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Jannick Damgaard

Mathies Lau Friis Laursen

Robert Wederkinck

Danmarks Nationalbank

Forecasting Direct Investment Equity Income for the Danish Balance of Payments

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Please direct any enquiries to
Danmarks Nationalbank, Communication Desk, Havnegade 5, DK-1093 Copenhagen K Denmark
Tel.: +45 33 63 70 00 (direct) or +45 33 63 63 63
Fax : +45 33 63 71 03
E-mail:info@nationalbanken.dk

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Resumé
Formueindkomsten fra direkte investeringer revideres ofte markant i forbindelse med den årlige revision af betalingsbalancens løbende poster, hvilket påvirker anvendeligheden af de foreløbige opgørelser. Hidtil har de foreløbige skøn for formueindkomsten fra direkte investeringer, egenkapital alene været baseret på oplysninger om virksomhedernes historiske rentabilitet. Vi tester en række modeller og konkluderer, at skøn baseret på en kombination af historisk egenkapitalforrentning og ændringer i konsensusdata for den forventede forbrugsvækst er mere nøjagtige end de hidtidige skøn.

Når de nyudviklede modeller anvendes på den danske betalingsbalance, observeres de største forbedringer separat for udadgående og indadgående direkte investeringer. Revisioner på nettoformueindkomsten falder kun marginalt, da de store bruttorevisioner, som er resultatet af at anvende den hidtidige metode, har en tendens til (delvist) at udligne hinanden på nettobasis.

Forecasting Direct Investment Equity Income for the Danish Balance of Payments*

Jannick Damgaard Mathies Lau Friis Laursen

Robert Wederkinck

Danmarks Nationalbank

11 February 2010

Abstract

Late and significant revisions are often observed in direct investment equity income, hampering the quality of preliminary balance of payments statistics. We test a range of models and find that forecasts for direct investment equity income based on a combination of past profitability and consensus data for changes in expected private consumption growth outperform the current forecasts solely based on historical profitability. When the refined models are applied to the Danish balance of payments, the largest improvements are observed for outward and inward direct investment separately. Revisions on net direct investment equity income only decrease marginally because the significant revisions in gross terms resulting from the historical models have a tendency to (partly) cancel out each other on a net basis.

*The authors are grateful to Niels Haldrup (CREATES, Aarhus University) for inspiration and practical advice regarding the choice of model specification. This paper also benefited from constructive comments and suggestions from participants at the joint Eurostat/ECB FDI Workshop in November 2009 and the following colleagues from Danmarks Nationalbank: Allan Sall Tang Andersen, Bent Christiansen, Niels Lynggård Hansen, and Niki Saabye. Any remaining errors are the responsibility of the authors alone. Authors' contact details: jda@nationalbanken.dk, mfl@nationalbanken.dk, rwe@nationalbanken.dk.

I. Introduction

The outcome of the annual revision of the Danish balance of payments is published in October every year. Frequently, the largest revisions in the current account can be attributed to direct investment equity income in the previous year, particularly in gross terms (i.e. for outward and inward direct investment separately). However, net direct investment equity income is often revised significantly as well, directly affecting the current account balance. Large revisions of preliminary statistics cast doubt on the data and hamper the analytical usefulness of these statistics.

The late and significant revisions in direct investment equity income have become common since the *5th Edition of the IMF Balance of Payments Manual (BPM5)* introduced the estimation of reinvested earnings on direct investment equity in 1993. Whereas most other data used for compilation of the preliminary monthly balance of payments are collected from reporters in time to be included in the first assessment, actual data for total direct investment equity income and thereby reinvested earnings are obtained from the reporting companies' annual financial statements. These statements are only available with a considerable time lag and therefore direct investment equity income need to be forecasted for the preliminary balance of payments.

The current forecast model for direct investment equity income used in the Danish balance of payments is based on a 3-year moving average for the profitability of direct investment enterprises. The purpose of this study is to test refined forecast models that include macroeconomic and financial indicators in addition to past performance in order to correct for turning points in the general economic conditions. We find consensus data for changes in expected private consumption growth to be the strongest predictor for the development in profitability. The refined models based on expected private consumption growth changes outperform the 3-year moving average models as well as simple models solely based on performance in the latest available period. On average, the revisions on outward and inward direct investment equity income are significantly reduced whereas the

impact on net revisions is smaller.

The remainder of this paper is organized as follows. Section 2 explains how direct investment equity income should be recorded in the balance of payments according to the international macroeconomic statistical manuals. In Section 3, the specification of the refined forecast model is introduced, and the results of the empirical modeling are presented in Section 4. Comparisons between the refined models and the simpler models are made in Section 5 to quantify the impact of implementing a new forecast method for the preliminary Danish balance of payments. Section 6 concludes the paper.

II. Recording Direct Investment Equity Income

According to the international macroeconomic statistical manuals in the area of direct investment[1], income on equity between companies in a direct investment relationship is recorded in the balance of payments in the following way:

$$INC_t = RIE_t + D_t, \tag{1}$$

where INC_t denotes direct investment equity income in year t, RIE_t reinvested earnings in year t, and D_t dividends payable in year t.[2] In a balance of payments context, direct investment equity income is ideally compiled according to the current operating performance concept (COPC), which focuses on the net operating surplus and excludes any gains or losses arising from valuation changes such as write-offs, write-downs, or write-ups (*BD4*, paragraph 208). In practical terms, reinvested earnings are calculated as a residual item and are included as imputed transactions in both the income and financial accounts of the

[1] Direct investment statistics are currently compiled on the basis of the *Fifth Edition of the IMF Balance of Payments Manual (BPM5)* and the *Third Edition of the OECD Benchmark Definition of Foreign Direct Investment (BD3)*. In 2008-09, however, the IMF and the OECD released new and fully consistent editions of the international standards, also known as *BPM6* and *BD4*, which will be implemented in the coming years. The guidelines for recording direct investment equity income have only changed slightly from *BPM5/BD3* to *BPM6/BD4*; we will refer to the new manuals in this study.

[2] Annex A contains a summary of the basic notation used in this paper.

balance of payments.[3] Reinvested earnings may be negative in case of high dividends or negative net operating earnings.

Typically, dividends payable will be reported frequently whereas information about total direct investment equity income is available only after the publication of the companies' annual financial statements. In Denmark, reporting on the profitability of direct investment enterprises takes place annually within five months from the end of the financial year. As the monthly balance of payments is published with a lag of 40 days, it is necessary to forecast direct investment equity income until the actual data become available.

Like a number of other EU countries (Foreign Direct Investment Task Force (2004), paragraph 226), Denmark applies an all-inclusive concept for direct investment equity income rather than the COPC. Investment income defined according to the all-inclusive concept will be more volatile than income defined according to the COPC due to the inclusion of valuation changes and is thus likely to be more difficult to predict. Nevertheless, reporters to the Danish balance of payments are instructed to exclude extraordinary gains and losses from direct investment equity income.

The international macroeconomic statistical manuals do not explicitly state how the annual direct investment equity income should be distributed within the year. However, compilation of investment income is generally based on the accrual principle, and since no reliable distribution indicator is available, the actual annual income for a given direct investment enterprise is distributed evenly throughout the year in the Danish balance of payments. Still, total direct investment equity income may differ from month to month as the population of direct investment enterprises continuously changes due to M&A activity.

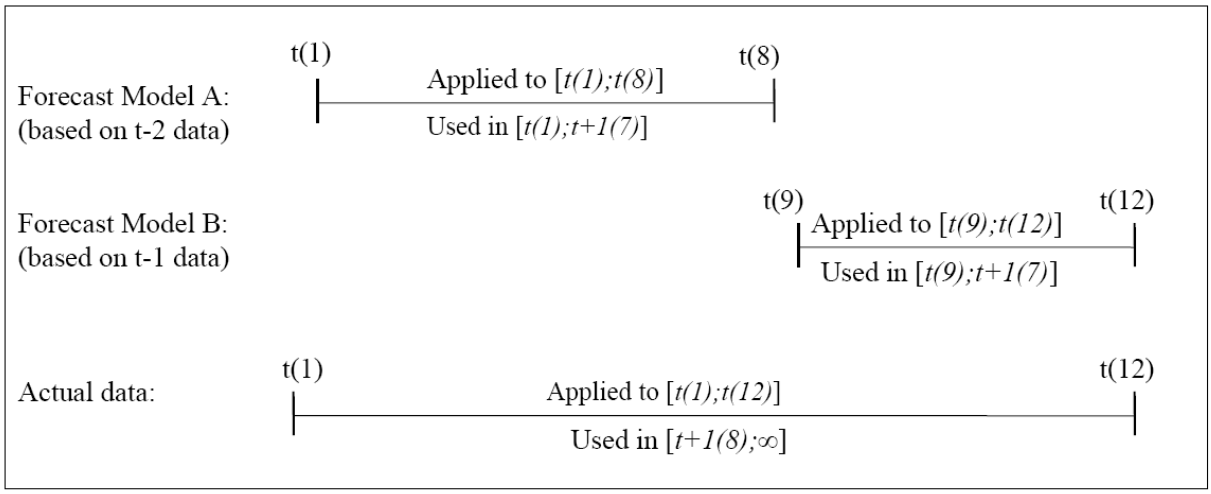
As a result of the late availability of final accounting data on direct investment enterprises' profitability, it is necessary to estimate two models that can be used to forecast direct investment equity income in year t until the actual data become available, cf. Figure 1.[4]

[3] For portfolio investment, with the exception of investment fund shares, investment income only includes dividends and not reinvested earnings (*BPM6*, paragraph 11.104).

[4] Even though the annual financial statements are available five months after the end of the financial year, the final data are not ready to be included in the published data until the detailed data validation process

Forecast Model A is based on data from year $t-2$ and is used to construct forecasts for the period $[t(1); t(8)]$. In contrast, Forecast Model B is based on data from year $t-1$ and is used to make forecasts for the period $[t(9); t(12)]$. The actual data for year t are incorporated in the annual revision in October with the first publication of $t+1(8)$ data.

Figure 1: Use of input data in forecast models



III. Specifications of Forecast Models

The current forecast model for direct investment equity income applied in the Danish balance of payments is exclusively based on a 3-year moving average for past performance. Initial forecasts for return on equity (ROE) ratios in month m of year t are calculated at company level in the following way:

$$E\left[ROE_{t(m),j,A,MA3}\right]_{t(m)} = \frac{1}{12}\sum_{t=-4}^{-2}\left(\frac{INC_{t,j}}{0.5\left(EQ_{t-1,j}+EQ_{t,j}\right)}\right)/3, \tag{2}$$

where $INC_{t,j}$ and $EQ_{t,j}$ denote the direct investment equity income and position, respectively, for company j in a given period. When actual data for year $t-1$ become available,

is finalized in October. For technical reasons, $t-1$ data can only be used in the forecast models when $t(9)$ data are published in November. To simplify, we do not take into account the fact that the account dates of a minority of reporting companies do not follow the Gregorian calendar year.

the model will be based on data for the period $[t-3; t-1]$. The use of the arithmetic mean for the calculation of monthly ROE ratios rather than the geometric mean may cause a slight, general upward bias in the forecasts. Since extreme ROE ratios are often observed at company level, outliers are removed from the calculations.

The refined forecast models proposed in this paper are also based on ROE ratios rather than on investment income directly because ROE ratios, unlike direct investment equity income, are stationary.[5] The econometric literature (see for instance Granger and Newbold, 1974) has long emphasized that models estimated on non-stationary data often lead to spurious correlations, also termed nonsense correlations. Whereas both types of models are based on ROE ratios, the refined models differ from the current moving average models in two important ways. First, in order to avoid the extreme ROE ratios often observed at company level, the refined models are estimated at country/industry group level for outward/inward direct investment equity. As the Danish balance of payments system is based on company-level calculations, the ROE ratio for a given country/industry group is applied to all companies in that group. An additional advantage is that this ratio can be applied to new direct investment enterprises entering the population, for which historical data would often not be available.

The second and most important deviation is that the refined models follow the recommendations of the report of the *EMI Sub-group 4 of the BOP Financial Flows and Stocks Task Force* (1997) and include macroeconomic and financial indicators in order to reflect turning points in the economy in the estimation of ROE ratios. In practice, the refined models compute expected ROE ratios as the sum of the latest available ROE ratio and a correction term. This specification can be regarded as a difference transformation of the data and is in line with the recommendations of Granger and Newbold (1974).

[5] It may be argued that the ROE ratios in general will be upwardly biased because unlisted direct investment equity positions are included in the Danish international investment position at *own funds at book value*, which may be lower than the actual market value due to the lack of registration of many intangible assets in international accounting standards (Kumah, Damgaard, and Elkjaer, 2009). However, the valuation principle is constant over time and will consequently only affect the scale of the ROE ratios, but not the forecasted investment income.

To illustrate the calculation and use of ROE ratios, we first introduce a simple model, in which the ROE ratio in a given period is assumed to be equal to the observation for the corresponding month in year $t-2$ or $t-1$, depending on data availability, to take into account seasonal patterns. Even though investment income is equally distributed throughout the year, there may be seasonal effects in the ROE ratios. For instance, Danish companies typically pay out dividends in March-May, which would ceteris paribus have a negative effect on positions and consequently lead to higher ROE ratios in these months. The ROE ratio for Forecast Model A in the simple version is given by:

$$(3) \qquad E\left[ROE_{t(m),c,i,A,simple}\right]_{t(m)} = ROE_{t-2(m),c,i} = \frac{INC_{t-2(m),c,i}}{0.5\left(EQ_{t-2(m-1),c,i} + EQ_{t-2(m),c,i}\right)}.$$

When $t-1$ data become available for the publication of $t(9)$ data, these data will be used instead of $t-2$ data, and Forecast Model B will be implemented. Forecast Model B is similar to Forecast Model A with the only exception being that it is based on $t-1$ data instead of $t-2$ data. As dividends and other flows such as capital injections/withdrawals, M&A activity, and valuation changes are reported/calculated on a monthly basis, positions including reinvested earnings can be estimated by applying the ROE ratios.

The simple model has the obvious weakness that it does not take business cycle changes into account. When the economy goes into a recession, last year's ROE ratio is likely to be upwardly biased and vice versa. Such turning points in the economy can be incorporated into the models by including a correction term. We specify a model for the correction term, which is defined as the difference between the actual ROE ratio and the latest available ROE ratio. The correction terms (CT) used in Forecast Model A for a certain country/industry group are computed for all periods available in the data in the following way:

$$(4) \qquad CT_{t(m),c,i,A} = ROE_{t(m),c,i} - ROE_{t-2(m),c,i}.$$

The calculation of past correction terms is based on actual data for both year t and

$t-2$. There will be eight observations per year for the estimation of Forecast Model A as actual data for the previous year will be available for the estimation in period $t(9)$ onwards. Conversely, there will be four observations per year for the estimation of Forecast Model B, for which the correction terms are defined as:

$$CT_{t(m),c,i,B} = ROE_{t(m),c,i} - ROE_{t-1(m),c,i}. \tag{5}$$

We have now constructed data for past correction terms, and the next step is to estimate models that will be able to predict the correction terms needed when simply applying the latest available ROE ratios. These models will be used as components in the refined Forecast Models A and B, respectively, and are specified in the following ways:

$$CT_{t(m),c,i,A} = \alpha_{c,i,A} + \beta_{1_{c,i,A}} x_{1_{t(m),c,i,A}} + ... + \beta_{n_{c,i,A}} x_{n_{t(m),c,i,A}} + \varepsilon_{c,i,A} \tag{6}$$

$$CT_{t(m),c,i,B} = \alpha_{c,i,B} + \beta_{1_{c,i,B}} x_{1_{t(m),c,i,B}} + ... + \beta_{n_{c,i,B}} x_{n_{t(m),c,i,B}} + \varepsilon_{c,i,B}, \tag{7}$$

where $[x_1; x_n]$ denote the macroeconomic and financial variables that will be used to predict the changes in the ROE ratios. As the dependent variable, i.e. the correction terms, is defined as a change variable, all input variables will be differenced. Forecast Model A considers changes from year $t-2$ to t whereas Forecast Model B focuses on changes from year $t-1$ to t.

Forecast Models A and B are based on monthly rather than annual data. It may be argued that the application of monthly models will inflate the number of observations used for the estimations because we are essentially interested in estimating 1/12 of the annual direct investment equity income every month. An alternative solution would have been to estimate models on actual annual data and rescale them before applying them to monthly data. On the other hand, actual data for a given year will not be available when the models

have to be applied; only forecasts for the macroeconomic variables and year-to-date values for financial variables such as stock market changes are available at that point in time. These data can only be regarded as proxies for the actual annual data. If the models were to be estimated on actual annual data, we would consequently use proxies (forecast and year-to-date data) for the correction term proxies (actual annual data for changes in the general economic and financial conditions) when applying the model. In addition, "actual" data are often revised; such revisions can significantly change the results and make it even more difficult to choose the proper "actual" data to be used in the models, see for instance Croushore and Stark (2001). By estimating monthly models, we use the available monthly data in the estimation as well as in the application of the models.

The parameter estimates are assumed to be time-invariant, but the estimates may change marginally when new data are added to the model. As the between-year differences in data are expected to be more significant than within-year differences, autocorrelation within a year is anticipated. Autocorrelation will lead to underestimated standard errors in a standard OLS estimation, but we adjust for this by calculating heteroscedasticity and autocorrelation consistent standard errors as proposed by Newey and West (1987). In addition, the data have been detrended by using ROE ratios rather than total direct investment equity income and by specifying a difference model rather than a level model in order to remove general time trends from the data.

The correction terms used in Forecast Models A and B are estimated on all available historical data. When we are in period $[t(1); t(8)]$, actual company data will not be available for that period. Consequently, Forecast Model A computes the ROE ratio used to forecast direct investment equity income in a given month in year t as the sum of the ROE ratio in the corresponding month in year $t-2$ and the expected correction term:

$$E\left[ROE_{t(m),c,i,A,refined}\right]_{t(m)} = ROE_{t-2(m),c,i} + E\left[CT_{t(m),c,i,A,refined}\right]_{t(m)}. \tag{8}$$

When we reach period $t(9)$, actual data for year $t-1$ will be available. Forecast Model B uses these data to construct forecasts for the period $[t(9); t(12)]$ in the following way:

$$E\left[ROE_{t(m),c,i,B,refined}\right]_{t(m)} = ROE_{t-1(m),c,i} + E\left[CT_{t(m),c,i,B,refined}\right]_{t(m)}. \tag{9}$$

The ROE ratios can be used to forecast direct investment equity income as well as direct investment equity positions. If the projections of positions are incorrect, the forecast for the investment income would in principle also be incorrect even if the forecasted ROE ratio for a given month is correct. This situation might occur late in the year if the ROE estimates for the first months of the year were incorrect, for instance due to imperfect early consensus forecasts for the economic developments, thus leading to incorrect position estimates. However, the possible projection errors on positions are likely to be relatively small as other financial flows are reported/estimated on a monthly basis, which means that the possible position projection errors could be attributed to reinvested earnings alone.

IV. Empirical Modeling of Forecast Models

A. Data

The dataset comprises *i)* company data reported to Danmarks Nationalbank for balance of payments and international investment position statistics aggregated at country/industry group level and *ii)* macroeconomic and financial indicators reflecting general economic conditions. Company data are available for the period 1999-2008, with annual data being available for the period 1999-2004 and monthly data for the period 2005-08. We construct monthly data for the period 1999-2004 by distributing direct investment equity income and other flows evenly throughout the year. This allows us to estimate Forecast Model A on data for the period 2001-08 since $t-2$ data are needed as input for this model. Similarly, Forecast Model B can be estimated on data for the period 2000-08. Naturally, it would have been useful to base the model estimations on a longer time series, but additional data are not

available at the necessary level of detail in the case of Denmark.

According to NBER's determination of American business cycles, the data covers two peaks (March 2001 and December 2007) and one trough (November 2001). Bordo and Helbling (2003) demonstrate an increased synchronization of national business cycles, and this conclusion validates the decision to aggregate data across countries in this study. The benefit of aggregation is that it makes the estimations less vulnerable to extreme ROE observations for countries, in which Danish companies have established only a few direct investment enterprises. In addition, by limiting the number of models, the burden of maintaining and applying the models in the monthly production of balance of payments statistics will be kept at a reasonable level. Whereas the models for outward direct investment equity are estimated for three country groups, the models for inward direct investment equity are estimated for three industry groups, cf. Table 1.

Table 1: Aggregation levels used for the forecast models

Variable	**Code**	**Description**	**Position**
Country group:	EU/EFTA	Countries in the EU/European Free Trade Association	323.2
(Outward FDI)	NAFTA	Countries in the North American Free Trade Agreement	36.0
	ROW	Rest of the world and not allocated	70.3
Industry group:	DK1	Manufacturing, energy, materials, and utilities	50.4
(Inward FDI)	DK2	Trade, transportation, and consumer goods	163.3
	DK3	ICT and finance	111.3

Note: The last column gives the total direct investment equity position in DKK billion for each group at end-2008.

With regard to macroeconomic and financial indicators used for the estimation of correction terms, we include a number of possible variables in the data. The macroeconomic indicators (growth rates for: GDP, private consumption, investment, corporate profits, and industrial production) are expected to have an impact on direct investment enterprises' profitability in the short run. The financial indicators include developments in stock indexes and interest rates. The former are expected to reflect earnings potentials of companies whereas the latter, as a measure of financing costs, will have a direct impact on profitability.

The macroeconomic indicators used in this study are consensus forecasts from *Consensus Economics Inc.* that predict the growth for the whole year since we are basically interested in forecasting 1/12 of the annual profits every month. New consensus forecasts are available every month. By including consensus forecast data in the models, we use other forecasters' predictions directly as input for our forecasting models. The variables used in Forecast Model A should in principle reflect the changes from year $t-2$ to year t while the variables used in Forecast Model B should represent changes from year $t-1$ to year t. Regarding financial indicators, we do not rely on forecasts, but only use actual data. However, new data will be available every month so that updated information will be added to the independent variables throughout the year.

Changes between periods can be calculated in many different ways, and we thus construct a large number of variables based on the basic macroeconomic and financial indicators. The independent variables in the models consist of the basic indicator name and an extension, indicating how the variable is constructed, cf. Annex B. For the macroeconomic indicators, we use growth variables directly as well as variables reflecting the change in growth rates. With regard to the financial indicators, we include a range of lagged variables in addition to year-to-date values because financial markets often respond more quickly to new developments than does the real economy.

Since we estimate models for country groups rather than individual countries, we use weighted macroeconomic and financial indicators. For the EU/EFTA countries, the indicators are computed as the average of the national indicators for the five largest destinations for Danish direct investment equity in this country group, namely Germany, Norway, Sweden, Switzerland, and the UK. The calculation of NAFTA indicators is also based on the relative size of Danish direct investment equity in the specific group of countries so that the national US indicators weigh 2/3 and the national Canadian indicators 1/3. The ROW group consists of many countries and is rather heterogeneous. In lack of a self-evident variable, we use the EU/EFTA indicators for the ROW group. Finally, we also use the EU/EFTA indicators in

the estimation of the Danish models rather than Danish data. The reason is that a large proportion of Danish direct investment enterprises are export-oriented (Statistics Denmark, 2009) and are thus highly exposed to the economic developments in the EU/EFTA countries. Moreover, Dam (2008) finds that Danish business cycles to a large extent are harmonized with European business cycles.[6]

Before the models are estimated, we remove certain observations from the data in order to ensure that the models are estimated for homogeneous groups of companies. First, we take out data for Special Purpose Entities (SPEs), which in the Danish balance of payments are defined as pass-through companies with little or no economic activity in Denmark. The direct investment income is balanced for these companies to ensure that they have a neutral effect on the primary income account in the balance of payments. Second, we remove a few special companies that have earnings patterns which cannot be explained by the developments in the general economic conditions. Examples include companies with extraordinarily lucrative patents or property rights for natural resources. These companies are defined as having annual profits in excess of DKK 1 billion and ROE ratios above 35% in at least three consecutive years including the most recent.[7] The profits of these companies are rather stable over time so the latest observation for direct investment income can be used as an approximation for the direct investment equity in the current period. In case of changing conditions, the estimates for the special companies can be adjusted by using information on dividend payouts and quarterly financial statements if available.[8]

The impact of including independent variables and the sizes of the parameter estimates are expected to differ across the models. For instance, companies selling consumer goods are likely to be more sensitive to the growth in private consumption than pharmaceutical

[6] Consensus forecasts for corporate profits are only available for Canada, the UK, and the US. Hence, only UK data will be used for this variable in the EU/EFTA, ROW and industry group models.

[7] Obviously, a direct investment enterprise does not have to meet the two criteria for excessive profits in the most recent year if it has exited the population due to M&A activity.

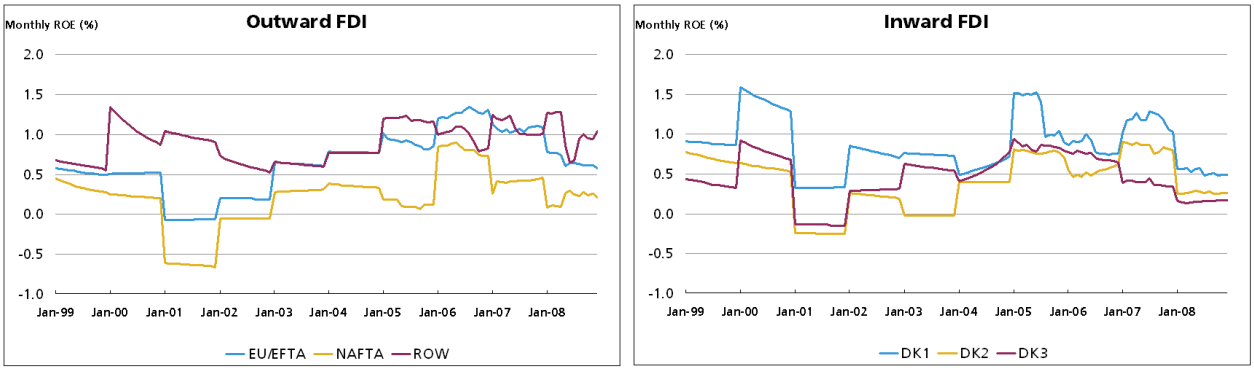
[8] Most direct investment enterprises are not listed and are thus only obliged to publish annual financial statements. However, some of the special companies produce quarterly financial statements, allowing us to use this information for the preliminary direct investment equity income estimates.

companies. Similarly, the profitability of direct investment enterprises located in different countries may be impacted differently by macroeconomic and financial developments.

B. Estimation Results

In general terms, the evolution of *ROE* ratios for direct investment equity seems to be synchronized with business cycles, cf. Figure 2. The ratios moved from a high level in the end of the 1990s and 2000 to a low level in connection with the trough in 2001 and increased gradually thereafter until the peak in 2006-07. When the downturn started by the end of 2007, this had an immediate negative effect on *ROE* ratios. These harmonized trends indicate that macroeconomic and financial data can be used in the prediction of direct investment equity income.

Figure 2: Evolution of ROE ratios for direct investment equity



In order to find the best predictor for the development in *ROE* ratios, i.e. the correction term, we estimate univariate versions of Equations 6 and 7 with every constructed independent variable. The results of these estimations can be found in Annex C and reveal that the performances of the independent variables vary across models as expected. Nevertheless, some variables perform well in most cases, for instance private consumption. Interestingly, variables based on changes in private consumption growth turn out to be better predictors for the development in *ROE* ratios than consumption growth itself. The reason is that changes in consumption growth are better than consumption growth at predicting the sharp

falls in ROE ratios that are observed when the downturn sets in. For Forecast Model B, the variable based on year-to-year changes in private consumption growth is the best indicator whereas a variable calculated as the current year's expected consumption growth minus the sum of consumption growth in the two previous years performs best in Forecast Models A.

Overall, private consumption performs slightly better than the other macroeconomic indicators. This may be explained by the structure of direct investment in the case of Denmark. For instance, inward direct investment equity is concentrated in industries that are highly exposed to developments in consumption, cf. Table 1. It may seem surprising that expected corporate profits growth does not give more explanatory power to the models than is the case because this variable represents directly what we are trying to measure. However, it may be more difficult to forecast this variable than GDP components such as private consumption and investment, which could explain the relatively poor performance by this variable. In addition, forecasts for corporate profits are only available for a few countries, meaning that the data used in the models are not necessarily representative for the country/industry groups with the exception of the NAFTA group.

The variables based on stock market developments and money-market interest rates are sound predictors, but they are outperformed by the best performing macroeconomic variables. A possible explanation for this is that the financial indicators only contain year-to-date data rather than data for the entire year as the latter are not available when the models have to be put into effect.

We choose to apply univariate models with an identical independent variable across country/industry groups to forecast direct investment equity income. The main reason for this is that the models have to be easy to implement in practice as they have to be used every month for the Danish balance of payments production. In addition, multicollinearity would be an issue in multivariate models because the variables to a large degree convey the same information. Finally, the estimations of univariate models have shown that it is possible to find a variable that performs consistently well across models, namely changes in expected

private consumption growth.

The final models are presented in Table 2. There are no constant terms in Forecast Models B as these were insignificant. This insignificance was anticipated as the variable based on changes in consumption growth is expected to be stationary with a mean of zero. In all models with the exception of the ROW models, the prediction power, measured by R^2, exceeds 0.20 and the independent variable is significant even when the standard errors are corrected by the Newey and West (1987) procedure. The prediction power is low for the heterogeneous ROW group, indicating that the refined ROW models cannot be expected to perform significantly better than the simple ROW models. However, due to comparatively small positions (cf. Table 1) and low variation in ROE ratios for the ROW group (cf. Figure 2), the revisions, and therefore the importance of these models, are expected to be smaller than for some of the other country/industry groups.

Table 2: Regression models for correction terms based on data for the period 2000/01-2008

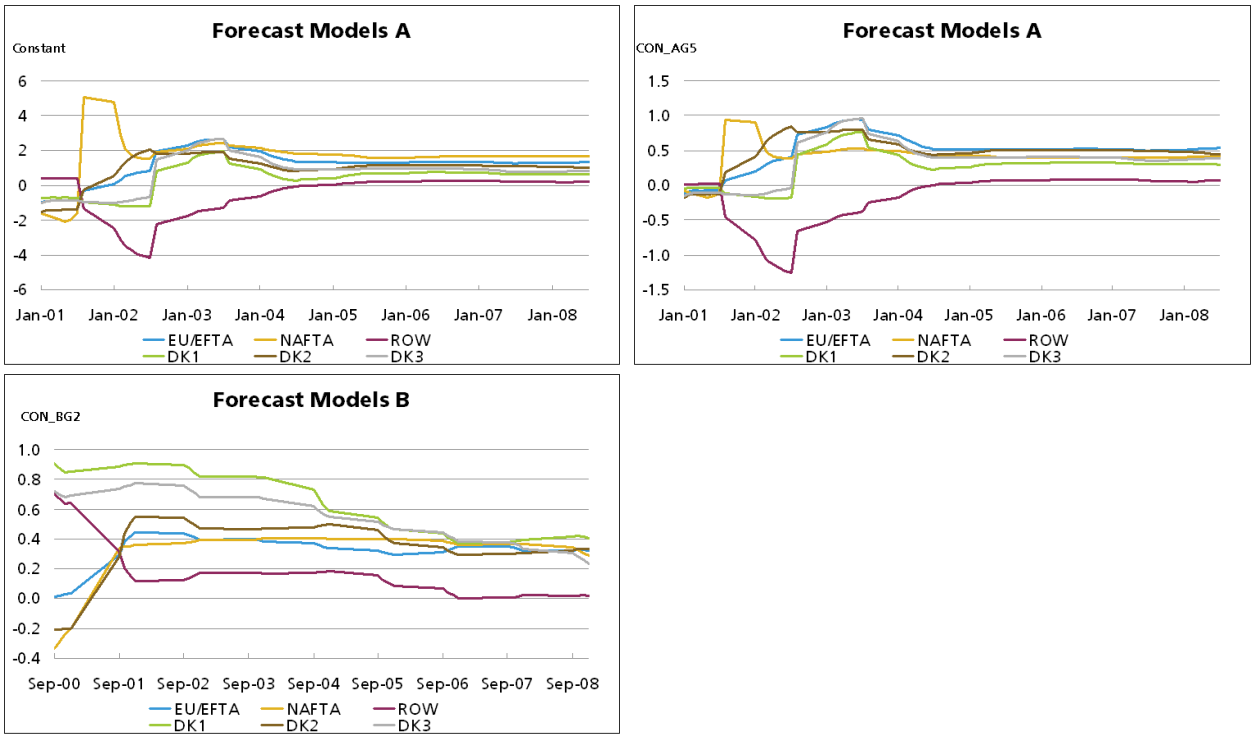
	EU/EFTA	**NAFTA**	**ROW**	**DK1**	**DK2**	**DK3**
	Forecast Models A					
Constant term	1.36	1.66	0.24	0.63	1.01	0.81
t-value	*9.09*	*6.91*	*1.25*	*1.97*	*4.07*	*3.95*
CON_AG5	0.54	0.41	0.08	0.30	0.44	0.38
t-value	*10.73*	*8.43*	*0.96*	*2.72*	*4.48*	*6.26*
R^2	0.76	0.61	0.03	0.25	0.53	0.40
	Forecast Models B					
CON_BG2	0.32	0.29	0.02	0.40	0.34	0.23
t-value	*5.91*	*3.94*	*0.29*	*2.94*	*3.37*	*1.75*
R^2	0.49	0.41	0.01	0.38	0.33	0.20

Note: Forecast Models A and B are based on Equations 6 and 7, respectively.

A way to evaluate the robustness, and thereby the validity, of the models is to monitor the impact on parameter estimates when new data are included in the estimations. If the models are specified correctly and there are no structural breaks, each parameter estimate will converge to its own unique value over time. Figure 3 shows how the parameter estimates in Forecast Models A and B develop as new observations from our data are added to the

models. These empirical pieces of evidence strongly suggest that convergence is taking place, thus supporting the models' robustness and choice of independent variables. The parameter estimates seem to converge faster for Forecast Models A than for Forecast Models B. In this regard, one has to keep in mind that Forecast Models A are estimated on a larger number of observations than Forecast Models B as the former include 8 observations per year whereas the latter are based on 4 observations per year. Based on the results displayed in Figure 3, we conclude that the refined models can be used with changes in private consumption as the independent variable, but continued parameter estimate convergence should be monitored when re-estimating the models as new data become available.

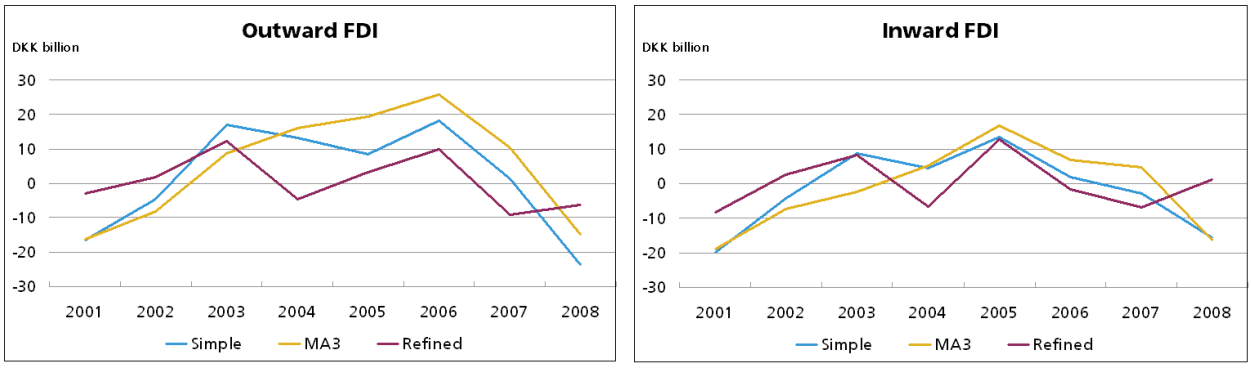
Figure 3: Developments in parameter estimates when new data are added to the models



V. Comparisons of Forecast Models

The best way to test the prediction power of a forecast model is to compare it to the alternatives. In our case, the refined forecast models can be compared to the simple forecast models solely based on the latest observation and the 3-year moving average models. We apply all models at the country/industry group level. Moreover, we assume that the parameter estimates of the refined models converge as illustrated in Figure 3 so that the models based on 2000/01-2008 data are applied for all years. Figure 4 illustrates the size of the revisions if the three different models had been applied for the period 2001-2008. On average, the refined models lead to smaller revisions for both inward and outward direct investment equity income than the simple models and 3-year moving average models. Annex D presents the monthly forecast errors for each model at the country/industry group level.

Figure 4: Revisions of direct investment equity income



Note: As data are only available from 1999 onwards, the 3-year moving average is based on fewer observations in 2001-02.

As recommended in the IMF's Data Quality Assessment Framework (2003) and the ECB Quality Report (2009), we consider both the average and the absolute average size of the revisions. The former measure contains information about possible systematic biases whereas the latter indicates the accuracy of a model. We can only conclude that a model performs well if both measures display low values.

The results in Table 3 confirm that the refined models, on average, yield considerably

Table 3: Revisions resulting from the implementation of three different forecasts methods

Model	2001	2002	2003	2004	2005	2006	2007	2008	Average(abs)
	Outward direct investment equity income								
Simple	-16.4	-4.5	16.8	13.2	8.3	18.3	1.4	-23.7	1.7 (12.8)
MA3	-16.2	-8.0	8.6	15.8	19.3	25.8	10.4	-15.1	5.1 (14.9)
Refined	-2.9	1.8	12.3	-4.4	3.1	9.9	-9.2	-5.8	0.6 (6.2)
	Inward direct investment equity income								
Simple	-19.8	-4.3	8.8	4.4	13.4	2.0	-2.6	-15.5	-1.7 (8.9)
MA3	-19.0	-7.3	-2.2	5.3	16.7	6.7	4.7	-16.2	-1.4 (9.8)
Refined	-8.3	2.6	8.3	-6.4	12.8	-1.7	-6.9	1.1	0.2 (6.0)
	Net direct investment equity income								
Simple	3.4	-0.2	8.0	8.7	-5.1	16.3	4.0	-8.3	3.4 (6.8)
MA3	2.8	-0.8	10.8	10.5	2.7	19.1	5.8	1.1	6.5 (6.7)
Refined	5.4	-0.8	4.0	2.0	-9.7	11.5	-2.4	-6.9	0.4 (5.3)

Note: The last column contains the average revisions for the period followed by the absolute average revisions in brackets; the absolute average is calculated as the average of the aggregate annual revisions in absolute terms. The figures are based on the 2000/01-2008 models and are given in DKK billion.

lower revisions for outward and inward direct investment than the other models. We apply the Diebold and Mariano (1995) test for comparing predictive accuracy and find that the improvements are statistically significant, cf. Annex D. However, on a net basis, the refined models only perform slightly better in terms of absolute revisions. The reason is that the simple and 3-year moving average models lead to large errors in the forecasts, but as these errors often go in the same direction, they cancel out each other to some extent on a net basis. Still, the results show that the refined models are preferable as they clearly outperform the simple and the 3-year moving average models in gross terms and also lead to marginally better net estimates on average.

As a final robustness check of the models, we follow the recommendations of Fildes and Makridakis (1995) and conduct out-of-sample tests for the years 2006, 2007, and 2008. These results can be found in Table 4 and are similar to the results presented in Table 3. This was expected due to the strong convergence of the parameter estimates in the forecast models,

cf. Figure 3. The Diebold and Mariano test shows that the out-of-sample improvements in gross revisions are also significant, cf. Annex D.

Table 4: Out-of-sample tests for revisions in 2006, 2007, and 2008

Model	**EU/EFTA**	**NAFTA**	**ROW**	**DK1**	**DK2**	**DK3**	**Net income**
				2006			
Simple	15.9	2.1	0.2	0.6	0.3	1.1	16.3
MA3	22.4	2.4	1.1	0.5	4.5	1.8	19.1
Refined	7.2	2.4	-0.1	0.1	-2.4	-0.9	12.6
				2007			
Simple	1.0	0.3	0.1	-0.1	2.3	-4.8	4.0
MA3	8.7	0.4	1.3	1.6	6.5	-3.4	5.8
Refined	-10.8	0.0	-0.3	-0.8	-0.5	-7.1	-2.7
				2008			
Simple	-20.9	-2.2	-0.6	-2.6	-6.5	-6.4	-8.3
MA3	-13.7	-1.1	-0.3	-2.5	-6.6	-7.1	1.1
Refined	-5.9	-1.2	-0.4	0.0	2.6	-0.7	-9.5
				Average (absolute) 2006-2008			
Simple	-1.3 (12.6)	0.1 (1.6)	-0.1 (0.3)	-0.7 (1.1)	-1.3 (3.0)	-3.4 (4.1)	4.0 (9.5)
MA3	5.8 (14.9)	0.6 (1.3)	0.7 (0.9)	-0.1 (1.5)	1.5 (5.9)	-2.9 (4.1)	8.7 (8.7)
Refined	-3.2 (8.0)	0.4 (1.2)	-0.3 (0.3)	-0.2 (0.3)	-0.1 (1.8)	-2.3 (2.9)	0.1 (8.3)

Note: The refined models for 2006, 2007, and 2008 are based on data for 2000/01-2005, 2000/01-2006, and 2000/01-2007, respectively. The absolute average is displayed in brackets and is calculated as the average of annual revisions in absolute terms. The figures are given in DKK billion.

VI. Conclusions

The late and large revisions observed in direct investment equity income result in significant corrections of balance of payments data and violate the important statistical quality criterion of stability. Even though forecasting is always connected with uncertainty, this study has shown that it is possible to come up with a method to improve the preliminary estimates for direct investment equity income in the case of Denmark.

We find that variables constructed from changes in consensus data for expected private consumption growth serve as useful indicators for the development in direct investment

enterprises' profitability. Forecast models using this information clearly outperform models solely based on historical profitability for outward and inward direct investment, respectively. The net revisions are only slightly smaller because the large gross revisions observed in the simpler models have a tendency to (partly) cancel out each other.

The models are based on data for the period 1999-2008 and should be re-estimated annually to take the extra information into account. The empirical evidence presented in this paper point to quick parameter estimate convergence, but possible future changes in parameter estimates should be monitored as these may be signs of structural breaks.

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A Summary of Basic Notation

α: Constant term in regression model

β: Parameter estimate for independent variable in regression model

ε: Error term in regression model

A: Indicates variable specific for Forecast Model A (based on $t-2$ data for the simple and refined models and $[t-2; t-4]$ data for the moving average model)

B: Indicates variable specific for Forecast Model B (based on $t-1$ data for the simple and refined models and $[t-1; t-3]$ data for the moving average model)

c: Country group

CT: Correction term

D: Dividends

$E[]$: Expected (forecasted) value of variable in square brackets

EQ: Direct investment equity capital

FE: Forecast error (forecasted ROE ratio minus actual ROE ratio)

i: Industry group

INC: Direct investment equity income (defined as net income from P&L statement excluding extraordinary gains and losses)

j: Company

n: Number of independent variables in the model

(m): Indicates monthly variable (January-December represented by 1-12)

$MA3$: (Variable specific for) moving average forecast model based on performance in last 3 available periods – excluding expected correction term

$refined$: (Variable specific for) refined forecast model – including expected correction term

RIE: Reinvested earnings on direct investment equity

ROE: Return on equity (defined as direct investment equity income divided by average direct investment equity position)

simple: (Variable specific for) simple forecast model solely based on performance in last available period – excluding expected correction term

t: Indicates value of variable in year t

- For stock variables: position at the end of year t

- For flow variables: flow in year t

x: Independent variable in the model (e.g. consensus forecast for expected GDP growth)

B Indicators Included in the Data and Construction of Variables

Table B.1: Basic indicators in the data

Indicator	**Description**	**Data**	**Type**
GDP	Gross domestic product	Consensus forecast	Growth rate
CON	Private consumption	Consensus forecast	Growth rate
INV	Investment	Consensus forecast	Growth rate
CP	Corporate profits	Consensus forecast	Growth rate
IP	Industrial production	Consensus forecast	Growth rate
MMIR	3-month money market interest rate	Actual data	Ratio
BBS	Broad-based stock index	Actual data	Level

Table B.2: Construction of independent variables for Forecast Models A for reference period $t(m)$

Extension	**Model**	**Raw variable type**	**Construction of variable**	**New variable unit**
_AG1	A	Growth rate	$\left(1+E\left[X_{t/t-1}\right]_{t(m)}\right)\left(1+E\left[x_{t-1/t-2}\right]_{t-1(12)}\right)-1$	Percent
_AG2	A	Growth rate	$\left(1+E\left[X_{t/t-1}\right]_{t(m)}\right)\left(1+E\left[x_{t-1/t-2}\right]_{t-1(m)}\right)-1$	Percent
_AG3	A	Growth rate	$E\left[x_{t/t-1}\right]_{t(m)}+E\left[x_{t-1/t-2}\right]_{t-1(12)}-E\left[x_{t-2/t-3}\right]_{t-2(12)}$	Percentage points
_AG4	A	Growth rate	$E\left[x_{t/t-1}\right]_{t(m)}+E\left[x_{t-1/t-2}\right]_{t-1(m)}-E\left[x_{t-2/t-3}\right]_{t-2(m)}$	Percentage points
_AG5	A	Growth rate	$E\left[x_{t/t-1}\right]_{t(m)}-E\left[x_{t-1/t-2}\right]_{t-1(12)}-E\left[x_{t-2/t-3}\right]_{t-2(12)}$	Percentage points
_AG6	A	Growth rate	$E\left[x_{t/t-1}\right]_{t(m)}-E\left[x_{t-1/t-2}\right]_{t-1(m)}-E\left[x_{t-2/t-3}\right]_{t-2(m)}$	Percentage points
_AR1	A	Ratio	$x_{t(m)}-x_{t-2(12)}$	Percentage points
_AR2	A	Ratio	$x_{t(m)}-x_{t-2(m)}$	Percentage points
_AL1	A	Level	$\left(x_{t(m)}\right)/\left(x_{t-2(12)}\right)-1$	Percent
_AL2	A	Level	$\left(x_{t(m)}\right)/\left(x_{t-2(m)}\right)-1$	Percent
_AL3	A	Level	$\left(x_{t-1(12)}\right)/\left(x_{t-3(12)}\right)-1$	Percent
_AL4	A	Level	$\left(x_{t(m)}\right)/\left(x_{t-2(12)}\right)-\left(x_{t-2(12)}\right)/\left(x_{t-4(12)}\right)$	Percentage points
_AL5	A	Level	$\left(x_{t(m)}\right)/\left(x_{t-2(m)}\right)-\left(x_{t-2(12)}\right)/\left(x_{t-4(12)}\right)$	Percentage points
_AL6	A	Level	$\left(x_{t-1(12)}\right)/\left(x_{t-3(12)}\right)-\left(x_{t-2(12)}\right)/\left(x_{t-4(12)}\right)$	Percentage points

Note: The calculations in the table are performed for all the basic indicators (cf. Table B.1), and the resulting variables are used in the estimation of Forecast Models A.

Table B.3: Construction of independent variables for Forecast Models B for reference period $t(m)$

Extension	**Model**	**Raw variable type**	**Construction of variable**	**New variable unit**
_BG1	B	Growth rate	$E\left[X_{t/t-1}\right]_{t(m)}$	Percent
_BG2	B	Growth rate	$E\left[X_{t/t-1}\right]_{t(m)} - E\left[X_{t-1/t-2}\right]_{t-1(12)}$	Percentage points
_BG3	B	Growth rate	$E\left[X_{t/t-1}\right]_{t(m)} - E\left[X_{t-1/t-2}\right]_{t-1(m)}$	Percentage points
_BR1	B	Ratio	$x_{t(m)} - x_{t-1(12)}$	Percentage points
_BR2	B	Ratio	$x_{t(m)} - x_{t-1(m)}$	Percentage points
_BL1	B	Level	$\left(x_{t(m)}\right) / \left(x_{t-1(12)}\right) - 1$	Percent
_BL2	B	Level	$\left(x_{t(m)}\right) / \left(x_{t-1(m)}\right) - 1$	Percent
_BL3	B	Level	$\left(x_{t-1(12)}\right) / \left(x_{t-2(12)}\right) - 1$	Percent
_BL4	B	Level	$\left(x_{t(m)}\right) / \left(x_{t-1(12)}\right) - \left(x_{t-1(12)}\right) / \left(x_{t-2(12)}\right)$	Percentage points
_BL5	B	Level	$\left(x_{t(m)}\right) / \left(x_{t-1(m)}\right) - \left(x_{t-1(12)}\right) / \left(x_{t-2(12)}\right)$	Percentage points
_BL6	B	Level	$\left(x_{t-1(12)}\right) / \left(x_{t-2(12)}\right) - \left(x_{t-2(12)}\right) / \left(x_{t-3(12)}\right)$	Percentage points

Note: The calculations in the table are performed for all the basic indicators (cf. Table B.1), and the resulting variables are used in the estimation of Forecast Models B.

C Selection of Forecasting Indicator

Table C.1: R^2 values for Forecast Models A depending on input variable

Variable	EU/EFTA	NAFTA	ROW	DK1	DK2	DK3	Average
GDP_AG1	0.20	0.01	0.26	0.01	0.01	0.30	0.16
GDP_AG2	0.24	0.01	0.21	0.02	0.03	0.36	0.18
GDP_AG3	0.01	0.12	0.55	0.05	0.04	0.02	0.07
GDP_AG4	0.10	0.06	0.54	0.00	0.00	0.13	0.11
GDP_AG5	0.60	0.58	0.03	0.14	0.24	0.47	0.42
GDP_AG6	0.30	0.41	0.30	0.08	0.14	0.17	0.24
CON_AG1	0.56	0.05	0.13	0.21	0.30	0.61	0.42
CON_AG2	0.56	0.08	0.11	0.20	0.35	0.56	0.43
CON_AG3	0.05	0.05	0.39	0.00	0.00	0.09	0.07
CON_AG4	0.14	0.00	0.34	0.00	0.03	0.14	0.12
CON_AG5	**0.76**	**0.61**	**0.03**	**0.25**	**0.53**	**0.40**	**0.55**
CON_AG6	0.31	0.32	0.14	0.09	0.23	0.08	0.23
INV_AG1	0.09	0.04	0.36	0.00	0.00	0.17	0.10
INV_AG2	0.08	0.01	0.22	0.00	0.00	0.17	0.08
INV_AG3	0.01	0.03	0.70	0.10	0.11	0.00	0.10
INV_AG4	0.03	0.01	0.57	0.02	0.01	0.06	0.08
INV_AG5	0.49	0.50	0.00	0.14	0.18	0.55	0.36
INV_AG6	0.23	0.30	0.37	0.15	0.13	0.25	0.22
CP_AG1	0.07	0.16	0.32	0.11	0.18	0.04	0.12
CP_AG2	0.06	0.21	0.26	0.09	0.22	0.00	0.11
CP_AG3	0.01	0.37	0.11	0.00	0.03	0.00	0.04
CP_AG4	0.01	0.22	0.30	0.00	0.00	0.02	0.04
CP_AG5	0.00	0.33	0.08	0.10	0.18	0.00	0.07
CP_AG6	0.07	0.26	0.01	0.03	0.04	0.03	0.06
IP_AG1	0.14	0.00	0.35	0.00	0.00	0.22	0.12
IP_AG2	0.17	0.01	0.28	0.00	0.01	0.27	0.14
IP_AG3	0.00	0.12	0.65	0.05	0.03	0.01	0.08
IP_AG4	0.04	0.06	0.60	0.01	0.00	0.08	0.09
IP_AG5	0.55	0.60	0.02	0.13	0.17	0.51	0.39
IP_AG6	0.37	0.44	0.26	0.12	0.18	0.26	0.29
MMIR_AR1	0.20	0.22	0.11	0.01	0.05	0.26	0.16
MMIR_AR2	0.41	0.04	0.06	0.09	0.15	0.51	0.30
BBS_AL1	0.17	0.09	0.33	0.09	0.21	0.03	0.16
BBS_AL2	0.01	0.00	0.48	0.13	0.13	0.00	0.09
BBS_AL3	0.05	0.17	0.42	0.02	0.01	0.11	0.09
BBS_AL4	0.58	0.36	0.13	0.22	0.45	0.42	0.45
BBS_AL5	0.41	0.22	0.36	0.38	0.55	0.31	0.41
BBS_AL6	0.24	0.05	0.53	0.34	0.45	0.18	0.30

Note: The table displays R^2 values resulting from univariate estimations of Equation 6. The average R^2 value is weighted by end-2008 positions.

Table C.2: R^2 values for Forecast Models B depending on input variable

Variable	EU/EFTA	NAFTA	ROW	DK1	DK2	DK3	Average
GDP_BG1	0.00	0.12	0.08	0.07	0.05	0.01	0.03
GDP_BG2	0.38	0.52	0.01	0.25	0.27	0.22	0.30
GDP_BG3	0.36	0.51	0.02	0.25	0.26	0.20	0.28
CON_BG1	0.02	0.03	0.09	0.19	0.04	0.01	0.04
CON_BG2	**0.49**	**0.41**	**0.01**	**0.38**	**0.33**	**0.20**	**0.36**
CON_BG3	0.49	0.38	0.00	0.38	0.30	0.21	0.35
INV_BG1	0.00	0.00	0.22	0.03	0.02	0.04	0.03
INV_BG2	0.41	0.38	0.19	0.22	0.21	0.18	0.30
INV_BG3	0.34	0.38	0.26	0.23	0.20	0.13	0.27
CP_BG1	0.10	0.39	0.09	0.41	0.44	0.05	0.20
CP_BG2	0.17	0.73	0.02	0.56	0.27	0.14	0.23
CP_BG3	0.16	0.73	0.03	0.52	0.29	0.13	0.22
IP_BG1	0.00	0.11	0.13	0.05	0.03	0.01	0.03
IP_BG2	0.45	0.55	0.05	0.31	0.27	0.30	0.35
IP_BG3	0.39	0.51	0.05	0.27	0.24	0.24	0.30
MMIR_BR1	0.05	0.31	0.01	0.26	0.16	0.03	0.10
MMIR_BR2	0.03	0.28	0.01	0.22	0.14	0.01	0.07
BBS_BL1	0.35	0.08	0.18	0.17	0.15	0.05	0.22
BBS_BL2	0.36	0.10	0.20	0.26	0.20	0.08	0.25
BBS_BL3	0.00	0.06	0.11	0.03	0.03	0.00	0.02
BBS_BL4	0.27	0.16	0.01	0.04	0.03	0.05	0.14
BBS_BL5	0.36	0.20	0.02	0.11	0.07	0.10	0.20
BBS_BL6	0.20	0.07	0.03	0.11	0.20	0.21	0.17

Note: The table displays R^2 values resulting from univariate estimations of Equation 7. The average R^2 value is weighted by end-2008 positions.

D Comparisons of Forecast Model Performances

Figure D.1: Comparisons of forecast errors across forecast models (outward FDI)

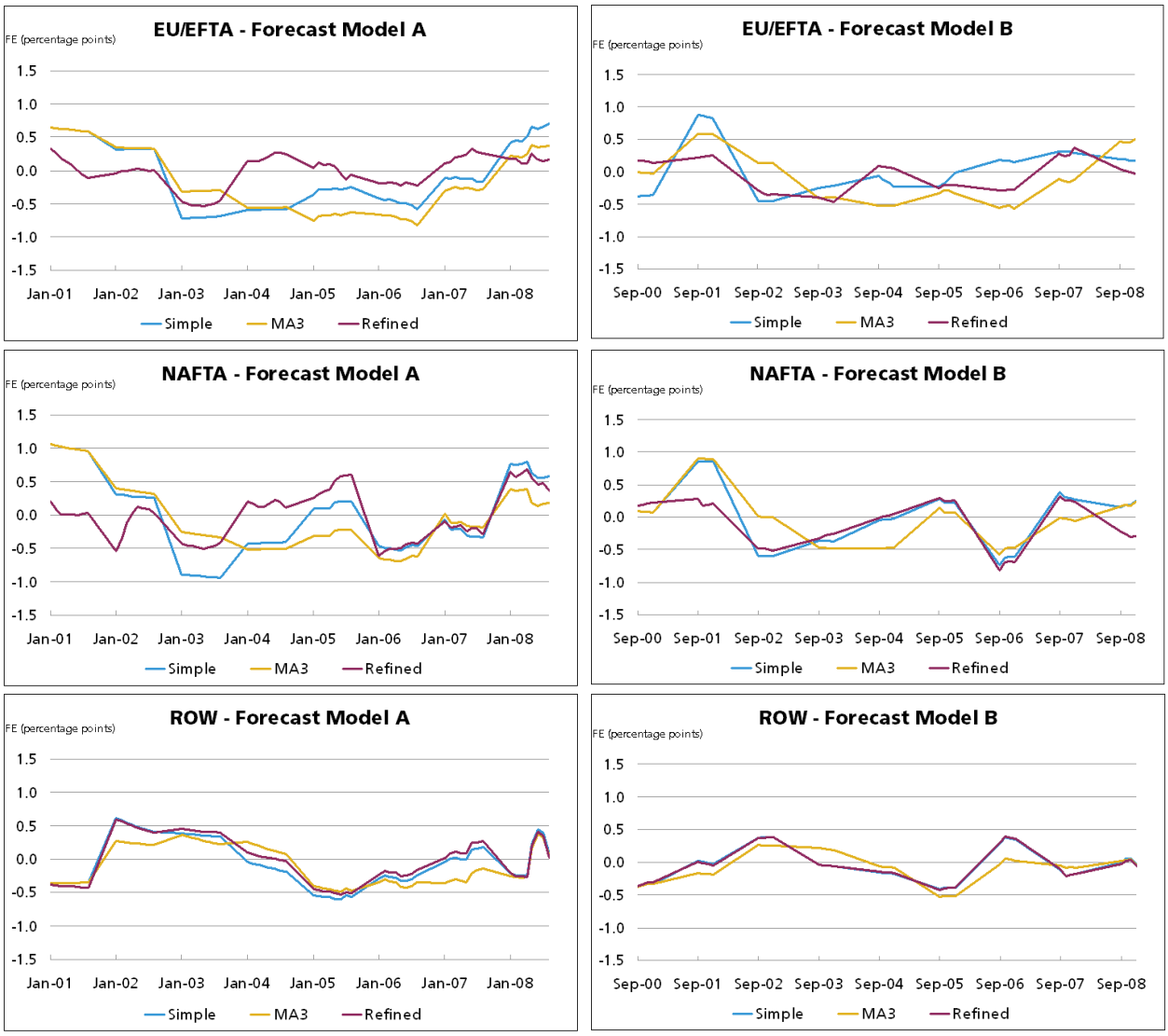

Figure D.2: Comparisons of forecast errors across forecast models (inward FDI)

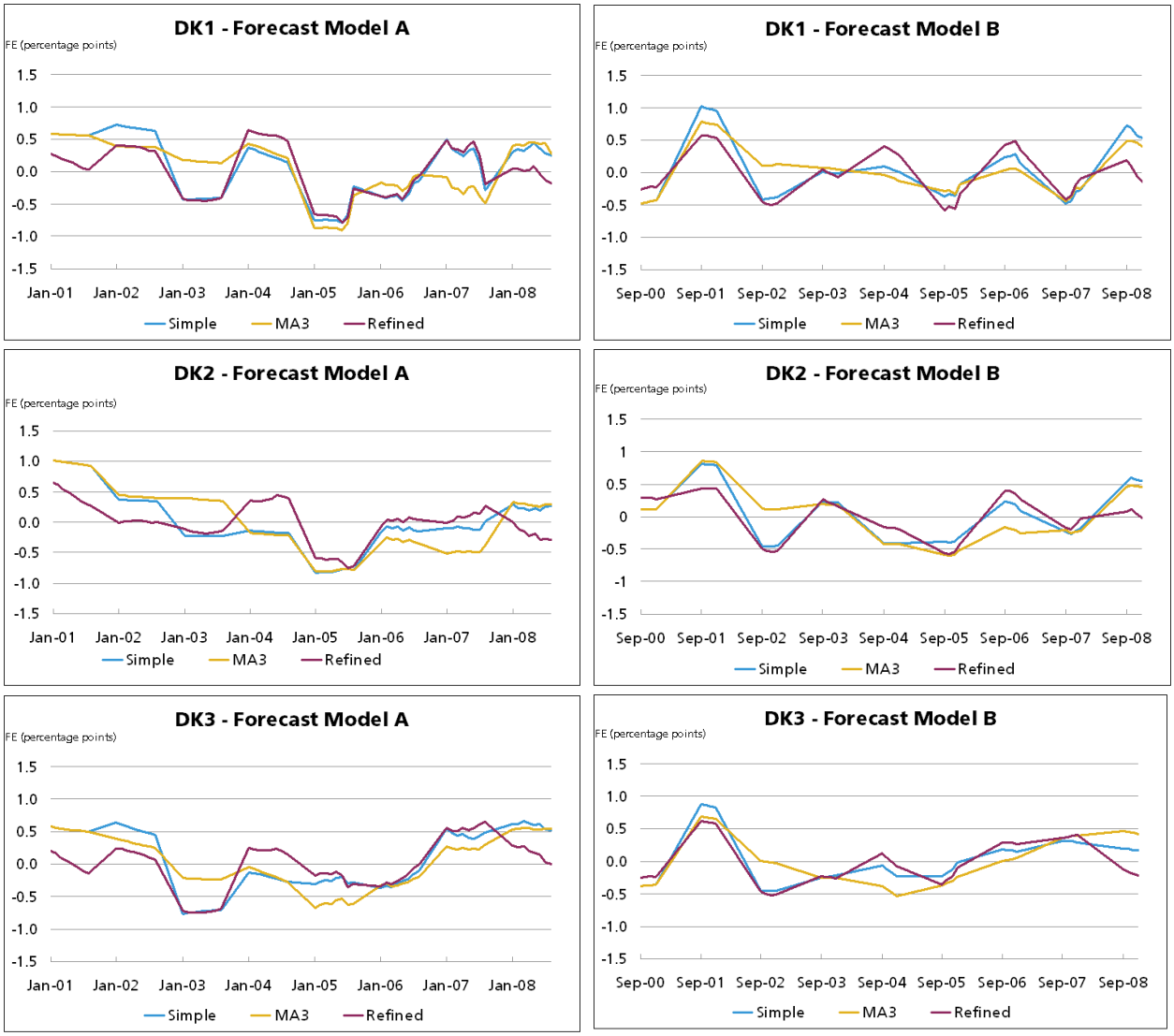

Table D.1: Comparing predictive accuracy

Comparison	**Inward FDI**	**Outward FDI**	**Net FDI**
	In-sample tests (2001-2008)		
Refined vs. simple	-4.67**	-11.10**	-4.20**
Refined vs. MA3	-2.85**	-9.98**	-1.32
	Out-of-sample tests (2006-2008)		
Refined vs. simple	-2.15*	-4.28**	-3.70**
Refined vs. MA3	-2.47**	-4.75**	-0.34

Note: The table displays the Diebold-Mariano test statistic, S, for comparisons between predictive accuracy of monthly data. The null hypothesis of equal predictive accuracy is given by $H_0 : E[d_t] = 0$ where $d_t = |FE_{refined}| - |FE_{simple/MA3}|$. A negative test statistic indicates that the refined models have higher predictive accuracy than the simple/MA3 models. $S \overset{a}{\sim} N(0,1)$; * and ** indicate significance at the 5% and 1% levels, respectively.