999	0.999	1.000	1.000	1.000	1.000
1992	1.001	1.001	1.000	1.000	1.000	1.000
1993	1.000	1.000	1.000	1.000	1.000	1.000
1994	1.000	1.000	1.000	0.999	0.999	1.000
1995	0.998	0.998	1.000	1.000	1.000	1.000
1996	0.999	0.999	1.000	1.000	1.000	1.000
1997	1.000	1.000	1.000	1.000	1.000	1.000
1998	1.000	1.000	1.000	1.000	1.000	1.000
1999	1.000	1.000	1.000	1.000	1.000	1.000
2000	1.000	1.000	1.000	1.000	1.000	1.000
2001	1.000	1.000	1.000	1.000	1.000	1.000
2002	0.999	0.999	1.000	1.000	1.000	1.000
2003	0.999	0.999	1.000	1.000	1.000	1.000
2004	1.000	1.000	1.000	1.000	1.000	1.000
2005	1.001	1.001	1.000	1.000	1.000	1.000
2006	1.001	1.001	1.000	1.000	1.000	1.000
2007	0.998	0.998	1.000	1.000	1.000	1.000
2008	0.999	0.999	1.000	1.001	1.001	1.000
2009	1.001	1.000	1.000	1.000	1.000	1.000
2010	1.002	1.002	1.000	1.000	1.000	1.000
2011	0.998	0.998	1.000	1.000	1.000	1.000
2012	0.998	0.999	0.999	1.000	1.000	1.000
2013	1.004	1.003	1.001	1.000	1.000	1.000
2014	1.000	1.000	1.000	1.000	1.000	1.000
2015	1.000	0.999	1.001	1.000	1.000	1.000
2016	1.007	1.004	1.002	1.000	1.000	1.000
2017	1.000	1.000	1.000	0.999	0.999	1.000
2018	1.000	1.000	1.000	1.000	1.000	1.000
	Geometric average annual growth rates, per cent*					
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)
1972-2018	0.01	-0.01	0.02	0.00	0.00	0.00
1972-1980	-0.05	-0.03	-0.02	-0.03	-0.02	0.00
1981-1990	0.02	-0.03	0.05	0.00	0.00	0.00
1991-2000	-0.02	-0.02	0.00	0.00	0.00	0.00
2001-2010	0.02	0.01	0.00	0.01	0.01	0.00
2011-2018	0.08	0.04	0.04	-0.01	0.00	0.00
1972-1977	-0.10	-0.07	-0.03	-0.03	-0.03	0.00
1978-1986	0.03	-0.02	0.05	0.00	0.00	0.00
1987-1998	-0.02	-0.02	0.01	0.00	0.00	0.00
1999-2007	0.00	0.00	0.00	0.00	0.00	0.00
2008-2013	0.04	0.03	0.01	0.02	0.02	0.00
2014-2018	0.12	0.06		0.06	-0.02	-0.02 0.00

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.8 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018, in categories of Other goods (2)

	Manufacturing products			Electricity		
	TG	TOT	RER	TG	TOT	RER
	(Growth factors)					
Year	(1) = (2) * (3)	(2)	(3)	(4) = (5) * (6)	(5)	(6)
1973	1.006	1.006	1.000	1.000	1.000	1.000
1974	1.006	1.014	0.992	1.001	1.000	1.001
1975	1.005	1.003	1.002	0.999	1.000	0.999
1976	0.995	0.992	1.004	1.000	1.000	1.000
1977	1.000	0.999	1.001	1.000	1.000	1.000
1978	0.983	0.985	0.998	1.000	1.000	1.000
1979	0.996	1.003	0.993	1.000	1.000	1.000
1980	0.999	1.002	0.996	1.000	1.000	1.000
1981	1.007	1.000	1.006	1.000	1.000	1.000
1982	1.004	0.998	1.006	1.000	1.000	1.000
1983	1.002	1.002	1.000	0.998	0.999	0.999
1984	1.011	1.007	1.004	1.000	1.001	1.000
1985	0.998	0.995	1.002	1.001	1.001	1.000
1986	1.004	0.996	1.008	1.000	1.000	1.000
1987	1.001	0.998	1.003	1.000	1.000	1.000
1988	1.017	1.017	1.000	1.000	1.000	1.000
1989	1.006	1.006	1.000	1.000	1.000	1.000
1990	0.991	0.987	1.004	1.000	1.000	1.000
1991	1.001	1.001	1.000	1.001	1.001	1.000
1992	0.995	0.991	1.004	0.999	1.000	1.000
1993	0.998	0.996	1.002	1.001	1.001	1.000
1994	1.003	1.004	0.999	1.000	1.000	1.000
1995	1.016	1.019	0.998	1.000	1.000	1.000
1996	1.000	0.998	1.003	0.999	0.999	0.999
1997	1.004	1.003	1.002	1.000	0.999	1.001
1998	1.003	1.002	1.001	1.000	1.000	1.000
1999	1.009	1.006	1.003	1.000	1.000	1.000
2000	1.007	1.011	0.996	1.000	1.000	1.000
2001	1.001	0.999	1.002	1.000	1.000	1.000
2002	1.002	0.996	1.006	1.000	0.999	1.000
2003	1.000	0.998	1.002	1.001	1.001	1.000
2004	1.004	1.007	0.997	1.001	1.000	1.000
2005	1.007	1.006	1.000	1.000	1.000	1.000
2006	1.009	1.012	0.997	1.000	1.000	1.000
2007	1.002	1.002	1.000	0.999	1.000	1.000
2008	0.998	0.996	1.002	1.001	1.000	1.001
2009	0.994	0.990	1.005	0.999	1.000	1.000
2010	1.008	1.006	1.001	1.000	1.000	1.000
2011	1.004	1.007	0.997	0.999	0.999	1.000
2012	1.001	0.999	1.002	1.000	1.001	1.000
2013	0.998	0.996	1.002	1.000	1.000	1.000
2014	0.997	0.999	0.998	1.000	1.000	1.000
2015	0.994	0.996	0.998	1.000	1.000	1.000
2016	0.997	0.995	1.002	1.000	1.000	1.000
2017	1.002	1.005	0.998	1.000	1.000	1.000
2018	1.000	1.003	0.997	1.001	1.000	1.001
	Geometric average annual growth rates, per cent*					
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)
1972-2018	0.18	0.12	0.06	0.00	0.00	0.01
1972-1980	-0.13	0.05	-0.18	0.01	0.01	0.00
1981-1990	0.40	0.06	0.34	-0.01	0.00	-0.01
1991-2000	0.35	0.30	0.05	0.00	-0.01	0.01
2001-2010	0.25	0.13	0.11	0.02	0.00	0.01
2011-2018	-0.09	0.00	-0.09	0.01	0.00	0.01
1972-1977	0.24	0.28	-0.04	0.01	0.01	0.00
1978-1986	0.03	-0.13	0.16	-0.01	0.00	-0.01
1987-1998	0.29	0.18	0.11	0.00	-0.01	0.01
1999-2007	0.46	0.43	0.03	0.01	0.00	0.01
2008-2013	0.04	-0.11	0.15	0.01	0.00	0.01
2014-2018	-0.20	-0.04	-0.16	0.02	0.00	0.01

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.9 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018, in categories of Manufacturing products (1)

	Food products, beverages and tobacco			Textiles, wearing apparel, leather			Wood products		
	TG	TOT	RER	TG	TOT	RER	TG	TOT	RER
	(Growth factors)								
Year	(1) = (2)*(3)	(2)	(3)	(4) = (5)*(6)	(5)	(6)	(7) = (8)*(9)	(8)	(9)
1973	1.005	1.002	1.003	1.001	1.001	1.000	1.000	1.000	1.000
1974	1.002	1.000	1.002	1.000	1.000	1.000	1.000	1.000	1.000
1975	0.993	0.996	0.996	1.001	1.000	1.001	1.000	1.000	1.000
1976	1.003	1.003	1.000	1.001	0.999	1.001	0.999	0.999	1.000
1977	1.002	1.001	1.001	1.000	1.000	1.000	1.000	1.001	1.000
1978	1.001	1.000	1.000	0.998	0.999	0.999	1.000	0.999	1.000
1979	0.998	0.999	1.000	0.999	1.000	0.999	1.000	1.000	1.000
1980	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1981	0.999	1.000	0.999	1.003	1.001	1.002	1.000	1.000	1.000
1982	0.999	1.000	0.999	1.001	1.000	1.001	1.000	1.000	1.001
1983	1.001	1.001	1.000	1.000	0.999	1.001	1.000	1.000	1.000
1984	0.998	0.999	0.999	1.001	1.000	1.001	1.000	1.000	1.000
1985	1.001	1.001	1.000	0.999	0.999	1.000	1.000	1.000	1.000
1986	1.002	1.002	1.000	1.000	1.000	0.999	1.000	1.000	1.000
1987	1.001	1.001	1.000	1.001	1.000	1.001	1.000	1.000	1.000
1988	1.000	1.001	1.000	1.000	0.999	1.001	1.000	1.000	1.000
1989	0.999	0.999	0.999	1.003	1.001	1.002	1.000	1.000	1.000
1990	1.000	1.000	1.000	1.000	0.999	1.001	1.000	1.000	1.000
1991	1.002	1.001	1.001	1.000	1.000	0.999	1.000	1.000	1.000
1992	0.998	0.999	1.000	1.001	1.000	1.000	1.000	1.000	1.000
1993	0.999	0.999	1.000	1.000	1.000	1.001	1.000	1.000	1.000
1994	0.999	0.999	1.000	1.000	1.000	1.001	1.000	1.000	1.000
1995	1.000	0.999	1.000	1.001	1.000	1.001	1.000	1.000	1.000
1996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1997	1.000	1.000	1.000	0.999	0.999	1.000	1.000	1.000	1.000
1998	1.002	1.000	1.001	1.000	0.999	1.000	1.000	1.000	1.000
1999	1.000	1.001	1.000	1.001	1.001	1.000	1.000	1.000	1.000
2000	1.001	1.001	1.000	1.001	1.001	1.000	1.000	1.000	1.000
2001	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002	0.999	0.999	1.000	1.001	1.001	1.001	1.000	1.000	1.000
2003	0.998	0.999	1.000	1.001	1.000	1.001	1.000	1.000	1.000
2004	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2005	1.002	1.002	1.000	1.001	1.000	1.001	1.000	1.000	1.000
2006	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2007	0.999	0.999	1.000	1.000	1.000	1.001	1.000	1.000	1.000
2008	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2009	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2010	1.001	1.001	1.000	1.001	1.000	1.001	1.000	1.000	1.000
2011	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2012	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2013	0.999	0.999	1.000	1.000	0.999	1.001	1.000	1.000	1.000
2014	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2015	1.000	1.000	1.000	0.999	1.000	0.999	1.000	1.000	1.000
2016	1.001	1.002	1.000	0.999	1.000	0.999	1.000	1.000	1.000
2017	1.000	1.000	1.000	1.000	0.999	1.000	1.000	1.000	1.000
2018	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Geometric average annual growth rates, per cent*								
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)	(7) = (8)+(9)	(8)	(9)
1972-2018	0.01	0.01	0.00	0.02	-0.01	0.03	0.00	0.00	0.00
1972-1980	0.06	0.02	0.04	-0.01	-0.01	0.01	-0.01	0.00	-0.01
1981-1990	0.00	0.03	-0.03	0.07	-0.01	0.08	0.01	0.00	0.01
1991-2000	0.01	-0.01	0.01	0.02	0.00	0.03	0.00	0.00	0.00
2001-2010	-0.02	-0.01	-0.01	0.04	0.00	0.04	0.01	0.00	0.01
2011-2018	0.01	0.02	-0.01	-0.05	-0.04	-0.01	-0.01	0.00	0.00
1972-1977	0.09	0.03	0.06	0.06	0.00	0.06	0.01	0.01	0.00
1978-1986	0.00	0.02	-0.02	0.00	-0.02	0.02	0.00	-0.01	0.01
1987-1998	0.00	-0.01	0.01	0.04	-0.01	0.05	0.01	0.01	0.00
1999-2007	0.00	0.01	-0.01	0.06	0.02	0.04	0.00	0.00	0.00
2008-2013	-0.02	-0.02	0.00	0.00	-0.03	0.03	0.01	0.00	0.01
2014-2018	0.03	0.04	-0.01	-0.06	-0.03	-0.03	-0.01	0.00	-0.01

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.10 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018, in categories of Manufacturing products (2)

	Pulp, paper and paper products & Printing and publishing			Refined petroleum products			Basic chemicals, chemical and mineral products		
	TG	TOT	RER	TG	TOT	RER	TG	TOT	RER
				(Growth factors)					
Year	(1) = (2)*(3)	(2)	(3)	(4) = (5)*(6)	(5)	(6)	(7) = (8)*(9)	(8)	(9)
1973	1.000	1.001	1.000	0.995	1.001	0.995	1.001	1.001	1.001
1974	1.007	1.002	1.005	0.988	1.004	0.984	1.001	1.003	0.998
1975	1.002	1.001	1.001	1.005	1.001	1.004	1.003	1.003	1.000
1976	0.997	0.999	0.998	0.999	0.999	1.000	1.000	0.998	1.001
1977	0.999	1.000	0.999	1.000	1.000	1.000	1.000	0.999	1.001
1978	1.000	1.000	1.000	1.001	1.001	1.000	0.999	0.999	1.000
1979	1.001	1.001	1.001	0.992	1.001	0.990	1.000	1.001	0.999
1980	1.000	1.000	1.001	0.994	0.998	0.996	1.000	1.001	0.999
1981	1.000	1.000	1.000	0.998	0.999	0.999	1.000	1.000	1.001
1982	1.000	1.000	1.000	1.002	1.001	1.001	1.001	1.000	1.001
1983	0.999	1.000	1.000	1.000	1.000	1.001	0.999	0.999	1.000
1984	0.999	1.000	1.000	1.000	0.999	1.001	1.001	1.001	1.000
1985	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000
1986	1.000	1.000	1.000	1.010	1.001	1.008	0.999	0.999	1.001
1987	1.000	1.000	1.000	1.000	0.999	1.001	1.001	1.000	1.001
1988	1.001	1.001	1.000	1.002	1.001	1.001	1.001	1.001	1.000
1989	1.001	1.001	1.000	0.999	1.000	0.999	0.999	0.999	1.000
1990	0.999	1.000	1.000	1.000	1.000	1.000	0.998	0.998	1.001
1991	1.000	1.000	1.000	1.002	1.002	1.000	0.999	0.999	1.000
1992	0.999	0.999	1.000	1.000	1.000	0.999	0.999	0.999	1.001
1993	0.999	1.000	0.999	1.000	1.000	1.000	1.001	1.001	1.000
1994	1.000	1.000	1.000	0.999	0.999	1.000	1.001	1.001	1.000
1995	1.003	1.002	1.001	1.000	1.000	1.000	1.004	1.004	0.999
1996	0.998	0.998	0.999	1.000	1.000	1.000	1.001	1.001	1.000
1997	0.999	0.999	0.999	1.001	1.001	1.000	1.000	1.000	1.000
1998	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1999	1.000	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.000
2000	1.000	1.000	1.000	1.002	1.001	1.001	1.001	1.001	0.999
2001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002	0.999	0.999	0.999	1.000	1.000	1.000	1.000	0.999	1.001
2003	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2004	1.000	1.000	1.000	1.000	0.999	1.000	1.001	1.001	1.000
2005	1.000	1.000	1.000	1.000	1.000	1.001	1.001	1.001	1.000
2006	1.000	1.000	1.000	1.001	1.000	1.000	1.001	1.001	1.000
2007	1.000	1.000	1.000	1.000	1.000	1.000	1.002	1.002	1.000
2008	1.000	1.000	1.000	1.000	0.999	1.001	0.999	1.000	1.000
2009	1.000	1.000	1.000	1.000	1.001	0.999	0.998	0.998	1.000
2010	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.001
2011	1.000	1.000	1.000	1.001	1.001	1.000	1.000	1.001	1.000
2012	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000
2013	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.999	1.000
2014	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000
2015	1.000	1.000	1.000	0.998	0.999	0.999	0.999	1.000	0.999
2016	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.999	1.000
2017	1.000	1.000	1.000	0.999	1.000	1.000	1.001	1.001	1.000
2018	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
				Geometric average annual growth rates, per cent*					
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)	(7) = (8)+(9)	(8)	(9)
1972-2018	0.01	0.00	0.00	-0.02	0.02	-0.04	0.02	0.01	0.01
1972-1980	0.08	0.03	0.05	-0.33	0.06	-0.39	0.04	0.06	-0.02
1981-1990	-0.01	0.01	-0.02	0.13	0.02	0.11	0.02	-0.02	0.04
1991-2000	-0.01	-0.01	0.00	0.04	0.03	0.01	0.05	0.05	0.00
2001-2010	-0.02	-0.01	-0.01	0.01	0.00	0.01	0.02	0.00	0.02
2011-2018	0.00	0.00	0.00	-0.01	0.00	-0.01	-0.03	-0.02	-0.01
1972-1977	0.12	0.06	0.06	-0.26	0.10	-0.36	0.10	0.10	0.00
1978-1986	-0.01	0.00	-0.01	-0.02	0.01	-0.03	0.00	-0.01	0.01
1987-1998	-0.01	0.00	-0.01	0.02	0.02	0.00	0.04	0.02	0.01
1999-2007	-0.01	-0.01	-0.01	0.04	0.01	0.03	0.05	0.05	0.00
2008-2013	0.00	0.00	0.00	0.02	0.02	0.00	-0.05	-0.06	0.02
2014-2018	0.00	0.00	0.00	-0.03	-0.01	-0.01	-0.04	-0.02	-0.02

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.11 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018, in categories of Manufacturing products (3)

	Basic metals			Machinery and other equipment n.e.c			Furniture and other manufacturing products & Transport equipment, non-competitive imports		
	TG	TOT	RER	TG	TOT	RER	TG	TOT	RER
	(Growth factors)								
Year	(1) = (2)*(3)	(2)	(3)	(4) = (5)*(6)	(5)	(6)	(7) = (8)*(9)	(8)	(9)
1973	0.998	0.999	0.999	1.005	1.001	1.003	1.001	1.000	1.000
1974	1.005	1.004	1.001	1.002	1.002	1.000	1.000	1.000	1.000
1975	1.001	1.001	1.000	0.999	1.003	0.996	1.000	1.000	1.000
1976	0.998	0.998	1.000	0.999	0.998	1.001	0.999	1.000	1.000
1977	1.002	1.003	1.000	0.997	0.996	1.001	0.999	0.999	1.000
1978	1.001	1.001	1.000	0.991	0.992	0.999	0.995	0.995	1.000
1979	1.003	1.001	1.002	1.002	1.002	1.000	1.001	1.002	0.999
1980	1.002	1.001	1.001	0.999	0.997	1.002	1.002	1.001	1.000
1981	0.997	0.998	0.999	1.008	1.006	1.002	1.001	0.999	1.002
1982	0.997	0.997	1.000	1.003	1.002	1.002	1.000	1.000	1.001
1983	1.003	1.003	1.000	1.000	1.001	0.999	0.999	0.999	1.000
1984	1.005	1.005	1.000	1.005	1.000	1.005	1.001	1.000	1.001
1985	0.997	0.997	1.000	1.000	0.999	1.001	1.001	1.000	1.000
1986	0.996	0.997	0.999	1.000	1.001	0.999	0.998	1.000	0.998
1987	1.000	1.000	1.000	0.999	0.999	1.000	0.999	0.999	1.000
1988	1.006	1.005	1.001	1.005	1.002	1.003	1.000	1.000	1.000
1989	1.002	1.000	1.002	1.003	1.001	1.002	1.001	1.000	1.001
1990	0.990	0.993	0.997	1.003	1.001	1.002	1.001	1.000	1.000
1991	0.999	0.999	1.000	1.001	1.002	0.999	0.999	1.000	0.999
1992	0.998	0.999	0.999	1.000	0.999	1.001	1.001	1.001	1.000
1993	0.999	0.999	1.000	0.999	0.999	1.000	1.000	1.000	1.000
1994	1.004	1.004	1.000	1.000	0.999	1.002	0.999	1.000	1.000
1995	1.006	1.006	1.000	1.003	1.001	1.002	1.000	1.000	1.001
1996	0.997	0.998	1.000	1.004	1.003	1.002	1.000	1.000	1.000
1997	1.001	1.001	1.000	1.005	1.003	1.002	1.000	1.000	1.000
1998	1.001	1.001	1.000	1.000	1.000	1.001	0.999	0.999	1.000
1999	1.002	1.002	1.000	1.003	1.000	1.003	1.001	1.000	1.001
2000	1.001	0.999	1.002	1.001	1.000	1.001	1.001	1.000	1.000
2001	0.998	0.999	1.000	1.002	1.001	1.001	1.000	1.000	1.000
2002	0.998	0.999	0.999	1.005	1.002	1.003	1.000	1.000	1.001
2003	0.999	1.000	1.000	1.003	1.001	1.002	1.001	1.000	1.000
2004	1.001	1.000	1.001	1.001	1.001	1.001	1.000	1.000	1.000
2005	0.998	0.998	1.000	1.003	1.001	1.003	1.000	1.000	1.001
2006	1.005	1.005	1.001	1.001	1.000	1.001	1.001	1.001	1.000
2007	0.998	0.998	1.000	1.002	1.000	1.002	1.001	1.000	1.001
2008	0.998	0.999	1.000	1.000	0.999	1.001	1.000	1.000	1.000
2009	0.996	0.997	1.000	1.001	1.002	0.999	1.000	1.000	0.999
2010	1.002	1.002	1.000	1.003	1.001	1.002	1.001	1.000	1.001
2011	1.002	1.001	1.000	1.000	0.999	1.001	1.000	1.000	1.000
2012	1.000	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.001
2013	1.000	1.000	1.000	1.001	1.000	1.001	1.000	1.000	1.000
2014	0.999	0.999	1.000	0.999	0.999	1.000	1.000	1.000	1.000
2015	1.000	1.000	1.000	0.999	1.000	0.999	1.000	1.001	0.999
2016	0.999	0.999	1.000	0.998	0.998	1.000	0.999	1.000	0.999
2017	1.002	1.002	1.000	0.999	0.999	1.001	1.000	0.999	1.001
2018	0.999	0.999	1.000	1.001	1.000	1.001	1.000	0.999	1.001
	Geometric average annual growth rates, per cent*								
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)	(7) = (8)+(9)	(8)	(9)
1972-2018	0,02	0,02	0,00	0,12	0,02	0,09	0,01	-0,01	0,01
1972-1980	0,13	0,10	0,04	-0,08	-0,11	0,03	-0,03	-0,03	0,00
1981-1990	-0,08	-0,06	-0,02	0,25	0,11	0,14	0,00	-0,02	0,03
1991-2000	0,08	0,08	0,00	0,17	0,06	0,12	-0,01	0,00	-0,01
2001-2010	-0,04	-0,04	0,00	0,20	0,07	0,14	0,05	0,01	0,05
2011-2018	0,02	0,02	0,00	-0,04	-0,06	0,02	0,00	0,00	-0,01
1972-1977	0.10	0.09	0.01	0.03	0.00	0.03	0.00	-0.01	0.01
1978-1986	0.00	0.00	0.00	0.08	-0.02	0.10	-0.03	-0.04	0.01
1987-1998	0.02	0.03	-0.01	0.19	0.08	0.12	-0.01	-0.01	0.00
1999-2007	0.02	0.00	0.02	0.23	0.06	0.18	0.06	0.01	0.05
2008-2013	-0.04	-0.03	-0.01	0.09	0.03	0.06	0.04	0.01	0.02
2014-2018	0.01	0.01	0.00	-0.10	-0.09	0.00	-0.02	0.00	-0.01

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.12 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018, in categories of Services

	Shipping and oil related			Travel			Other services		
	TG	TOT	RER	TG	TOT	RER	TG	TOT	RER
	(Growth factors)								
Year	(1) = (2)*(3)	(2)	(3)	(4) = (5)*(6)	(5)	(6)	(7) = (8)*(9)	(8)	(9)
1973	1.005	0.995	1.010	1.000	1.000	1.000	1.000	1.000	1.000
1974	0.995	0.990	1.005	1.001	1.000	1.000	0.999	1.000	1.000
1975	0.962	0.966	0.996	1.000	1.000	1.000	1.000	1.000	1.000
1976	0.987	0.992	0.994	1.001	1.001	1.000	0.999	0.999	1.000
1977	0.986	0.989	0.996	1.000	1.000	1.000	1.000	1.000	1.000
1978	1.006	0.999	1.007	0.998	0.999	0.999	1.000	1.000	1.000
1979	1.010	0.997	1.013	0.998	0.998	1.000	1.000	1.000	1.000
1980	1.010	1.001	1.009	1.000	1.000	1.000	1.000	1.001	1.000
1981	0.988	0.990	0.997	1.002	1.001	1.000	1.001	1.000	1.000
1982	0.991	0.993	0.998	1.002	1.002	1.000	1.000	1.000	1.000
1983	0.997	0.998	0.999	1.001	1.001	1.000	0.999	1.000	1.000
1984	0.996	1.000	0.996	1.001	0.999	1.001	1.001	1.000	1.001
1985	0.995	0.994	1.000	0.999	0.999	1.000	0.999	0.999	1.000
1986	0.995	1.002	0.992	1.000	1.001	1.000	0.999	1.000	1.000
1987	1.001	0.999	1.002	1.001	1.001	1.000	0.999	1.000	1.000
1988	1.001	1.003	0.998	1.001	1.001	1.000	1.001	1.000	1.000
1989	1.004	1.003	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1990	0.996	0.998	0.998	0.999	0.999	1.000	1.000	1.000	1.000
1991	1.007	1.004	1.002	0.998	0.999	0.998	1.000	1.000	1.000
1992	0.991	0.993	0.998	1.000	1.000	0.999	1.000	1.000	1.000
1993	1.005	1.001	1.003	1.000	1.000	1.000	1.001	1.000	1.001
1994	0.998	0.999	0.998	0.999	0.999	1.000	0.999	1.000	0.999
1995	0.999	1.000	0.999	1.000	1.000	1.000	1.001	1.001	1.000
1996	0.999	0.998	1.001	0.999	1.000	1.000	1.001	1.001	1.000
1997	1.003	1.000	1.002	1.001	1.001	1.000	1.001	1.001	1.000
1998	0.997	0.998	0.999	0.999	0.999	0.999	1.000	1.000	1.000
1999	1.000	0.998	1.002	1.001	1.001	1.000	1.001	1.001	1.000
2000	1.006	1.002	1.004	1.001	1.001	1.000	1.000	1.000	1.000
2001	1.010	1.006	1.003	1.001	1.001	1.000	1.000	1.000	1.000
2002	0.994	0.996	0.999	1.002	1.002	1.000	1.001	1.001	1.000
2003	1.002	1.001	1.001	0.998	0.998	0.999	1.001	1.001	1.000
2004	1.000	0.998	1.002	0.998	0.998	0.999	1.001	1.001	1.000
2005	1.003	1.002	1.002	1.002	1.001	1.001	0.999	0.999	1.000
2006	1.002	1.003	0.999	1.000	1.000	1.000	1.000	1.000	1.000
2007	0.999	0.999	1.001	1.002	1.001	1.001	1.001	1.001	1.000
2008	1.005	1.005	1.001	1.000	1.000	1.000	1.000	1.000	1.000
2009	0.997	0.998	0.999	0.999	1.000	1.000	0.997	0.997	1.000
2010	0.995	0.995	1.000	1.003	1.002	1.001	0.998	0.998	1.000
2011	0.993	0.995	0.998	1.001	1.000	1.000	0.999	0.999	1.000
2012	1.001	1.002	0.999	1.001	1.001	1.000	0.999	0.999	1.000
2013	1.001	1.002	1.000	0.999	0.999	1.000	1.000	1.000	1.000
2014	0.998	0.997	1.001	0.998	0.999	0.999	1.000	1.000	1.000
2015	0.996	0.995	1.001	0.997	0.998	0.999	1.000	1.000	1.000
2016	0.996	0.997	0.999	0.999	1.000	1.000	0.999	0.999	1.000
2017	1.000	1.002	0.998	0.999	0.999	1.000	0.999	0.999	1.000
2018	0.999	0.998	1.001	1.001	1.001	1.000	0.998	0.998	1.000
	Geometric average annual growth rates, per cent*								
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)	(7) = (8)+(9)	(8)	(9)
1972-2018	-0.18	-0.23	0.05	0.00	0.01	-0.01	-0.01	-0.01	0.00
1972-1980	-0.51	-0.88	0.38	-0.03	-0.01	-0.02	-0.03	-0.01	-0.02
1981-1990	-0.37	-0.19	-0.18	0.05	0.05	0.01	0.00	-0.01	0.00
1991-2000	0.04	-0.05	0.09	-0.03	0.01	-0.03	0.03	0.03	0.00
2001-2010	0.08	0.03	0.05	0.04	0.03	0.02	-0.02	-0.03	0.00
2011-2018	-0.20	-0.16	-0.04	-0.06	-0.03	-0.03	-0.05	-0.05	0.00
1972-1977	-1.34	-1.35	0.01	0.04	0.04	0.00	-0.05	-0.03	-0.02
1978-1986	-0.14	-0.28	0.15	0.00	0.01	-0.01	-0.01	0.00	0.00
1987-1998	-0.01	-0.02	0.01	-0.02	0.00	-0.02	0.02	0.02	0.00
1999-2007	0.19	0.06	0.13	0.04	0.03	0.01	0.05	0.04	0.01
2008-2013	-0.12	-0.05	-0.06	0.05	0.03	0.02	-0.10	-0.10	0.00
2014-2018	-0.23	-0.23	0.00	-0.11	-0.06	-0.05	-0.06	-0.06	0.00

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.

Table B1.13 Decomposing trading gains (TG) into terms of trade (TOT) effect and real exchange rate (RER) effect in the Norwegian market economy, 1972-2018, in categories of Other services

	Other transport			Financial and business services			Services n.e.c		
	TG	TOT	RER	TG	TOT	RER	TG	TOT	RER
	(Growth factors)								
Year	(1) = (2)*(3)	(2)	(3)	(4) = (5)*(6)	(5)	(6)	(7) = (8)*(9)	(8)	(9)
1973	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1974	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	0.999
1975	1.000	1.000	1.000	1.001	1.001	1.000	0.999	1.000	0.999
1976	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.999	1.000
1977	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1978	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	0.999
1979	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1980	1.001	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000
1981	1.000	1.000	1.000	1.000	1.000	1.000	1.001	1.000	1.001
1982	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1983	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000
1984	0.999	1.000	0.999	1.000	1.001	1.000	1.001	1.000	1.001
1985	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1986	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.999	1.000
1987	1.000	1.000	1.000	1.000	1.000	1.000	0.999	0.999	1.000
1988	1.000	1.000	1.000	1.000	1.000	1.000	1.001	1.000	1.000
1989	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1990	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.001
1991	1.001	1.000	1.001	1.001	1.000	1.000	0.999	0.999	0.999
1992	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1993	1.000	1.000	1.000	1.000	1.000	1.000	1.001	1.000	1.000
1994	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1995	1.000	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.000
1996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1999	1.000	1.000	1.000	1.000	1.001	1.000	1.001	1.001	1.000
2000	1.001	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000
2001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002	1.000	1.000	1.000	1.000	1.000	1.000	1.001	1.001	1.000
2003	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2004	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2005	1.000	1.000	1.000	0.999	0.999	1.000	1.000	1.000	1.000
2006	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2007	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000
2008	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2009	0.999	0.999	0.999	0.998	0.998	1.000	1.000	1.000	1.000
2010	0.999	0.999	1.000	0.999	0.999	1.000	1.000	1.000	1.000
2011	1.000	1.000	1.000	0.999	0.999	1.000	1.000	1.000	1.000
2012	1.000	1.000	1.000	0.999	0.999	1.000	1.000	1.000	1.000
2013	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2014	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2015	1.000	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.000
2016	0.998	0.999	0.999	1.001	1.001	1.000	1.000	1.000	1.000
2017	1.000	1.000	1.000	0.999	0.999	1.000	1.000	1.000	1.000
2018	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Geometric average annual growth rates, per cent*								
	(1) = (2)+(3)	(2)	(3)	(4) = (5)+(6)	(5)	(6)	(7) = (8)+(9)	(8)	(9)
1972-2018	0.00	-0.01	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00
1972-1980	0.02	0.00	0.02	0.00	-0.01	0.01	-0.06	-0.03	-0.03
1981-1990	-0.01	-0.01	0.00	0.00	0.00	0.00	0.01	-0.03	0.04
1991-2000	0.02	0.00	0.02	0.02	0.02	0.00	-0.01	0.00	-0.01
2001-2010	-0.01	0.00	-0.01	-0.02	-0.03	0.01	0.01	0.01	0.00
2011-2018	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	-0.01	-0.01	0.00
1972-1977	0.01	-0.01	0.01	0.01	0.00	0.01	-0.07	-0.04	-0.03
1978-1986	0.01	0.00	0.01	-0.01	-0.01	0.00	-0.01	-0.03	0.02
1987-1998	0.01	0.00	0.01	0.02	0.02	0.00	-0.01	-0.02	0.00
1999-2007	0.02	0.02	0.00	0.02	0.01	0.01	0.01	0.01	0.00
2008-2013	-0.03	-0.02	0.00	-0.08	-0.08	0.00	0.01	-0.01	0.01
2014-2018	-0.07	-0.04	-0.03	0.02	0.01	0.00	-0.01	-0.01	0.00

Source: Author's own calculations.
Note: * Percentage points do not sum up exactly because they are multiplicative, and because of rounding errors.