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MODELLING INDUSTRIAL NEW ORDERS FOR THE EURO AREA

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In 2014 all ECB publications feature a motif taken from the €20 banknote.

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ABSTRACT

This paper models industrial new orders across European Union (EU) Member States for various breakdowns. A common modelling framework exploits both soft data (business opinion surveys) and hard data (industrial turnover). The estimates show for about 200 cases that the model determinants significantly help in explaining monthly growth rates for new orders. An alternative estimation method, different model specifications and out-of-sample and real-time forecasting all show that the model results are robust. We present real-time outcomes of a European Central Bank (ECB) indicator on industrial new orders at an aggregated euro area level. This indicator is largely based on national new orders data and on estimates yielded by the model for those countries that no longer report new orders at the national level. Finally, we demonstrate the leading nature of the ECB indicator on euro area new orders in relation to industrial production.

JEL codes C22, C52, E32.

Keywords industrial new orders; leading indicators; real-time analysis; euro area

NON-TECHNICAL SUMMARY

This paper models industrial new orders across European Union (EU) Member States for various breakdowns. The reason for this modelling exercise was to fill a data gap that emerged following the decision to terminate the collection of data on industrial new orders by Eurostat, the statistical office of the EU, at the end of May 2012 (the final reporting period was March 2012). Against this background, the ECB has developed and released on a monthly basis since July 2013 an indicator on euro area industrial new orders for the following breakdowns: total, total excluding heavy transport equipment, main industrial groupings (MIGs), domestic and non-domestic (data are available from the ECB's Statistical Data Warehouse at http://sdw.ecb.europa.eu/browse.do?node=2120800).

For the period up to March 2012, the euro area series consists of the official data as released by Eurostat. From April 2012 onwards, the series is based on national (seasonally and working day adjusted) data for those countries that have continued with the collection at the national level and model estimates for those euro area countries that have discontinued the data collection, which, at the time this paper was prepared, included Ireland, France, Cyprus, Luxembourg, Malta and Slovenia, and now (June 2014) also include Belgium, Greece, the Netherlands and Portugal. The ECB indicator for euro area industrial new orders is an aggregate of national results, using a weighting scheme based on Eurostat weights for industrial turnover indices for the base year 2010. Each monthly observation for the euro area is calculated once the new official national data cover at least 60% of the aggregated euro area level, which is typically achieved around 55 days after the end of the reference month (i.e. close to the timing observed for the official statistics prior to being discontinued).

New orders are widely monitored by analysts and policy makers across the globe, because they are important for economic analysis for at least three main reasons. First, new orders have historically displayed leading properties for the business cycle. Manufacturing new orders for capital goods have consistently served as inputs to the Conference Board's Leading Economic Index for both the United States and the euro area. New orders are also among the leading series used for the OECD's widely monitored composite leading indicator. Second, data on new orders have proved useful for cross-checking data on industrial production, especially in times of heightened uncertainty. Third, they contain unique information on the origin of demand (i.e. domestic or foreign).

Notwithstanding the importance of new orders for economic analysis, little literature exists that explicitly models industrial new orders and could therefore underpin our modelling exercise. To the best of our knowledge, this is the first time that industrial new orders have been modelled

across all EU Member States and for several breakdowns (total, total excluding heavy transport equipment, MIGs, domestic and non-domestic, broken down into euro area and non-euro area), while applying a common modelling framework that capitalises on a broad range of sources and helps to enhance the robustness of the model-based proxy for industrial new orders. In particular, we use survey data (soft data) from the European Commission (DG ECFIN) business opinion survey in manufacturing as well as from the Markit Purchasing Managers Index (PMI), Eurostat's official statistics on industrial turnover (hard data), and variables aimed at improving the model dynamics. Our work on the modelling of industrial new orders is thus pioneering in terms of its geographical scale, scope (numerous groupings), and the varied sources of information deployed to obtain the final estimates. Given the lack of formal academic research and the small number of observations available for industrial new orders (in some cases starting in 2003 and ending in 2012), the model is constructed by diagnostically building on its simplest versions. Several criteria for accepting the final model version are applied. Apart from statistical criteria (not only t-statistics, but also the white noise property of the model residuals), consideration is also given to restrictions accounting for plausible economic properties (e.g. it is implausible for new orders to consistently grow faster than sales).

The main finding of our work is that the model we have designed provides useful information on month-on-month (m-o-m) growth rates for industrial new orders, significantly benefiting from the selected model determinants across all cases. In particular, turnover and surveys on new orders matter for monthly new order growth. At the euro area aggregate level, the model explains about 50% of the variation in the m-o-m growth rate for total new orders. For the other breakdowns of new orders considered at the euro area aggregate level, the explanatory power varies between around 30% (for capital goods) and 70% (for intermediate goods). These are promising outcomes for the inherently noisy monthly growth rates for industrial new orders. The robustness of our model is analysed in various ways (including an alternative estimation method and different model specifications), confirming that it provides outcomes that are both statistically and economically reliable, even out-of-sample and in real time.

Our work not only sheds light on an under-researched, policy-relevant area, but also delivers an empirical indicator of European and international importance: the ECB indicator on euro area industrial new orders. The publication of this indicator allows policy-makers, analysts and academics to continue monitoring and analysing new orders at the euro area aggregate level. We therefore recommend that the ECB indicator on euro area new orders be included in the set of indicators used to assess and monitor the state of the euro area economy. Our study may also provide a useful starting point for future research on modelling industrial new orders, given the surprising lack of other empirical studies in this field.

I INTRODUCTION

This study models industrial new orders for EU Member States for the following breakdowns: total, total excluding heavy transport equipment, main industrial groupings (MIGs), domestic and non-domestic. The model deploys various data sources. In particular, we use surveys from the European Commission (DG ECFIN) business survey in manufacturing as well as from the Markit Purchasing Managers Index (PMI), Eurostat's official statistics on industrial turnover, and variables aimed at improving the model dynamics.

Prior to its termination, the quantitative information on new order intake in manufacturing industries was part of the statistical framework of short-term indicators, as included in the Short-term Statistics Regulation.[1] A set of statistical indicators, covering the areas of manufacturing, construction, retail trade and services, was set up with the aim of measuring, analysing and forecasting patterns of economic activity. For manufacturing industries, among others, these indicators include industrial production, as a measure of quantitative activity, and new orders, as a measure that anticipates economic activity. Furthermore, short-term indicators are used as inputs for the other statistical areas, e.g. national accounts and structural business statistics, increasing the integrity and consistency of the European statistical framework.

The reason for this modelling exercise was to fill a data gap on industrial new orders that emerged following the decision to terminate the collection of data on industrial new orders by Eurostat, the statistical office of the EU, at the end of May 2012, with the final reporting period being March 2012 (Eurostat, 2012). Eurostat's collection of the industrial new orders variables stopped in the context of prioritisation in the development and production of statistics in the light of reduced resources and with the objective of reducing the burden on the European Statistical System.[2] Another reason given for the termination by the European Statistical System Committee was that industrial new orders were intended to serve as a leading indicator of future production, but that the predictive capacity of new orders has proven to be limited. From a theoretical point of view, we find this questionable, because there is, by nature, a lead time between the placement of an order and the production of the product. However, the lead time typically varies across product types; it is short for non-durable consumer goods, but can be quite long for certain capital goods, e.g. aircraft.

Following the discontinuation of statistics on industrial new orders by Eurostat, our study introduces the ECB indicator on industrial new orders at an aggregated euro area level. This

1 Council Regulation (EC) No 1165/98 of 19 May 1998 concerning short-term statistics (OJ L 162, 5.6.1998, p. 1), available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1998R1165:20120621:EN:PDF

2 See recital 5 in the preamble to Commission Regulation (EU) No 461/2012 of 31 May 2012 (OJ L 142, 1.6.2012, p. 26), available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:142:0026:0029:EN:PDF

indicator is compiled from a mixture of national data, consisting of (1) hard statistics on new orders for those countries that have continued the collection of industrial new orders statistics at a national level and (2) new orders estimates obtained from the modelling framework presented in this article for those countries that have not. Accordingly, for the period up to March 2012, the euro area aggregate series consist of official hard data collected by Eurostat. From April 2012 onwards, the series consists of aggregates obtained from a combination of national data and the outcome of the estimation framework, using Eurostat's turnover country weights with a base year 2010. Despite the discontinuation at euro area aggregate level, a large number of EU Member States are continuing to collect new orders data at a national level, reflecting the importance of industrial new orders statistics for economic analysis in those countries. These countries transmit the nationally collected data to the ECB on a monthly basis. The transmitted time series are preferably seasonally and working-day adjusted, and expressed in terms of indices (from 2013 onwards, the base year is 2010). Ireland, France, Cyprus, Luxembourg, Malta and Slovenia (euro area), and Denmark, Latvia, Lithuania and the United Kingdom (non-euro area) had officially discontinued the data collection at the time this paper was prepared. All other EU Member States are continuing with the collection at the national level for the time being. The following countries have now (June 2014) also discontinued the release of new orders statistics: Belgium, Greece, the Netherlands, Portugal and Croatia.

New orders are widely monitored by analysts and policy makers across the globe, despite the fact that Eurostat discontinued the provision of euro area industrial new orders statistics, because new orders have historically been shown to empirically anticipate business cycle turning points. There is a long-standing tradition of new orders leading industrial production (Alexander and Stekler, 1959). More recent evidence supporting the leading properties of new orders is provided by Döpke, Krämer and Langfeldt (1994) for Germany and by García-Ferrer and Bujosa-Brun (2000) for France and Spain. Furthermore, new orders in manufacturing (specifically, non-defence capital goods excluding the aircraft orders sub-category) have historically exhibited high correlation with the cyclical components of the business cycle in the United States (Stock and Watson, 1999). Consistently, manufacturing new orders for capital goods have served as inputs to the Conference Board's Leading Economic Index for both the United States and the euro area. New orders are also among the leading series used for the OECD's widely monitored composite leading indicator.

From a central banking perspective, new orders are, among many other economic and financial variables, helpful in assessing the dynamics of real activity and in identifying the nature of shocks hitting the economy and their effects on cost and pricing behaviour and the short to medium-term prospects for their propagation in the economy. To take appropriate monetary

policy decisions, decision-makers need to have a comprehensive understanding of the prevailing economic situation and must be aware of the specific nature and magnitude of any economic disturbances threatening price stability. The ECB's approach to organising, evaluating and cross-checking the information relevant for assessing the risks to price stability is based on two analytical perspectives, referred to as the "two pillars": economic analysis and monetary analysis. They form the basis for the Governing Council's overall assessment of the risks to price stability and its monetary policy decisions. For the economic analysis, which assesses the short to medium-term determinants of price developments with a focus on real activity and financial conditions in the economy, the ECB indicator on euro area industrial new orders is useful for at least three main reasons. First, new orders have historically displayed leading properties for the business cycle. Second, they have proved useful for cross-checking industrial production data, especially in times of heightened uncertainty. Third, they contain unique information on the origin of demand (i.e. domestic or foreign).

Notwithstanding the importance of new orders for economic analysis, little literature exists that explicitly models industrial new orders and could therefore underpin our modelling exercise. We are aware of only a few studies that focus on modelling industrial new orders. Nicholson and Tebbutt (1979) draw upon early investment theories to model new orders received from the private industrial sector. They also appreciate that new orders for non-residential construction work lead UK construction industry activity. Other studies focus on the link between business sentiment surveys and the business cycle. For example, Klein and Moore (1981) find that entrepreneur surveys on new orders are relevant for an assessment of the UK business cycle, alongside traditional quantitative time series. More recent research concludes that business trend tendency surveys are able to predict the Italian business cycle, and hence are useful for forecasting the Italian real economy in the short run (Cesaroni, 2011). Etter and Graff (2003) model new orders for Switzerland using business surveys. They find that the ordinary least square (OLS) estimates predict levels, turning points, peaks and troughs in their reference series very closely throughout the whole estimation period. Finally, anticipating the subsequent discontinuation of euro area new orders statistics, the European Commission (2011) analyses the relevance of the European Commission business survey in manufacturing to the now discontinued series, concluding that surveys contain relevant information for assessing the latter.

To the best of our knowledge, our study is the first to model industrial new orders by deploying qualitative and quantitative data. Given the lack of formal academic research, as well as the small number of observations available for industrial new orders for EU Member States (in some cases starting in 2003 and ending in 2012), the model is constructed by diagnostically

building on its simplest versions. Several criteria for accepting the final model version are applied. Apart from statistical criteria (not only t-statistics, but also the white noise property of the model residuals), consideration is also given to restrictions accounting for plausible economic properties (e.g. it is implausible for new orders to consistently grow faster than sales).

The main finding of our work is that the model we have designed provides useful information on m-o-m growth rates for industrial new orders, significantly benefiting from the selected model determinants across all cases. In particular, turnover and surveys on new orders matter for monthly new order growth. At the euro area aggregate level, the model explains about 50% of the variation in the m-o-m growth rate for total new orders. For the other breakdowns of new orders considered at the euro area aggregate level, the explanatory power varies between around 30% (for capital goods) and 70% (for intermediate goods). These are promising outcomes for the inherently noisy monthly growth rates for industrial new orders. The robustness of our model is analysed in various ways (including an alternative estimation method and different model specifications), confirming that it provides outcomes that are both statistically and economically reliable, even out-of-sample and in real time.

The outline of this paper is as follows. Section 2 describes the model and its determinants and Section 3 the data. Section 4 presents the estimation results of our model, including out-of-sample forecasts, and explores a couple of estimation and modelling alternatives. Section 5 introduces the real-time outcome of the ECB indicator on euro area industrial new orders and examines its forecasting properties in real time. Section 6 reports results about new orders leading production. Section 7 concludes.

2 MODEL

Our study on modelling industrial new orders is pioneering in terms of scale (euro area aggregate as well as all EU Member States), scope (totals, totals excluding heavy transport equipment as well as breakdowns across all MIGs and origins of demand), and the use of a broad mix of qualitative and quantitative data. Given the novelty of our modelling exercise, and the lack of a commonly agreed theoretical and empirical framework to fall back on, the model determinants are drawn not only from business surveys on new orders, but also from hard data. Emphasis is thus put on exploiting information from a broad mix of data sources, which should help to enhance the robustness of the model-based proxy for new orders. The empirical framework is constructed by building on its simplest versions. The specific-to-general modelling strategy for the selection of explanatory variables is also sustained on the grounds of superior efficacy in terms of ex-ante forecasting performance in small samples (Herwartz, 2010).

We consider three groups of model determinants of m-o-m growth in new orders (NO): (i) (qualitative) surveys, (ii) (quantitative) hard data, and (iii) variables to improve the model dynamics, as summarised in Table 1.

Table 1 Overview of model determinants for euro area industrial new orders m-o-m growth

Variable	Macroeconomic determinant
Surveys	
Δ_3ECFIN	Three-month change in managers' assessment of the current level of order books
$\Delta\Delta_3$ECFIN	Three-month change in managers' assessment of the current level of order books (1st difference)
μ_t^{PMI}	Purchasing manager new orders index (PMI)
$\mu_t^{\Delta\,PMI}$	Purchasing manager new orders index (PMI) (1st difference)
Hard data	
TO m-o-m growth	Industrial turnover index in manufacturing (corresponds to market sales of goods or services)
TO_{t-1} m-o-m growth	Industrial turnover index in manufacturing (1 period lagged)
NO_{t-1} / TO_{t-1}	New orders to industrial turnover ratio (1 period lagged)
Variables that improve dynamics	
NO_{t-1} m-o-m growth	Lagged dependent variable (by 1 period)
NO_{t-2} m-o-m growth	Lagged dependent variable (by 2 periods)

The first group of model determinants is qualitative data sources. We consider not only DG ECFIN's monthly surveys in manufacturing on managers' assessment of the current level of order books (stock concept) as being *above normal/normal for the season/below normal*, but also purchasing managers' responses on total orders (flow concept) being *higher than/lower*

than/the same as one month ago. Both survey series are included in the model, with the ECFIN survey as the headline indicator, because, unlike the PMI, it is available for all EU Member States. To line up with the PMI survey series, which, from a conceptual point of view is preferred because it explicitly relates to m-o-m growth rates for new orders, the ECFIN surveys are transformed into third differences, i.e. the three-month change. Furthermore, only the information entrenched in the PMI that is not already included in the ECFIN series is taken into account. Each survey time series is contained in the model in terms of levels as well as first differences in order to "let the data speak", regardless of whether the levels alone (as expected from a conceptual point of view for the PMI) or also the changes (as more expected for the ECFIN series on order book levels) matter for monthly growth in new orders.

Second, building the model empirically from its simplest versions and relying only on surveys, we find that adding quantitative statistics on sales advances the model meaningfully. The addition of sales relates to the economic accounting definition of orders, i.e. the change in the order book is the result of new orders minus sales and cancelled orders:

$$\Delta \text{ order books} = \text{new orders} - \text{sales} - \text{cancelled orders} \quad (1)$$

The definition suggests that the model-based proxy for new orders would also benefit from an expression representing sales and cancelled orders. Whilst no data on cancelled orders are available, Eurostat's industrial turnover (TO) can be used to represent sales. Moreover, we enhance the model by including an industrial turnover m-o-m growth rate lagged by one period. Such an addition has a positive consequence at country level, because some countries release turnover data late. In the real-time application of the model, the turnover growth at time *(t-1)* serves as a proxy for sales at time *t*, and we subsequently revert to the original model once turnover for the current reference period has been released. In addition, we complement the model with a one-period lagged new orders/turnover ratio to represent a long-run equilibrium relationship between new orders and sales.

The third and final group of determinants help improve the behaviour of the model residuals, adding the dependent variable lagged by one period and two periods, respectively, in order to introduce more dynamics into the model and mitigate the temporal/spatial dependence of the error term.

Our new orders model (NOM) for estimating the monthly growth rate of industrial new orders for the euro area aggregate and for individual EU Member States reads as follows:

$$\begin{aligned} &NO \text{ m-o-m growth}_t = \beta_0 + \beta_1 \Delta_3 ECFIN_t + \beta_2 \Delta\Delta_3 ECFIN_t + \beta_3 \mu_t^{PMI} + \beta_4 \mu_t^{\Delta PMI} + \\ &\beta_5 TO \text{ m-o-m growth}_t + \beta_6 TO \text{ m-o-m growth}_{t-1} + \beta_7 NO_{t-1} / TO_{t-1} + \beta_8 NO \text{ m-o-m growth}_{t-1} + \\ &\beta_9 NO \text{ m-o-m growth}_{t-2} + \varepsilon_t \end{aligned} \quad (2)$$

The PMI residual terms are derived from extra regressions in the following fashion:

$$PMI_t = \beta_0 + \beta_1(\Delta_3 ECFIN_t) + \mu_t^{PMI} \quad (3)$$

$$\Delta\, PMI_t = \beta_0 + \beta_1(\Delta\Delta_3 ECFIN_t) + \mu_t^{\Delta PMI} \quad (4)$$

Equation (2) represents the estimated NOM, whilst equations (3) and (4) serve as intermediate regressions from which the PMI residual terms are extracted and plugged into equation (2). The PMI residual terms potentially capture all extra information absent in ECFIN surveys, assuming that PMI and ECFIN surveys do not encompass identical information. All right-hand-side variables – with the exception of the lagged dependent terms and the one-period lagged new order/turnover ratio term – are expected to exhibit a positive relationship with new orders.

Starting with the freely estimated results yielded by the NOM, we estimate additional restricted specifications for the euro area aggregate and at country level. The coefficient restrictions imposed in each case are tailored to each country's data availability, as well as the country's individual performance under free estimation, i.e. we eliminate right-hand-side variables that have been shown to have little explanatory power, and limit other coefficients to ensure economic viability of their magnitudes vis-à-vis the monthly growth rate for new orders, e.g. new orders growth should not exceed sales growth $(\beta_6 = 1 - \beta_5)$.

3 DATA

3.1 OPINION SURVEYS

The DG ECFIN survey in manufacturing[3] measures order books, in which changes may be due to new orders, order completions or order cancellations. An increase in the indicator signals that enterprises' stocks of orders are larger than normal, which could hint at a comparatively higher order intake. DG ECFIN's headliner survey in manufacturing asks:

- Do you consider your current overall order books to be *more than sufficient (above normal) / sufficient (normal for the season) / not sufficient (below normal)*?

In contrast, the PMI surveys[4] conducted by *Markit* assess new orders in manufacturing based on the following query:

- The level of total orders received this month compared with one month ago was *higher/lower/same*.

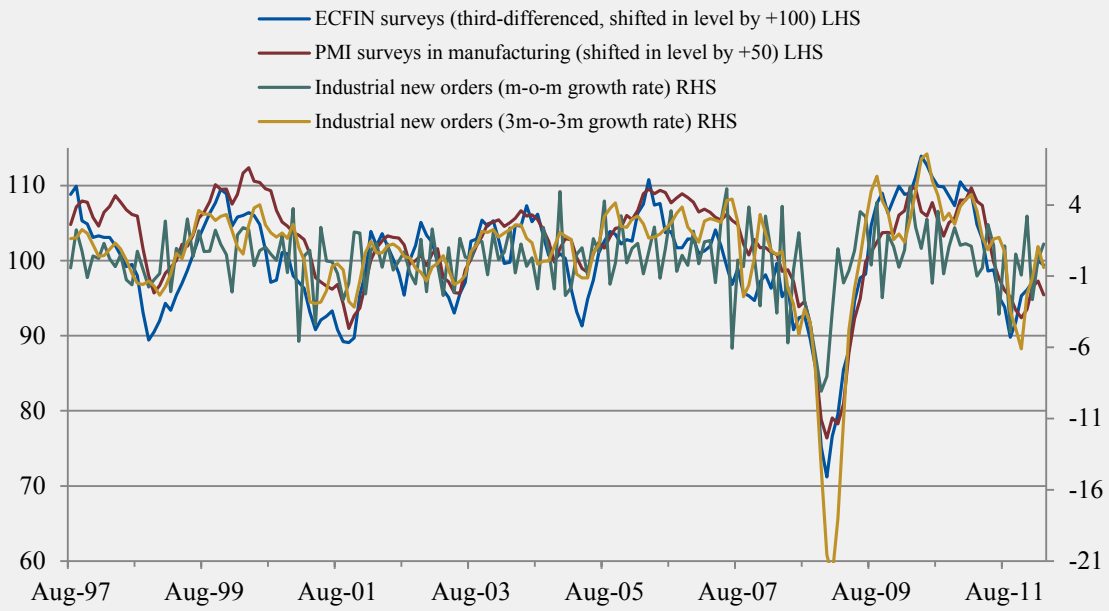
Despite the obvious methodological differences between the ECFIN and PMI surveys, the three-month change in ECFIN order books and the manufacturing PMI new orders index exhibit pronounced co-movement and turning point alignment (see Figure 1). The ECFIN series transformed into a three-month change (rather than a one-month change) also proves to be a better determinant empirically, when diagnostically constructing the NOM. The finding that the three-month change in the ECFIN survey performs empirically better than the one-month change might relate to quarterly reporting by many firms. Directors have a long-standing and intense focus on quarterly results (Lorsch and Clark, 2008). As a consequence, firms may be adjusting their survey responses at a quarterly rather than a monthly frequency. Another explanation might be that, given that the monthly developments in new orders can be quite erratic, respondents are uncertain whether monthly movements are just noise (not affecting their survey response) or a true signal (affecting their response) and therefore wait for a couple of months to confirm a potential signal. Figure 1 therefore plots the dependent variable in terms of the estimated m-o-m growth as well as a three-month-on-three-month (3m-o-3m) growth rate.

[3] The European Commission (DG ECFIN) Joint Harmonised EU Programme of Business and Consumer Surveys, available at http://ec.europa.eu/economy_finance/db_indicators/surveys/method_guides/index_en.htm.

[4] Results from the PMI surveys in manufacturing are available only for Germany, Ireland, Greece, Spain, France, Italy, the Netherlands and Austria in the euro area, and for the Czech Republic, Poland and the United Kingdom outside the euro area. Euro area data and most national data start in 1998; the series are seasonally adjusted.

Figure 1 Euro area surveys on new orders and total new orders growth

(level, left-hand scale; %, right-hand scale)



3.2 INDUSTRIAL TURNOVER

Industrial turnover measures the totals invoiced by enterprises or kind-of-activity unit during the reference period, which corresponds to market sales of goods or services supplied to third parties. Industrial turnover includes all other charges (e.g. transport, packaging) passed on to the customer, even if these charges are listed separately on the invoice.

Industrial turnover can be broken down into domestic and non-domestic turnover, which requires it to be split according to the first destination of the product based on the change of ownership. The destination is determined by the residence of the third party that purchased the goods and services. The domestic market is defined as third parties residing in the same national territory as the observation unit. Non-domestic turnover is further sub-divided into turnover from euro area countries and non-euro area countries. The turnover index is a value index with a fixed base year (since 2013, the base year is 2010 = 100). Its timeliness across EU Member States varies between 45 and 75 days after the end of the reference month.

Figure 2 illustrates the close relationship between total new orders and total turnover in manufacturing for the euro area (given in terms of the 3m-o-3m growth rate, as the m-o-m rate is too erratic to reveal the association). Although the statistics on industrial turnover and industrial new orders differ in terms of coverage (industrial turnover covers all manufacturing industries, whereas industrial new orders cover only industries that work on the basis of orders)

and valuation (turnover is recorded at prices at the time of sale, whereas orders are recorded at prices at the time that the order is taken), they have a lot in common.

Figure 2 Euro area turnover, one-period lagged new orders/turnover ratio and new orders growth

(level, left-hand scale; %, right-hand scale)

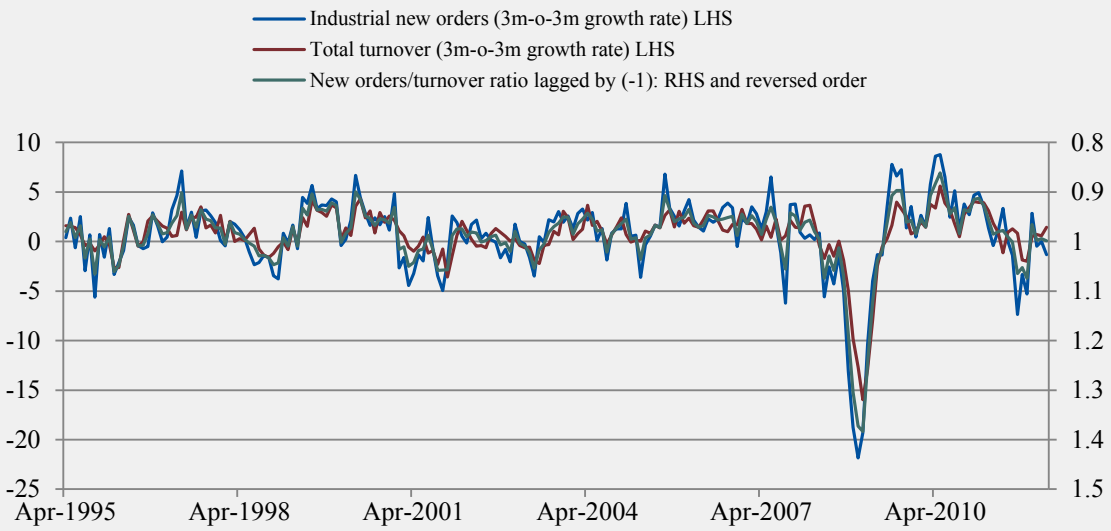


Table 2 summarises the correlation between the model determinants and new orders in levels, m-o-m growth rates and first-order autocorrelations. The upper panel shows comparatively high correlations with new orders in levels for turnover in levels and for the one-month lagged new orders/turnover ratio as well as, to a somewhat lesser extent, for the ECFIN survey and PMI residuals in levels. The correlations with the m-o-m growth rates in new orders are comparatively high for current turnover growth (see lower panel).

Table 2 Cross-correlations between new orders (in levels and m-o-m growth rates) and the model determinants and first-order autocorrelations

Levels

	Correlations									
	NO levels	*ECFIN*	Δ_3*ECFIN*	*PMI* residuals	Δ*PMI* residuals	*TO*	TO_{t-1}	NO_{t-1} / TO_{t-1}	NO_{t-1}	NO_{t-2}
NO levels	1.00	0.72	0.14	0.75	-0.06	0.91	0.88	0.91	0.97	0.94
ECFIN		1.00	0.30	0.84	-0.06	0.89	0.86	0.47	0.71	0.70
Δ_3*ECFIN*			1.00	0.01	0.26	0.12	0.01	0.15	0.09	0.02
PMI residuals				1.00	0.06	0.86	0.85	0.54	0.74	0.71
Δ*PMI* residuals					1.00	-0.13	-0.16	0.00	-0.08	-0.18
TO						1.00	0.98	0.72	0.92	0.91
TO_{t-1}							1.00	0.70	0.91	0.92
NO_{t-1} / TO_{t-1}								1.00	0.93	0.88
NO_{t-1}									1.00	0.97
NOt-2										1.00
	First-order autocorrelations									
	0.97	0.91	0.42	0.94	-0.07	0.97	0.97	0.96	0.98	-0.98

Month-on-month growth rates

	Correlations									
	NO m-o-m	Δ_3*ECFIN*	$\Delta\Delta_3$*ECFIN*	*PMI* residuals	Δ*PMI* residuals	*TO m-o-m*	$TO\ m\text{-}o\text{-}m_{t-1}$	NO_{t-1} / TO_{t-1}	$NO\ m\text{-}o\text{-}m_{t-1}$	$NO\ m\text{-}o\text{-}m_{t-2}$
NO m-o-m	1.00	0.23	0.09	0.01	0.14	0.61	0.21	-0.08	0.08	0.21
Δ_3*ECFIN*		1.00	0.54	0.01	0.26	0.54	0.37	0.15	0.32	0.49
$\Delta\Delta_3$*ECFIN*			1.00	-0.18	0.00	0.33	-0.16	0.03	0.09	0.15
PMI residuals				1.00	0.06	0.04	0.16	0.54	0.09	0.11
Δ*PMI* residuals					1.00	0.14	0.29	0.00	0.40	0.23
TO m-o-m						1.00	0.21	0.12	0.29	0.42
$TO\ m\text{-}o\text{-}m_{t-1}$							1.00	0.16	0.61	0.29
NO_{t-1} / TO_{t-1}								1.00	0.20	0.17
$NO\ m\text{-}o\text{-}m_{t-1}$									1.00	0.08
NO m-o-mt-2										1.00
	First-order autocorrelations									
	0.03	0.43	-0.48	0.94	-0.07	0.09	0.09	0.96	0.03	0.03

4 ESTIMATIONS

4.1 NEW ORDERS MODEL

The NOM has been estimated by OLS for all sub-groupings of new orders using both euro area aggregate data and EU country-level data. The results show that all three groups of model determinants help explain the monthly growth rate for new orders, in particular, hard data and surveys, but also, to a much smaller extent, variables to improve the model dynamics. This is evidenced by expected relationships (indicated by the signs of the coefficients), recurring statistical significance, and by the economically sound magnitude of the coefficients. Importantly, the model yields healthy residuals for the euro area aggregate and at country level.

Table 3 reports euro area aggregate level results for all requested sub-groupings. Regarding euro area total new orders, both free and restricted estimation explain about 50% of the variation in the monthly growth rate for total new orders with a corresponding standard error (SE) of regression of 1.6 percentage points (see first two rows). The restricted estimation eliminates the Δ PMI residual term, which proved to have little explanatory power, and limits turnover growth variables not to jointly exceed 1, as it is not economically viable in the long run for sales growth to exceed orders growth. Each tailored restriction set is tested for statistical viability using the Wald test and shows that the restrictions cannot be rejected (see last column). The model residuals show a satisfactory absence of correlation, as indicated by the reported Ljung-Box Q-statistics at lags 4 and 12.

Table 3 Euro area (EA) aggregate new orders: detailed estimation results across sub-categories

	EC FIN	Δ EC FIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	NO-turnover ratio (-1)	Lagged dependent (-1)	Lagged dependent (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
EA total NO (free estimation)	**0.13**	**0.13**	**0.20**	0.10	**0.93**	**0.34**	**-22.09**	**-0.36**	**-0.22**	0.52	*1.61*	0.64	0.79	-
EA total NO (restricted in-sample)	**0.16**	**0.14**	**0.23**	0	**0.81**	(1-β5)	**-25.28**	**-0.30**	**-0.19**	0.52	*1.62*	0.93	0.89	0.34
EA NO (excl. heavy transport equipment)	**0.10**	**0.12**	**0.16**	**0.15**	**0.86**	(1-β5)	**-17.46**	**-0.27**	0	0.65	*1.14*	0.57	0.21	0.19
EA NO - capital goods	**0.17**	**0.17**	**0.27**	0	**0.42**	0.20	**-18.50**	**-0.43**	**-0.27**	0.29	*3.05*	0.92	0.63	0.13
EA NO - intermediate goods	**0.06**	0.04	0	0	**0.88**	(1-β5)	**-12.46**	-0.08	0	0.72	*1.16*	0.04	0.27	0.13
EA NO - consumer goods	**0.12**	0	**0.08**	0	**0.90**	(1-β5)	**-33.18**	**-0.39**	**-0.22**	0.57	*1.30*	0.03	0.03	0.53
EA NO - consumer durable goods	**0.09**	0	**0.13**	0	**0.59**	0.16	**-18.89**	**-0.51**	**-0.15**	0.44	*2.49*	0.32	0.17	0.36
EA NO - consumer non-durable goods	**0.10**	0	0	0	**0.80**	0	**-32.31**	**-0.28**	**-0.21**	0.50	*0.49*	0.05	0.01	0.72
EA NO - domestic goods	**0.15**	0	**0.14**	0	**0.69**	(1-β5)	**-12.36**	**-0.48**	**-0.33**	0.41	*2.03*	0.56	0.55	0.33
EA NO - non-domestic goods	**0.17**	**0.26**	**0.23**	0.22	**0.70**	**0.29**	**-22.54**	**-0.40**	**-0.20**	0.50	*1.99*	0.89	0.92	-
EA NO - non-domestic goods (EA)	**0.25**	**0.35**	**0.48**	0	**0.30**	0	**-32.64**	**-0.30**	0	0.45	*2.45*	0.90	0.95	0.68
EA NO - non-domestic goods (non-EA)	**0.22**	**0.26**	**0.31**	0	**0.60**	0.31	**-35.67**	**-0.40**	**-0.35**	0.49	*2.98*	0.42	0.74	0.21

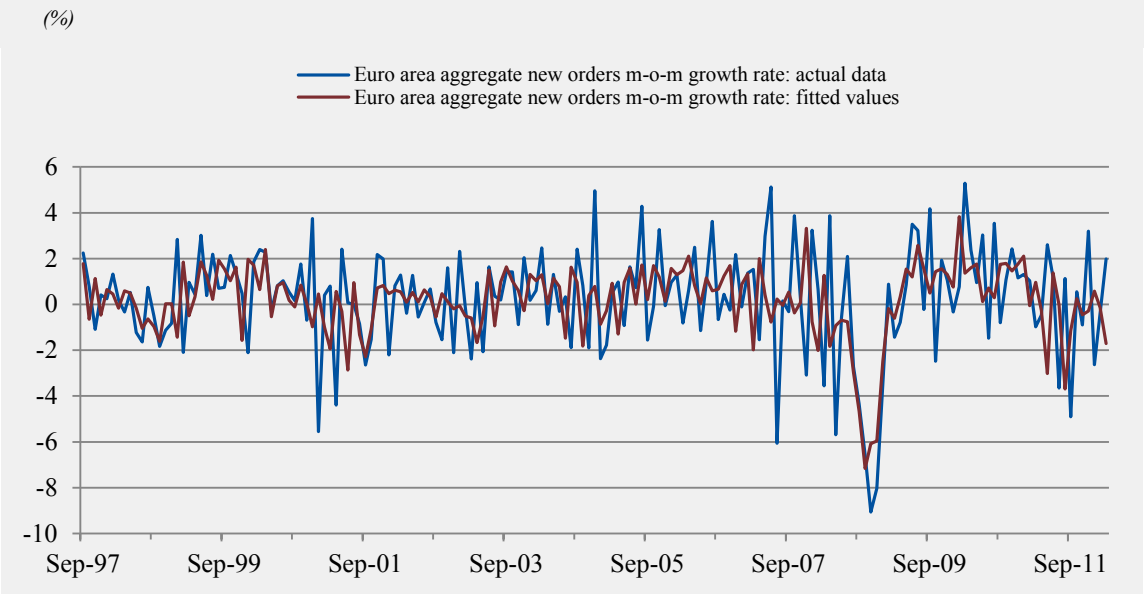
Notes: The sample period depends on data availability, which varies across variables. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively.

The average goodness of fit across the remaining requested sub-categories further corroborates the result for total new orders. We find that our model performs comparatively well for intermediate goods (with an adjusted R-squared of over 70%) and for the "excluding heavy

transport equipment" sub-category (65%). The latter, in particular, is in line with our expectations, as the sub-category is empirically known to more closely reflect real economy developments, undistorted by bulky and irregular ship, railway, and aerospace orders. By contrast, the capital goods sub-category comparatively underperforms with an adjusted R-squared of 30%.[5] In terms of goodness of fit, the remaining sub-categories oscillate around 50%. For all categories, except non-durable consumer goods, the model residuals behave correctly according to the Q-statistics. In all cases, the Wald statistics show that restrictions cannot be statistically rejected.

Figure 3 plots the actual and fitted values of the restricted in-sample estimation of the m-o-m growth rate of euro area aggregate total new orders. Given the inherent noise of m-o-m new order series, we find the fitted euro area aggregate values quite satisfactory, as, even for monthly growth rates, a close co-movement with the actual values is visible.

Figure 3 Euro area total new orders m-o-m growth rate: actual and fitted values



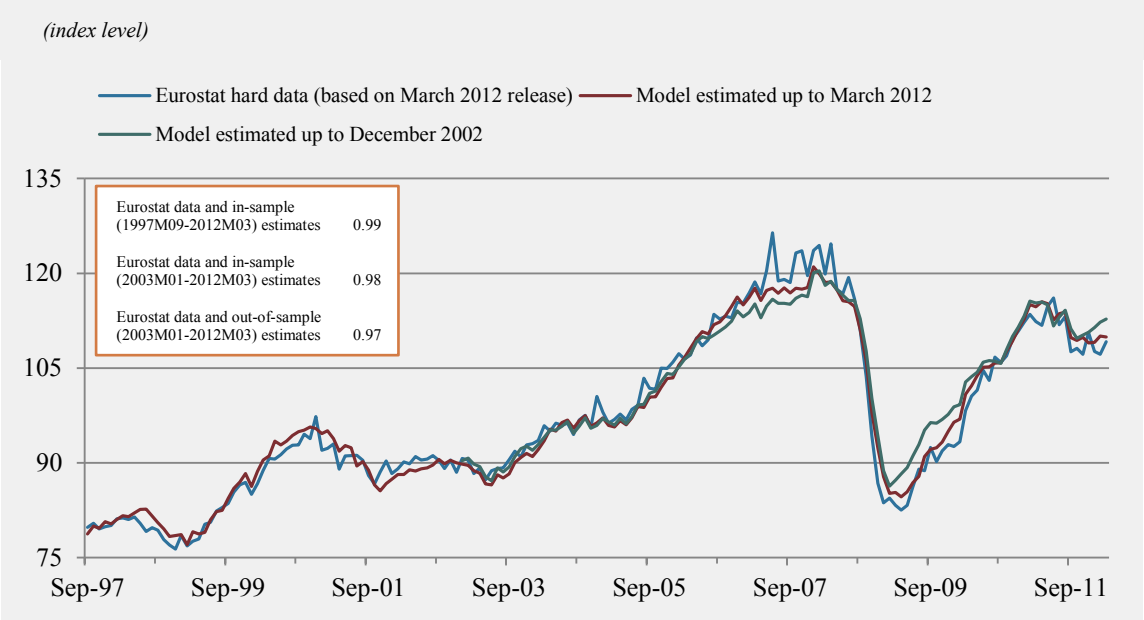
At euro area country level, the findings are similar. Detailed country-level estimation results are reported in the annex. Turnover data, surveys and lagged dependent variables help in explaining the monthly growth rates for new orders for euro area countries. The goodness of fit varies across euro area countries and the various breakdowns of new orders. No consistent difference

[5] The shares of euro area MIG components are large for intermediate goods (36.6% for industrial turnover for the current base year, 2010=100, and 40.2% for industrial new orders for the former base year, 2005=100) and capital goods (29.6% and 46.5%, respectively), smaller for non-durable consumer goods (23.0% and 11.0%, respectively) and small for durable consumer goods (3.1% and 2.4%, respectively).

in the explanatory power of the model can be seen between those countries that have discontinued and those that have continued the collection of new orders data. For example, for total new orders, the two countries with the highest adjusted R-squared (Ireland and Malta) and the two countries with the lowest adjusted R-squared (Slovenia and Luxembourg) are all among the countries that have discontinued new orders data collection (see Table A.1 in the annex). Serial correlation as indicated by the Ljung-Box Q-statistics is found only sporadically at country level: for no more than 2 out of the 16 countries for the various breakdowns. Restrictions are statistically allowed at the 1% confidence level for all countries, with the exception of Ireland.

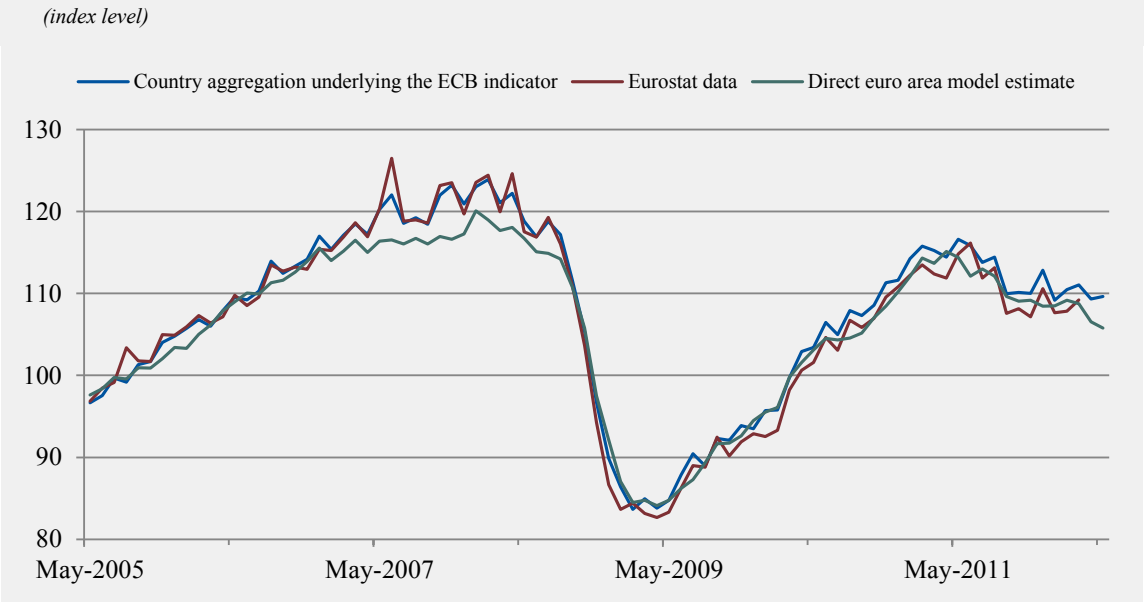
In order to check the validity of the NOM, we also estimate it for the euro area with the usual restrictions over a five-year period (1997 to 2002) and use these estimates to dynamically forecast a ten-year period (2003 to 2012) by using previously estimated values of the lagged dependent variables. Figure 4 plots the out-of-sample forecasts of the euro area total new orders index, along with the restricted model estimated for the full in-sample period, against the official Eurostat data up to March 2012. It shows that all three time series follow similar trajectories. The dynamic model forecasts for the euro area explain 97% of the variation in total industrial new orders index levels over the ten-year out-of-sample horizon. This compares with 98% for the in-sample results over the same period, and 99% for the full in-sample period. Overall, the results from the dynamic forecast exercise suggest that the NOM generates plausible outcomes.

Figure 4 Euro area total new orders: official Eurostat data, in-sample fitted values and out-of-sample dynamic forecasts



In order to further asses the plausibility of the NOM estimates, Figure 5 plots the official Eurostat data together with the model estimates using the country aggregation underlying the ECB indicator on new orders (i.e. using actual data for those countries that have continued with the release of national new orders data and the country model estimates for those countries that have discontinued) and the direct euro area model estimate. It shows that the outcomes from the country aggregation underlying the ECB indicator and the direct euro area model estimates have both followed the Eurostat data closely, although there have been some extended periods of deviation. In particular, the direct euro area model fitted lower values for the 2007/08 peak in new orders, whereas the country aggregation shows a slight upward bias from 2009 onwards. The latter may be due to the sharp fall in the series during the crisis and the somewhat slower response time of the model to such dramatic changes. Furthermore, the volatility of the monthly series from France was particularly large, mainly due to the recording of new orders in the aircraft industry. The model outcome for France has contributed to this effect, as France is one of the countries that have discontinued the collection of new orders statistics. All in all, the comparison with the Eurostat data shows that the NOM generates plausible outcomes at the euro area level, although it might take time for the NOM to move to the "true" steady index level.

Figure 5 **Euro area industrial new orders: Eurostat data, country aggregation underlying the ECB indicator on new orders and the direct euro area model estimate**



4.2 ALTERNATIVE SPECIFICATIONS

To further scrutinise the validity of our model, we estimate new orders transformed into 3m-o-3m growth rates (although m-o-m growth rates are preferred, as the overall aim is to fill in monthly data gaps). As for the right-hand-side variables, all hard data are transformed correspondingly into 3m-o-3m growth rates, and the lags are also adjusted as appropriate in order to avoid any overlapping observation. Not surprisingly, going from the noisy m-o-m growth rate to the much smoother 3m-o-3m growth rate, the goodness of fit as measured by the adjusted R-squared improves for total new orders markedly to 0.91 from 0.52, but this is at the cost of an incorrect behaviour of the model residuals, as evidenced by the significant Ljung-Box Q-statistics at lags 4 and 12.[6] The same is also found for the various breakdowns of euro area new orders considered.

As another robustness check, we estimated the NOM using seemingly unrelated regressions (SURs) (Zellner, 1962). The gains in coefficient efficiency (compared with single equation OLS estimation) can be remarkable, although explanatory variables are little correlated, whilst the disturbance terms across equations are highly correlated. Correspondingly, in the euro area context, it is easy to conceive a scenario in which, across individual countries, factors which illuminate new orders growth are little correlated, while the portion of the variance unexplained

[6] These results (and results from other robustness checks referred to in this sub-section) are available from the authors upon request.

by our model has a shared platform. The SUR results, however, are consistently inferior to the individual country-level OLS results. The average explanatory power is slightly lower than using the OLS estimation. There are therefore no efficiency gains in a system estimation compared to the single equation OLS estimations.

We also checked whether it makes sense to simplify the model by considering the "raw" PMI in terms of index level and its change rather than the applied residual approach. The underlying rationale is essentially not to omit any relevant information offered by alternative data sources even if a portion of the information found in surveys overlaps. Such an approach is expected to reduce the standard errors of the individual regressors and those of the regression. Indeed, the standard error of the regression marginally declines across the majority of sub-groupings of new orders and the explanatory power (as measured by the adjusted R-squared) marginally improves. However, in 7 out of the 11 sub-groupings, the simplified model version results in no impact for the ECFIN series. The latter is a strong argument in favour of the NOM, given that the ECFIN survey serves as the headline survey at country level for those countries for which PMI data are unavailable. Consequently, the NOM allows a fairer comparison between countries for which PMI data are available and those for which they are not.

In addition, considering only the ECFIN survey or only the PMI survey does not improve the NOM. In fact, when taking into account only the ECFIN survey, the adjusted R-squared declines for the euro area and for all 7 countries for which both survey series are available; and, when taking to account only the PMI survey, the fit deteriorates for the euro area and for 5 of the 7 countries for which both survey series are available.

The surveys were also scrutinised from the viewpoint of seasonal adjustment. Specifically, it was investigated whether adjusting the ECFIN surveys with DAINTIES (a standard seasonal adjustment performed by DG ECFIN) or Census X12 ARIMA (a standard method used by Eurostat) influences the model estimates. A visual comparison of the series seasonally adjusted in both ways reveals only minor differences. Additional estimates for the euro area showed that the seasonal adjustment method may subtly influence the coefficient magnitudes, but has no impact on either the fit or the regression's standard error.

Our final robustness check relates to adding a "foreign" indicator, i.e. new orders growth rates for countries that continued with the dissemination of new orders, to the NOM at country level. From the outset, such an approach appears profligate, as it necessarily results in a unique specification for each country and/or each category for which the data collection stops. Obviously, this is at the cost of the uniform framework across countries provided by the NOM. The new orders m-o-m cross-correlation matrix indicates that the "most relevant" foreign indicator for each discontinuing country, at best, lacks a sound conceptual and empirical basis

or, at worst, is arbitrary (see Table 4). The maximum correlation between the euro area countries that have discontinued the reporting of new orders and those that still release new orders data varies between 0.2 for Ireland and 0.4 for Slovenia. The correlations are difficult to explain in economic terms, as for instance, Greek new orders growth appears the most relevant for those in France and Malta. Given the lack of economic rationale, we shall refrain from adding the foreign indicator to the NOM, despite the fact that in three out of five cases it is statistically significant and slightly enhances the goodness-of-fit.

Table 4 Euro area country-level total new orders m-o-m growth rates: cross-correlation matrix

		Euro area countries that are continuing new orders data collection at a national level									
		Germany	Spain	Italy	Netherlands	Greece	Austria	Belgium	Estonia	Slovakia	Finland
Discontinuing euro area countries	Ireland	0.18	-0.08	0.01	-0.13	-0.10	0.02	0.18	-0.02	0.12	0.02
	France	0.16	0.07	0.31	0.09	0.29	0.21	0.09	0.18	0.21	0.01
	Luxembourg	0.23	0.05	0.07	0.23	0.20	0.16	0.31	0.10	0.15	0.01
	Malta	0.15	0.07	0.10	0.19	0.33	0.12	0.17	0.10	0.18	0.03
	Slovenia	0.24	0.32	0.23	0.43	0.16	0.32	0.10	0.31	0.41	0.18

Notes: Cyprus and Portugal have been left out of the matrix for reasons of consistency: total new orders series were not available at the time the robustness check was conducted.

All in all, moving from the inherently noisy m-o-m growth rates in new orders to the 3m-o-3m growth rates confirms the explanatory power of the NOM determinants, as they explain slightly above 90% of the new orders growth rates at this lower frequency. Moreover, the NOM estimates are not improved statistically or economically, either by system estimation, by simplifying the incorporation of surveys, by changing the seasonal adjustment of the headline survey, or by adding a “foreign” term at country level.

5 REAL-TIME RESULTS

5.1 ECB INDICATOR ON EURO AREA INDUSTRIAL NEW ORDERS

The ECB indicator on industrial new orders is calculated once the incoming national data coverage reaches the Eurostat threshold of 60% (i.e. when available national data represent at least 60% of the euro area aggregate, calculated on the basis of country shares as derived from the 2010 industrial turnover weights). National data received after the euro area database has been updated for a new monthly observation replace the estimated values and the euro area results are recalculated and/or revised accordingly.

The ECB indicator on euro area industrial new orders aggregates national new orders data for those countries that have continued to release such data and the outcomes of the estimated model (as described in Section 4.1) for those countries that have terminated the data collection, using 2010 turnover weights. For example, in order to calculate the December 2012 observation for the ECB indicator, national new orders data up to December 2012 were used where available and the outcome of the estimated model were used for the "missing" countries. The estimated series consists of an historical part, i.e. up to the latest available observation for new orders, which is typically March 2012, and an estimated part, starting in April 2012, using observations from surveys and turnover up to December 2012. Figure 6 plots the ECB indicator for euro area industrial new orders in terms of m-o-m growth rates and index levels up to December 2012 as available at the end of February 2013.

Unlike industrial production data, the ECB indicator on new orders provides information on the origin of demand (i.e. domestic or foreign), as illustrated for the euro area in Figure 7. Such information is distinctive and important for comprehensive monitoring of the euro area economy, since developments can vary for the different origins. For example, non-domestic new orders were close to record high levels in 2012, which was clearly not the case for domestic new orders.

Figure 6 ECB indicator on euro area industrial new orders as available at end-February 2013

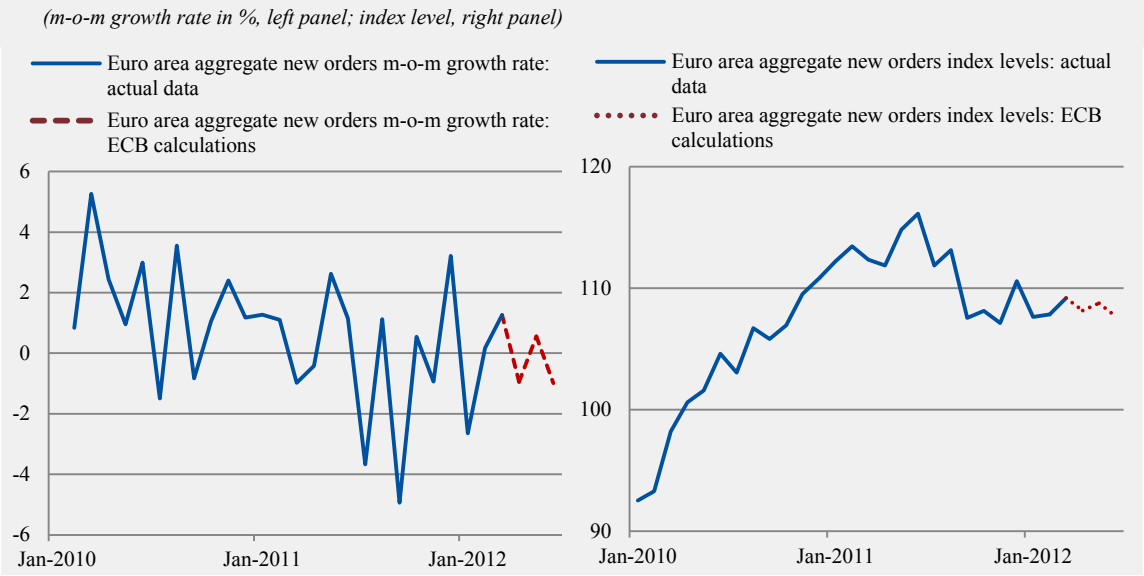
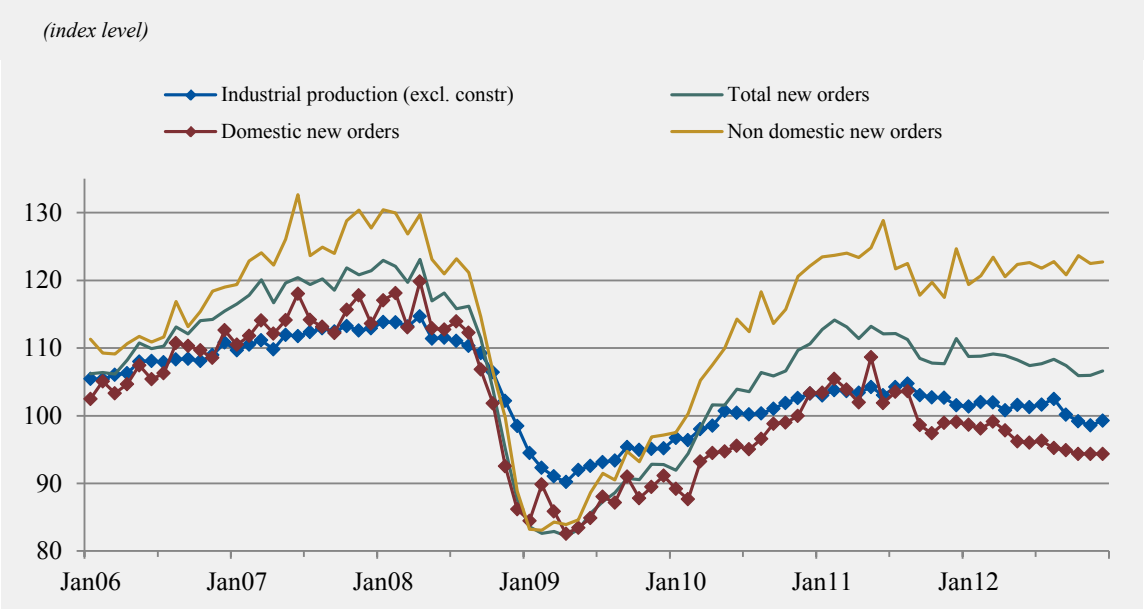


Figure 7 Euro area total new orders indices by origin and industrial production excluding construction as available at end-February 2013



5.2 REAL-TIME FORECASTS

It is important to assess whether the solution adopted for countries that discontinue the collection of new orders is robust in real time. To scrutinise the relationship under real-time conditions, we re-estimate the model once up to January 2009 for the countries that have discontinued the collection of new order statistics (France, Ireland, Luxembourg, Malta and

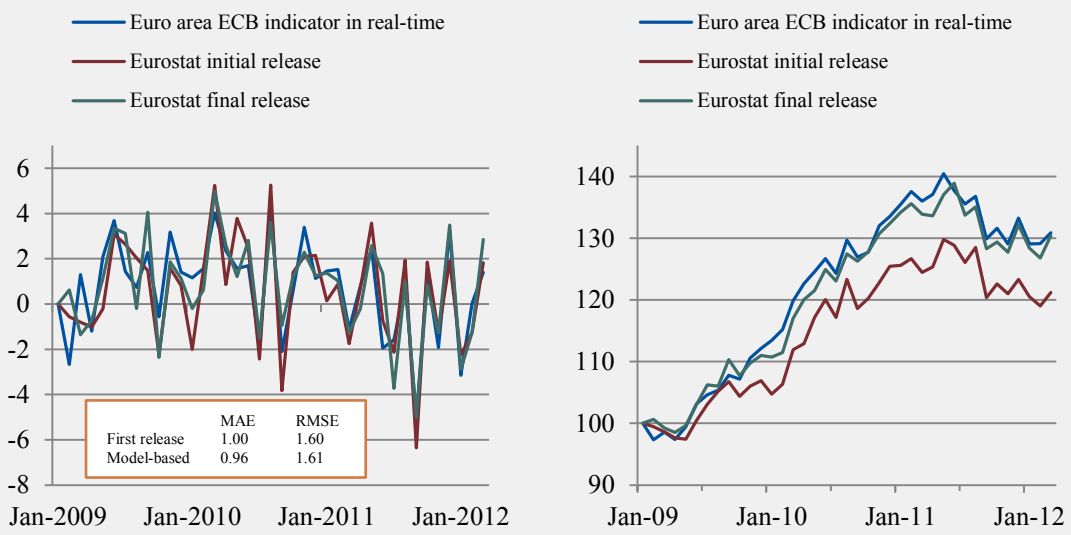
Slovenia) using historical monthly data vintages instead of the final data releases. Then we generate one-period ahead real-time forecasts for the respective countries, starting in February 2009 and ending in March 2012, i.e. 38 real-time m-o-m growth rates. This period is dictated by data availability at country level in real time. This is also the reason why Cyprus is missing, because no real-time data for Cyprus are available. To produce real-time euro area estimates, the real-time forecast results yielded at country level are aggregated with the vintage new orders data for those euro area countries that have continued to release new orders data, using the Eurostat new orders weighting scheme.

As is evident from Figure 8, the ECB indicator calculated in real time closely aligns with Eurostat's initial releases over the real-time sample period. In terms of mean absolute error (MAE), the real-time ECB indicator outperforms the initial Eurostat release with an MAE of 0.96 percentage points versus Eurostat's 1.00 percentage point, whereas the root mean squared error (RMSE) is 1.6 percentage points in both cases. The robustness of the model over time is further demonstrated at the index level, where it becomes apparent that the real-time ECB indicator is much closer to the final Eurostat release than the initial Eurostat release, where this index is derived from cumulated initial releases of m-o-m growth rates.

All in all, the real-time exercise, albeit based on a rather short sample owing to real-time data limitations at the country level, shows that the modelling approach used for the ECB indicator on euro area industrial new orders produces monthly growth rates as reliable in "predicting" the final releases for new orders as those from the initial Eurostat releases. Moreover, it shows that the index of the modelling approach used for the ECB indicator on new orders is close to the index of Eurostat's final releases and more accurate than the index derived by cumulating Eurostat initial releases.

Figure 8 ECB indicator on euro area industrial new orders in real time, Eurostat initial release and Eurostat final release

(m-o-m growth rate in %, left panel; index level, right panel)



6 NEW ORDERS AS LEADING SERIES

New orders are widely monitored, mainly because of their leading indicator properties for the business cycle. For example, new orders for capital goods have served as one of the components of the Conference Board's Leading Economic Index for the euro area. The OECD also deploys new orders in its composite leading indicator for the growth cycle for some euro area countries, e.g. Germany. We formally analyse whether euro area new orders lead industrial production. Our results, which are robust across sub-groupings of new orders as well as three different empirical methods, show that this is indeed the case. This implies that analysts may benefit from closely monitoring the ECB indicator on euro area new orders.

The first empirical method deployed is pairwise Granger causality. Granger causality does not necessarily imply "causality" in the usual sense of the word and "Granger predictability" can be used instead. The ECB indicator for new orders "Granger-predicts" industrial production if current production can be explained by its own past values and the past values of new orders, i.e. the coefficients of the lagged new orders are statistically different from zero. Table 5 shows the F-statistics of the pairwise Granger causality tests for a lag order up to 9 months. In the event of a significant F-statistic, the hypothesis that the former variable does not Granger-predict the latter can be rejected. The results confirm that new orders significantly Granger-predict production in all cases, but not the other way round (except for borderline results for lags 3 and 4 in the case of capital goods in levels). Moreover, the finding that new orders lead production and not vice versa holds across all other main industrial groupings, with the exception of the non-durable consumer goods sub-category and, consequently, consumer goods. The latter is not surprising as orders for non-durable consumer goods have, by nature, a very short production time.

Table 5 ECB indicator on euro area new orders Granger-predicts industrial production

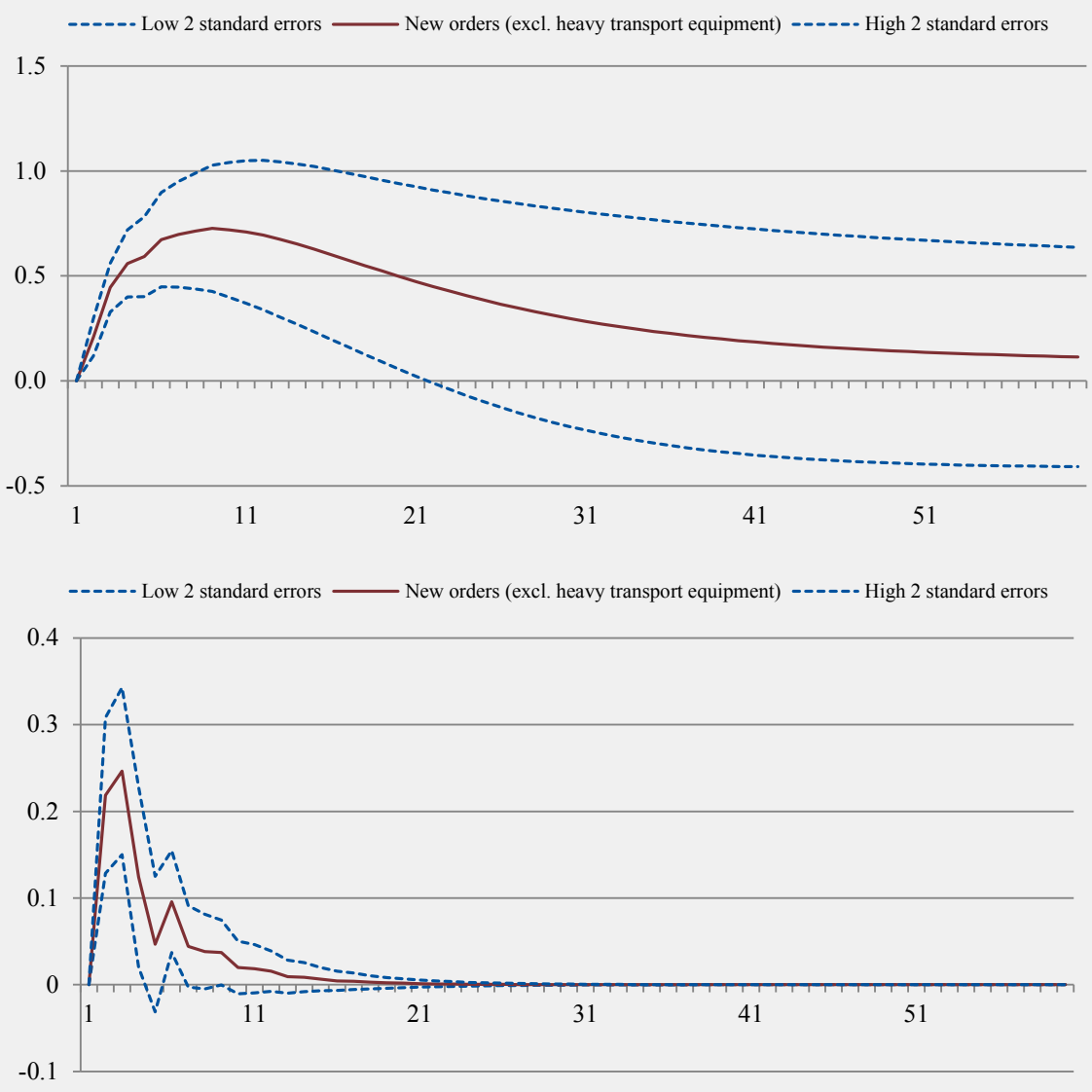
	Levels				*Change in levels*			
	Total		Capital Goods		Total		Capital Goods	
Lag	**NO → IP**	**IP → NO**	**NO → IP**	**IP → NO**	**NO → IP**	**IP → NO**	**NO → IP**	**IP → NO**
1	**11.0**	5.0	***82.1***	0.1	**16.7**	0.2	**8.4**	0.0
2	**11.0**	2.0	**50.4**	3.6	***26.5***	0.1	**12.4**	0.8
3	***17.6***	0.5	**31.8**	**4.1**	**22.4**	0.9	**20.9**	2.3
4	**16.3**	0.9	**23.8**	**3.7**	**17.1**	0.9	***22.5***	1.5
5	**13.5**	0.9	**21.1**	2.6	**12.8**	1.0	**19.1**	1.0
6	**10.7**	1.0	**17.7**	2.0	**10.7**	0.8	**17.7**	1.0
7	**9.4**	0.9	**15.8**	1.3	**9.3**	0.6	**16.1**	1.2
8	**8.2**	0.8	**14.5**	1.8	**8.3**	0.6	**14.7**	1.3
9	**7.3**	0.7	**13.3**	1.7	**7.1**	0.8	**12.9**	1.7

Source: ECB calculations.
Notes: NO = log of industrial new orders index. IP = log of industrial production index. Total NO refers to total new orders (excl. heavy transport equipment). Total IP refers to production (excl. construction). "→" denotes "leads". F-statistics are based on the sample January 1995 to August 2012. Bold type denotes strong evidence of a leading indicator: the hypothesis that the first variable does not Granger-predict the second variable is rejected at the 1% significance level. Cursive type denotes maximum F-statistics, indicating a peak in the leading properties of new orders.

The second empirical method deployed is an impulse response analysis based on a bivariate vector autoregressive model consisting of new orders and industrial production. The applied lag is 4 months for new orders in log levels, and 3 months for the change in log levels of new orders. The impulse response functions depicted in Figure 9 plot the adjustment of industrial production to an unexpected temporary shock in the level of new orders or in the change in new orders. Whilst pairwise Granger causality tests focus on the average lead impact of new orders on production, the second method investigates the lead relationship when an unexpected change occurs. Impulse responses show that an unexpected temporary shock in new orders is followed by a significant delayed adjustment in production. The adjustments in industrial production to shocks in the level of and change in new orders peak at about 9 months and 3 months, respectively. On the other hand, new orders do not react at all to a shock in production (not shown in the figure).

Figure 9 **Response of euro area industrial production (excl. construction) to shocks in new orders (excl. heavy transport equipment): log levels and changes**

(log level, top panel; change, bottom panel)

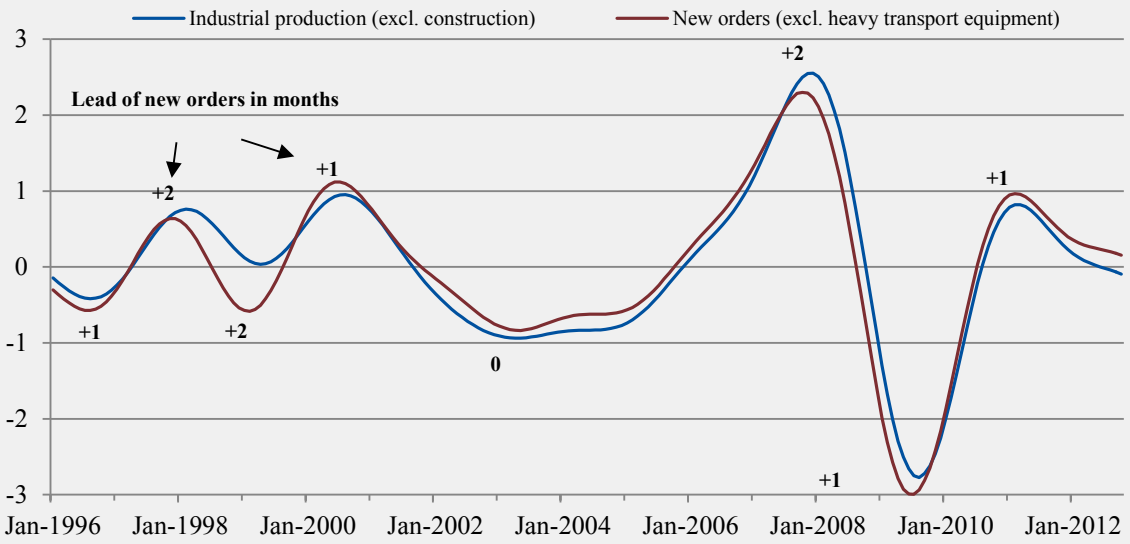


The third and final method analyses the leading properties of new orders for industrial production by using the concept of the deviation cycle (or growth cycle). This approach defines a cycle as cyclical fluctuations around a long-term trend. Figure 10 plots the euro area deviation cycles derived from the ECB indicators on new orders excluding heavy transport equipment and on industrial production excluding construction. The latter is similar to the deviation cycle derived from real GDP (see ECB, 2011). The new orders cycle leads peaks and troughs in the industrial production cycle by up to 2 months. The lead time of new orders is typically 1 or 2 months. In one case, no lead time is found, but this can be explained by the fact that the turning

point in both cycles was rather weak. A lead of the new orders cycle is also found if cycles are simply measured by growth rates. A cross-correlation analysis for different leads and lags between the three-month-on-three-month growth rates of new orders excluding heavy transport equipment and of industrial production excluding construction shows that new orders growth leads industrial production growth and not vice versa. The contemporaneous correlation between both growth rates is 0.91, but if the new orders growth rate leads industrial production growth by 1 month, the correlation increases to 0.94.

Figure 10 Euro area cycle indicators derived from new orders excluding heavy transport equipment and from industrial production excluding construction

(standardised percentage deviation from trend)



Note: The indicators are derived by applying a one-sided band-pass filter.

All in all, various empirical methods confirm that the ECB indicator on euro area industrial new orders leads industrial production, whereas the reverse is not the case. New orders therefore provide signals of current demand and future production, as there is a lead time between the placement of an order and the delivery of the product.

7 CONCLUSIONS

To the best of our knowledge, this is the first time that industrial new orders have been modelled across all EU Member States and for several breakdowns (total, total excluding heavy transport equipment, MIGs, domestic and non-domestic, broken down into euro area and non-euro area), while applying a common modelling framework that capitalises on a varied mix of data sources (including business opinion surveys and hard data on industrial turnover). Our work on the modelling of industrial new orders is thus pioneering in terms of its geographical scale, scope (numerous groupings), and the varied sources of information deployed to obtain the final estimates.

Our work not only sheds light on an under-researched, policy-relevant area, but also delivers an empirical indicator of European and international importance: the ECB indicator on euro area industrial new orders. This is compiled as an aggregation of national hard data (seasonally and working-day adjusted) transmitted by some national institutes to the ECB on a monthly basis and model estimates for those countries that have discontinued the collection of industrial new orders. The publication of this indicator allows policy-makers, analysts and academics to continue monitoring and analysing new orders at the euro area aggregate level. We therefore recommend that the ECB indicator on euro area new orders be included in the set of indicators used to assess and monitor the state of the euro area economy. Our study may also provide a useful starting point for future research on modelling industrial new orders, given the surprising lack of other empirical studies in this field.

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ANNEX

DETAILED ESTIMATION RESULTS FOR EURO AREA COUNTRIES

Table A.1 Euro area aggregate and country-level OLS estimation results by sub-grouping

	Totals		Totals (excl. heavy transport)		Capital goods		Intermediate goods		Consumer goods		Consumer durable goods		Consumer non-durable goods		Total domestic goods		Total non-domestic goods		Total non-domestic goods (EA)		Total non-domestic goods (non-EA)	
	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*	Adj-R^2	*SE*
Euro area aggregate estimation results overview																						
Euro area	0.52	*1.62*	0.65	*1.14*	0.29	*3.05*	0.72	*1.16*	0.57	*1.30*	0.44	*2.49*	0.50	*0.49*	0.41	*2.03*	0.50	*1.99*	0.45	*2.45*	0.49	*2.98*
Euro area countries that will continue new orders data collection at their national level																						
Belgium	0.37	*4.04*	0.35	*4.33*	0.25	*7.34*	0.36	*5.19*	0.47	*4.54*	0.06	*59.35*	0.47	*4.04*	0.30	*6.52*	0.25	*0.05*	0.25	*4.94*	0.11	*21.91*
Germany	0.43	*1.95*	0.49	*1.65*	0.26	*3.13*	0.60	*1.67*	0.46	*1.82*	0.43	*2.98*	0.43	*2.20*	0.38	*2.05*	0.42	*3.03*	0.41	*4.53*	0.50	*3.71*
Estonia	0.24	*11.96*	0.20	*10.83*	0.26	*16.99*	0.57	*4.01*	0.42	*6.43*	0.24	*10.87*	0.34	*0.34*	0.47	*6.79*	0.18	*11.92*	0.67	*3.81*	0.23	*18.84*
Italy	0.47	*3.47*	0.53	*2.50*	0.36	*7.51*	0.46	*2.92*	0.38	*3.31*	0.48	*4.25*	0.34	*3.68*	0.45	*3.96*	0.46	*4.99*	-	-	-	-
Netherlands	0.29	*3.46*	0.35	*3.30*	0.26	*8.40*	0.56	*2.61*	0.13	*5.10*	0.45	*9.66*	0.11	*4.29*	0.40	*4.42*	0.32	*4.17*	0.45	*4.46*	0.42	*4.52*
Slovakia	0.30	*4.22*	0.26	*4.46*	0.44	*4.99*	0.22	*8.46*	0.08	*17.94*	0.06	*30.64*	0.25	*9.44*	0.14	*6.49*	0.33	*4.68*	0.61	*4.56*	0.07	*10.28*
Finland	0.31	*8.01*	0.27	*4.22*	0.35	*5.79*	0.66	*3.67*	0.51	*3.21*	0.09	*14.14*	0.59	*5.09*	0.29	*10.51*	0.25	*10.30*	0.27	*11.32*	0.31	*9.00*
Portugal	0.29	*5.39*	0.25	*3.84*	0.40	*16.09*	0.30	*9.18*	0.31	*7.00*	0.26	*13.69*	0.01	*4.14*	0.21	*5.11*	0.21	*6.61*	-	-	-	-
Euro area countries that have discontinued new orders data collection as of observation period April 2012																						
France	0.38	*4.82*	0.43	*2.34*	0.37	*9.55*	0.44	*2.01*	0.29	*2.39*	0.22	*8.03*	0.29	*2.49*	0.32	*5.28*	0.35	*5.49*	0.51	*3.65*	0.26	*10.67*
Cyprus	-	-	0.40	*8.64*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malta	0.79	*3.20*	0.32	*6.93*	0.46	*7.46*	0.31	*9.05*	0.44	*10.62*	0.25	*24.80*	0.46	*10.81*	0.40	*13.61*	0.43	*4.59*	0.88	*2.86*	0.38	*7.80*
Luxembourg	0.18	*8.19*	0.28	*9.17*	0.26	*12.85*	0.32	*13.88*	0.14	*14.83*	-	-	0.13	*15.28*	0.20	*58.61*	0.28	*9.14*	0.20	*9.73*	0.22	*18.21*
Ireland	0.85	*2.70*	0.86	*2.71*	0.79	*4.38*	0.93	*2.23*	0.81	*5.37*	0.70	*5.07*	0.81	*5.53*	0.62	*4.17*	0.86	*2.81*	0.89	*3.79*	0.77	*4.00*
Slovenia	0.16	*6.52*	0.16	*6.59*	0.26	*6.87*	0.35	*6.95*	0.00	*11.73*	0.23	*10.10*	0.02	*16.17*	0.22	*7.57*	0.19	*6.88*	0.15	*4.30*	0.25	*5.82*
Euro area countries with no formal decision for 2013 onwards																						
Greece	0.32	*2.85*	0.52	*4.46*	0.41	*10.33*	0.53	*4.43*	0.56	*2.63*	0.49	*5.03*	0.45	*4.31*	0.42	*4.12*	0.31	*7.18*	0.47	*8.27*	0.24	*12.41*
Spain	0.55	*2.77*	0.65	*1.66*	0.32	*6.24*	0.51	*2.04*	0.37	*2.26*	0.41	*8.31*	0.38	*2.14*	0.52	*3.39*	0.37	*4.89*	0.48	*6.39*	0.23	*7.05*
Austria	0.48	*3.98*	0.52	*4.03*	0.42	*5.59*	0.43	*5.24*	0.27	*5.14*	0.22	*6.25*	0.31	*6.88*	0.31	*8.82*	0.54	*3.96*	0.49	*4.82*	0.46	*4.79*

Notes: The sample period depends on data availability, which varies across variables and countries. In the capital goods, intermediate goods, and consumer goods estimates for Austria, Greece, Ireland, and the Netherlands, PMI residual terms are obtained by regressing ECFIN surveys in the respective sub-category on total PMI surveys (as no matching PMI sub-categories are available for these countries). In the capital goods, intermediate goods, consumer goods, consumer durable goods, and consumer non-durable goods estimates for Finland, ECFIN surveys in the respective sub-categories are replaced by total ECFIN surveys, owing to missing observations. For Luxembourg, no consumer durable goods new order sub-category is available or estimated. In the consumer durable goods and consumer non-durable goods estimates for all countries, total PMI surveys are deployed for estimation (as no matching PMI sub-categories are available). In the total domestic goods estimate for all countries, total surveys (both, ECFIN and PMI) are deployed (as no matching PMI sub-category is available). In the total non-domestic goods estimates for all countries (euro area and non-euro area), total non-domestic surveys are deployed (as no matching PMI sub-category is available), while for Portugal, Cyprus, and Italy, a sufficient number of data observations for estimation is not available.

Table A.2 Total new orders

	EC FIN	Δ EC FIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.16**	0.14	**0.23**	0	**0.81**	(1-β5)	**-25.25**	**-0.30**	**-0.19**	0.52	*1.62*	0.93	0.89	0.34
Belgium	0.09	0	-	-	**0.55**	**0.34**	**-10.47**	**-0.42**	**-0.18**	0.37	*4.04*	0.65	0.69	0.39
Germany	**0.11**	**0.17**	**0.08**	**0.18**	**0.71**	(1-β5)	**-7.76**	**-0.39**	**-0.14**	0.43	*1.95*	0.69	0.13	0.93
Estonia	0.22	0	-	-	1.00	-	-2.00	**-0.40**	**-0.17**	0.24	*11.96*	0.59	0.06	0.33
Ireland	-	-	0.10	0	1.00	-	**-26.91**	**-0.08**	-0.06	0.85	*2.70*	0.02	0.05	0.10
Greece	0.06	0	0.11	0	**0.38**	0.06	-4.97	0	0	0.32	*2.85*	0.21	0.18	0.39
Spain	**0.15**	0	**0.27**	0	**1.03**	(1-β5)	**-45.41**	**-0.30**	-0.11	0.55	*2.77*	0.76	0.59	0.60
France	**0.11**	0	**0.22**	0	**0.41**	(1-β5)	**-12.84**	**-0.62**	**-0.35**	0.38	*4.82*	0.32	0.75	0.70
Italy	**0.19**	0	**0.25**	0	**0.83**	(1-β5)	**-35.67**	**-0.32**	**-0.30**	0.47	*3.47*	0.82	0.98	0.35
Cyprus	**0.51**	0	-	-	1.00	0	**-34.31**	**-0.17**	**-0.17**	0.40	*8.65*	0.67	0.05	0.15
Luxembourg	0.07	0	-	-	**0.47**	0	**-31.03**	-0.12	0	0.18	*8.19*	0.82	0.28	0.28
Malta	0.02	0	-	-	1.00	-	**-24.02**	0	**-0.27**	0.79	*3.20*	0.68	0.78	0.19
Netherlands	**0.21**	neg β1	**0.19**	0	**0.51**	0	**-12.69**	**-0.24**	**-0.11**	0.29	*3.46*	0.76	0.83	0.72
Austria	**0.22**	0	**0.48**	0	**0.56**	(1-β5)	**-52.17**	**-0.18**	β8	0.48	*3.98*	0.93	0.66	0.93
Portugal	0.03	0	-	-	**0.38**	0.23	**-33.21**	**-0.26**	-0.09	0.29	*5.39*	0.57	0.78	0.85
Slovenia	**0.13**	0	-	-	**0.52**	0	-3.45	-0.18	**-0.27**	0.16	*6.52*	0.16	0.21	0.42
Slovakia	0	0.01	-	-	**0.74**	(1-β5)	-2.81	**-0.32**	**-0.12**	0.30	*4.22*	0.87	0.38	0.14
Finland	**0.32**	**-0.32**	-	-	0.51	0.38	**-26.00**	**-0.40**	**-0.34**	0.31	*8.01*	0.95	0.94	-

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. For Cyprus, only the total new orders (excluding heavy transport equipment) series is available and estimated.

Table A.3 Total new orders (excl. heavy transport equipment)

	EC FIN	Δ EC FIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.10**	**0.12**	**0.16**	**0.15**	**0.86**	(1-β5)	**-17.46**	**-0.27**	0	0.65	*1.14*	0.57	0.21	0.19
Belgium	0.11	0	-	-	**0.50**	**0.28**	**-9.58**	**-0.48**	**-0.13**	0.35	*4.33*	0.70	0.99	0.44
Germany	**0.08**	**0.15**	0.06	**0.16**	**0.76**	(1-β5)	**-7.78**	**-0.32**	0	0.49	*1.65*	0.79	0.05	0.29
Estonia	0.23	0	-	-	**0.55**	(1-β5)	-2.00	**-0.39**	**-0.17**	0.20	*10.83*	0.20	0.01	0.45
Ireland	-	-	0.03	0	1.00	-	**-24.94**	**-0.09**	-0.05	0.86	*2.71*	0.01	0.03	0.12
Greece	0.12	0	**0.23**	0	**0.64**	0.16	**-8.99**	**-0.44**	**-0.23**	0.52	*4.46*	0.21	0.34	0.70
Spain	**0.13**	0	**0.20**	0	**0.86**	(1-β5)	**-33.38**	**-0.25**	**-0.15**	0.65	*1.66*	0.88	0.40	0.20
France	**0.11**	0	**0.20**	0	**0.66**	(1-β5)	**-8.42**	**-0.56**	**-0.31**	0.43	*2.34*	0.86	0.40	0.79
Italy	**0.15**	0	**0.23**	0	**0.84**	(1-β5)	**-32.85**	**-0.30**	**-0.26**	0.53	*2.50*	0.80	0.21	0.82
Cyprus	**0.51**	0	-	-	1.00	-	**-34.31**	**-0.17**	**-0.18**	0.40	*8.64*	0.66	0.05	0.28
Luxembourg	0.06	0	-	-	**0.61**	0.31	**-37.91**	**-0.27**	0	0.28	*9.17*	0.94	0.63	0.45
Malta	**0.11**	0	-	-	**0.37**	0	**-24.46**	**-0.39**	-0.17	0.32	*6.93*	0.28	0.64	0.78
Netherlands	**0.14**	0	0	**0.28**	**0.61**	**0.23**	**-8.73**	**-0.31**	0	0.35	*3.30*	0.43	0.38	0.31
Austria	**0.27**	0	**0.48**	0	**0.63**	(1-β5)	**-53.15**	**-0.29**	**-0.28**	0.52	*4.03*	0.95	0.92	1.00
Portugal	0.03	0	-	-	**0.41**	0.24	**-24.21**	-0.18	0	0.25	*3.84*	0.65	0.98	0.35
Slovenia	**0.13**	0	-	-	**0.52**	0	-3.52	-0.18	**-0.27**	0.16	*6.59*	0.17	0.23	0.41
Slovakia	0	0.02	-	-	**0.74**	0.22	-3.39	**-0.30**	0	0.26	*4.46*	0.90	0.62	0.04
Finland	**0.25**	-0.13	-	-	0.30	0.18	-5.00	**-0.48**	**-0.29**	0.27	*4.22*	0.57	0.42	0.24

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively.

Table A.4 New orders for capital goods

	ECFIN	Δ ECFIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.17**	**0.17**	**0.27**	0	**0.42**	0.20	**-18.50**	**-0.43**	**-0.27**	0.29	*3.05*	0.92	0.63	0.13
Belgium	**0.17**	neg β1	-	-	0.10	0.04	-4.22	**-0.47**	**-0.25**	0.25	*7.34*	0.56	0.64	0.39
Germany	**0.13**	**0.09**	**0.12**	0	**0.41**	0.20	**-20.57**	**-0.34**	-0.11	0.26	*3.13*	0.81	0.65	0.27
Estonia	**0.19**	0	-	-	**0.71**	(1-β5)	-4.00	**-0.31**	**-0.17**	0.26	*16.99*	0.55	0.09	0.18
Ireland	-	-	0.11	0	1.00	-	-3.23	-0.12	**-0.15**	0.79	*4.38*	0.00	0.00	0.58
Greece	0.08	0	0	0.26	**0.52**	0	**-49.16**	**-0.24**	0	0.41	*10.33*	0.95	0.50	0.90
Spain	0.10	0	**0.22**	0	**0.48**	0	**-26.77**	**-0.44**	**-0.23**	0.32	*6.24*	0.50	0.32	0.61
France	0.06	0	**0.28**	0	**0.38**	(1-β5)	**-12.53**	**-0.62**	**-0.37**	0.37	*9.55*	0.93	0.97	0.90
Italy	**0.28**	0	0.13	0	**0.45**	0	**-35.99**	**-0.29**	**-0.34**	0.36	*7.51*	0.90	0.72	0.73
Luxembourg	0.10	0	-	-	**0.33**	0	**-43.61**	**-0.22**	-0.05	0.26	*12.85*	0.26	0.70	0.69
Malta	0.05	0	-	-	**0.57**	**0.22**	**-22.03**	**-0.22**	0	0.46	*7.46*	0.90	0.97	0.68
Netherlands	**0.32**	0	0	**0.47**	**0.41**	0	**-26.71**	**-0.30**	0	0.26	*8.40*	0.50	0.56	0.30
Austria	**0.22**	0	**0.42**	0	**0.62**	0	**-60.00**	0	**-0.17**	0.42	*5.59*	0.64	0.81	0.32
Portugal	0	0	-	-	0.35	0	**-50.30**	**-0.32**	**-0.21**	0.40	*16.09*	0.01	0.02	0.74
Slovenia	0.08	0	-	-	**0.42**	0.15	-12.10	**-0.52**	**-0.23**	0.26	*6.87*	0.94	0.79	0.12
Slovakia	0.05	0	-	-	**0.60**	**0.24**	**-21.70**	**-0.20**	0	0.44	*4.99*	0.20	0.06	0.67
Finland	**0.35**	**-0.32**	-	-	0.10	0	-4.00	**-0.60**	-0.16	0.35	*5.79*	0.74	0.14	0.17

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. For Austria, Greece, Ireland, and the Netherlands, the PMI residual terms are obtained from regressing ECFIN – capital goods data on total PMI, as no PMI – capital goods breakdown is available for these countries. For Finland, the ECFIN – capital goods series is replaced by the total ECFIN series, owing to missing observations. No capital goods breakdown is available for Cyprus.

Table A.5 New orders for intermediate goods

	ECFIN	Δ ECFIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.06**	0.04	0	0	**0.88**	(1-β5)	**-12.46**	-0.08	0	0.72	*1.16*	0.04	0.27	0.13
Belgium	0.10	0	-	-	**0.66**	(1-β5)	-4.00	**-0.44**	0	0.36	*5.19*	0.07	0.60	0.58
Germany	**0.06**	**0.08**	**0.08**	0	**0.96**	-	**-13.04**	**-0.15**	0	0.60	*1.67*	0.32	0.39	0.47
Estonia	0.05	0	-	-	1.00	-	-1.31	**-0.17**	0	0.57	*4.01*	0.14	0.50	0.33
Ireland	-	-	0.05	0	1.00	-	**-27.15**	-0.06	**-0.05**	0.93	*2.23*	0.38	0.14	0.24
Greece	**0.15**	0	0	0	**0.62**	**0.13**	**-20.07**	**-0.21**	**-0.19**	0.53	*4.43*	0.21	0.23	0.44
Spain	0.04	0	0	**0.12**	**0.74**	(1-β5)	**-5.77**	**-0.21**	0	0.51	*2.04*	0.06	0.48	0.30
France	**0.12**	0	**0.11**	0	**0.67**	0.15	**-13.79**	**-0.42**	**-0.13**	0.44	*2.01*	0.96	0.98	0.50
Italy	**0.10**	0	**0.18**	0	**0.59**	0.09	**-47.44**	0	0	0.46	*2.92*	0.01	0.00	0.10
Luxembourg	0.05	0	-	-	**0.80**	(1-β5)	**-37.58**	**-0.27**	-0.14	0.32	*13.88*	0.90	0.17	0.19
Malta	0.03	0	-	-	0.22	0	-10.24	**-0.57**	-0.16	0.31	*9.05*	0.79	0.29	0.52
Netherlands	0.07	0	**0.12**	0	**0.84**	(1-β5)	**-22.28**	**-0.17**	0	0.56	*2.61*	0.29	0.76	0.88
Austria	0.20	0	**0.51**	0	**0.72**	0	**-82.18**	0	0	0.43	*5.24*	0.76	0.88	0.41
Portugal	0.25	0	-	-	**0.58**	0	**-10.95**	**-0.54**	**-0.20**	0.30	*9.18*	0.32	0.17	0.43
Slovenia	**0.15**	0	-	-	**0.56**	**0.30**	-4.00	**-0.56**	**-0.26**	0.35	*6.95*	0.61	0.07	0.15
Slovakia	0.10	0	-	-	**0.66**	(1-β5)	**-17.74**	**-0.35**	**-0.24**	0.22	*8.46*	0.65	0.68	0.27
Finland	**0.15**	0	-	-	1.00	-	**-57.27**	**-0.17**	0	0.66	*3.67*	0.17	0.07	0.79

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. For Austria, Greece, Ireland, and the Netherlands, the PMI residual terms are obtained from regressing ECFIN – intermediate goods data on total PMI, as no PMI – intermediate goods breakdown is available for these countries. For Finland, the ECFIN – intermediate goods series is replaced by the total ECFIN series, owing to missing observations. No intermediate goods breakdown is available for Cyprus.

Table A.6 New orders for consumer goods

	ECFIN	Δ ECFIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.12**	0	**0.08**	0	**0.90**	(1-β5)	**-33.18**	**-0.39**	**-0.22**	0.57	*1.30*	0.03	0.03	0.53
Belgium	**0.17**	**-0.13**	-	-	1.00	-	**-24.67**	**-0.35**	**-0.23**	0.47	*4.54*	0.69	0.58	0.25
Germany	0.05	0	**0.12**	**-0.11**	**0.71**	(1-β5)	**-28.54**	**-0.36**	-0.16	0.46	*1.82*	0.60	0.42	0.40
Estonia	0.05	0	-	-	1.00	-	**-24.14**	**-0.46**	-0.17	0.42	*6.43*	0.89	0.53	0.11
Ireland	-	-	0.05	0	1.00	-	**-8.99**	**-0.23**	**-0.12**	0.81	*5.37*	0.03	0.10	0.00
Greece	0.03	0.05	**0.09**	0	**0.55**	**0.35**	-5.16	**-0.72**	**-0.27**	0.56	*2.63*	0.31	0.13	0.33
Spain	0.10	0	**0.06**	0	**0.53**	**0.27**	-10.53	**-0.68**	**-0.33**	0.37	*2.26*	0.98	0.03	0.14
France	0.10	0	0	0	**0.69**	(1-β5)	**-26.61**	**-0.36**	**-0.23**	0.29	*2.39*	0.52	0.31	0.22
Italy	0.05	0	**0.16**	0	**0.74**	0	**-46.27**	**-0.24**	**-0.16**	0.38	*3.31*	0.53	0.15	0.46
Luxembourg	0.10	0	-	-	0.07	0.02	**-25.26**	-0.20	0	0.14	*14.83*	0.93	0.68	0.71
Malta	0.03	**0.11**	-	-	1.00	-	**-10.51**	**-0.27**	**-0.16**	0.44	*10.62*	0.07	0.54	0.25
Netherlands	0.10	0	0.20	0	**0.65**	(1-β5)	-1.87	**-0.28**	0	0.13	*5.10*	0.49	0.59	0.33
Austria	0.05	0	**0.10**	0	0.20	0	-24.36	**-0.40**	**-0.23**	0.27	*5.14*	0.99	1.00	0.26
Portugal	0.25	0	-	-	**0.64**	0	-5.96	**-0.55**	**-0.30**	0.31	*7.00*	0.70	0.38	0.58
Slovenia	0.05	0	-	-	0.80	0	-2.05	0	**-0.28**	0.00	*11.73*	0.39	0.86	0.17
Slovakia	0.02	0	-	-	**0.74**	0	-1.93	**-0.21**	0	0.08	*17.94*	0.42	0.77	0.28
Finland	**0.13**	0	-	-	**0.82**	0	**-69.93**	-0.09	0	0.51	*3.21*	0.63	0.64	0.59

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. For Austria, Greece, Ireland, and the Netherlands, the PMI residual terms are obtained from regressing ECFIN – consumer goods data on total PMI, as no PMI – consumer goods breakdown is available for these countries. For Finland, the ECFIN – consumer goods series is replaced by the total ECFIN series, owing to missing observations. No consumer goods breakdown is available for Cyprus.

Table A.7 New orders for consumer durable goods

	ECFIN	Δ ECFIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.09**	0	**0.13**	0	**0.59**	0.16	**-18.89**	**-0.51**	**-0.15**	0.44	*2.49*	0.32	0.17	0.36
Belgium	0.27	0	-	-	0.50	0	-4.00	**-0.28**	**-0.14**	0.06	*59.35*	0.22	0.86	0.12
Germany	0.04	0	**0.07**	0	**0.68**	**0.19**	**-12.19**	**-0.45**	**-0.15**	0.43	*2.98*	0.50	0.81	0.60
Estonia	0.05	0	-	-	0.11	0.11	**-5.45**	**-0.54**	**-0.27**	0.24	*10.87*	1.00	0.96	0.15
Ireland	-	-	0.05	0	1.00	-	**-18.80**	**-0.22**	**-0.08**	0.70	*5.07*	0.85	0.48	0.20
Greece	**0.04**	0	0	0	**0.67**	**0.25**	-3.24	**-0.40**	-0.13	0.49	*5.03*	0.87	0.86	0.99
Spain	0.05	0	0.21	0	**0.82**	-	**-26.55**	**-0.47**	0	0.41	*8.31*	0.18	0.05	0.33
France	0.03	0	0	0	0.60	0	-3.62	**-0.42**	**-0.41**	0.22	*8.03*	0.28	0.63	0.26
Italy	0.05	0	0.07	0	**0.65**	**0.33**	**-23.07**	**-0.47**	**-0.15**	0.48	*4.25*	0.59	0.32	0.31
Malta	0.25	-0.15	-	-	**0.29**	0	**-45.29**	-0.16	**-0.11**	0.25	*24.80*	0.33	0.16	0.26
Netherlands	0.14	0	0	0	1.00	-	**-8.46**	**-0.32**	-0.23	0.45	*9.66*	0.14	0.05	0.88
Austria	0.05	0	0.11	0	0.10	0	-5.51	**-0.53**	-0.25	0.22	*6.25*	0.98	0.31	0.30
Portugal	0.05	0	-	-	**0.88**	(1-β5)	-11.58	**-0.15**	0	0.26	*13.69*	0.77	0.72	0.43
Slovenia	0.10	0	-	-	**0.33**	0	-6.72	**-0.49**	**-0.19**	0.23	*10.10*	0.26	0.39	0.45
Slovakia	0.05	0	-	-	**0.57**	0	**-3.48**	-0.16	0	0.06	*30.64*	0.73	0.88	0.69
Finland	0.10	0	-	-	**0.39**	0	**-26.19**	0	0	0.09	*14.14*	0.96	0.59	0.18

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. Total PMI surveys are deployed for the estimation, as no durable/non-durable goods breakdown is available for PMI survey data. For Finland, the ECFIN – durable goods series is replaced by the total ECFIN series, owing to missing observations. No durable goods breakdown is available for Cyprus and Luxembourg.

Table A.8 New orders for consumer non-durable goods

	ECFIN	Δ ECFIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.10**	0	0	0	**0.80**	0	**-32.31**	**-0.28**	**-0.21**	0.50	*0.49*	0.05	0.01	0.72
Belgium	0.10	0	-	-	1.00	-	**-19.41**	**-0.29**	**-0.13**	0.47	*4.04*	0.62	0.61	0.15
Germany	0.05	0	**0.10**	0	**0.58**	**0.25**	**-28.54**	**-0.43**	**-0.27**	0.43	*2.20*	0.55	0.11	0.17
Estonia	0.10	0	-	-	1.00	-	**-15.83**	**-0.47**	**-0.19**	0.34	*0.34*	0.83	0.65	0.18
Ireland	-	-	0.05	0	1.00	-	**-8.63**	**-0.23**	**-0.12**	0.81	*5.53*	0.04	0.11	0.00
Greece	0.05	0	0.16	0	**0.40**	0.15	-10.98	**-0.66**	**-0.25**	0.45	*4.31*	0.16	0.37	0.24
Spain	0.03	0	0	0	**0.57**	0.16	**-17.31**	**-0.49**	**-0.30**	0.38	*2.14*	0.47	0.01	0.17
France	**0.06**	0	0	0	**0.55**	0.21	**-18.82**	**-0.39**	**-0.24**	0.29	*2.49*	0.46	0.57	0.76
Italy	0.10	0	**0.12**	0	**0.39**	0	-35.00	**-0.30**	**-0.25**	0.34	*3.68*	0.10	0.01	0.22
Luxembourg	0.05	0	-	-	0.50	0	**-27.26**	**-0.22**	0	0.13	*15.28*	0.93	0.55	0.18
Malta	0.10	0	-	-	1.00	-	**-10.34**	**-0.28**	**-0.19**	0.46	*10.81*	0.24	0.62	0.34
Netherlands	0.05	0	**0.13**	0	0.28	0.07	-2.38	**-0.33**	**-0.15**	0.11	*4.29*	1.00	0.45	0.29
Austria	0.10	0	0.04	0	0.29	0	-19.18	**-0.47**	**-0.32**	0.31	*6.88*	0.92	0.92	0.32
Portugal	0.05	0	-	-	0.16	0	-2.00	-0.11	0	0.01	*4.14*	0.12	0.27	0.75
Slovenia	0.05	0	-	-	0.70	0	-2.61	0	**-0.24**	0.02	*16.17*	0.83	1.00	0.18
Slovakia	0.05	0	-	-	**0.43**	(1-β5)	**-11.55**	**-0.40**	**-0.23**	0.25	*9.44*	0.45	0.50	0.18
Finland	**0.11**	0	-	-	1.00	-	-90.00	0	0	0.59	*5.09*	0.77	0.29	0.14

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. Total PMI surveys are deployed for the estimation, as no durable/non-durable goods breakdown is available for PMI survey data. For Finland, the ECFIN – non-durable goods series is replaced by the total ECFIN series, owing to missing observations. No non-durable goods breakdown is available for Cyprus.

Table A.9 New orders for domestic goods

	ECFIN	Δ ECFIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.15**	0	**0.14**	0	**0.69**	(1-β5)	**-12.36**	**-0.48**	**-0.33**	0.41	*2.03*	0.56	0.55	0.33
Belgium	**0.26**	0	-	-	0.18	0	**-12.94**	**-0.50**	**-0.26**	0.30	*6.52*	0.25	0.20	0.96
Germany	**0.10**	0	**0.09**	**0.17**	**0.64**	**0.23**	**-14.99**	**-0.27**	0	0.38	*2.05*	0.06	0.00	0.11
Estonia	0.10	0	-	-	1.00	-	**-6.11**	**-0.48**	**-0.21**	0.47	*6.79*	0.73	0.10	0.23
Ireland	-	-	0.10	0	1.00	-	**-6.21**	**-0.14**	**-0.10**	0.62	*4.17*	0.54	0.57	0.30
Greece	0.10	0	**0.24**	0	**0.58**	**0.23**	-4.45	**-0.42**	0	0.42	*4.12*	0.09	0.06	0.11
Spain	**0.24**	0	**0.38**	0	**0.36**	0	**-21.57**	**-0.54**	**-0.22**	0.52	*3.39*	0.73	0.75	0.40
France	0.09	0	0	0	0.31	0	**-8.06**	**-0.60**	**-0.25**	0.32	*5.28*	0.07	0.17	0.95
Italy	**0.21**	0	**0.24**	0	**0.59**	0	**-22.67**	**-0.44**	**-0.36**	0.45	*3.96*	0.28	0.63	0.18
Luxembourg	**0.42**	0	-	-	0.58	0	**-46.97**	**-0.18**	0	0.20	*58.61*	1.00	0.82	0.46
Malta	0.10	0	-	-	1.00	-	**-22.03**	**-0.14**	0	0.40	*13.61*	0.63	0.00	0.00
Netherlands	**0.19**	0	0	0	**0.95**	0	**-9.40**	**-0.38**	**-0.16**	0.40	*4.42*	0.07	0.29	0.45
Austria	0.18	0	**0.59**	0	0.50	0	**-31.77**	**-0.40**	**-0.32**	0.31	*8.82*	0.84	0.42	0.20
Portugal	0.10	0	-	-	**0.35**	0	**-16.10**	**-0.29**	0	0.21	*5.11*	0.55	0.06	0.89
Slovenia	**0.18**	0	-	-	**0.66**	0	-4.00	**-0.32**	**-0.29**	0.22	*7.57*	0.10	0.00	0.11
Slovakia	0.01	0	-	-	**0.40**	**0.42**	**-2.87**	**-0.30**	-0.11	0.14	*6.49*	0.99	0.84	0.15
Finland	**0.28**	0	-	-	**0.58**	(1-β5)	-13.96	**-0.47**	**-0.17**	0.29	*10.51*	0.56	0.83	0.34

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. No total domestic goods survey data are available for countries. Instead, total surveys (both, ECFIN and PMI) are deployed in the estimation. No total domestic goods breakdown is available for Cyprus.

Table A.10 New orders for non-domestic goods

	ECFIN	Δ ECFIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.17**	**0.26**	**0.23**	0.22	**0.70**	**0.29**	**-22.54**	**-0.40**	**-0.20**	0.50	*1.99*	0.89	0.92	-
Belgium	0.12	0	-	-	0.05	0	**-8.14**	**-0.46**	0	0.25	*0.05*	0.61	0.24	0.65
Germany	**0.21**	**0.17**	**0.15**	0	**0.69**	**0.23**	**-31.23**	**-0.38**	**-0.16**	0.42	*3.03*	0.91	0.85	0.59
Estonia	0.26	0	-	-	**0.76**	(1-β5)	-2.00	**-0.33**	**-0.10**	0.18	*11.92*	0.95	0.90	0.22
Ireland	-	-	0.05	0	1.00	-	**-22.33**	**-0.07**	0	0.86	*2.81*	0.00	0.01	0.00
Greece	**0.21**	0	**0.35**	0	**0.37**	0	**-13.73**	**-0.33**	**-0.26**	0.31	*7.18*	0.48	0.48	0.89
Spain	0.10	0	**0.24**	0	**0.73**	0	**-69.62**	0	0	0.37	*4.89*	0.29	0.52	0.60
France	**0.13**	0	**0.40**	0	0.30	0	**-18.16**	**-0.55**	**-0.39**	0.35	*5.49*	0.90	0.68	0.18
Italy	**0.21**	0	**0.33**	0	**0.80**	(1-β5)	**-45.98**	**-0.32**	**-0.20**	0.46	*4.99*	0.91	0.65	0.93
Luxembourg	0.10	0	-	-	0.40	0	**-28.24**	**-0.31**	0	0.28	*9.14*	0.97	0.87	0.14
Malta	0.05	0	-	-	**0.49**	0	**-53.99**	0	0	0.43	*4.59*	0.69	0.81	0.12
Netherlands	**0.21**	0	0.10	0	**0.61**	**0.35**	**-13.57**	**-0.31**	**-0.11**	0.32	*4.17*	0.69	0.79	0.14
Austria	**0.25**	0	**0.49**	0	**0.80**	(1-β5)	**-88.49**	0	0	0.54	*3.96*	0.86	0.75	0.61
Portugal	**0.16**	0	-	-	0.22	0.18	**-11.08**	**-0.32**	0	0.21	*6.61*	0.63	0.99	0.55
Slovenia	**0.13**	0	-	-	**0.57**	0	-8.00	**-0.27**	**-0.20**	0.19	*6.88*	0.69	0.66	0.80
Slovakia	0.01	0	-	-	**0.66**	0	**-7.34**	**-0.18**	0	0.33	*4.68*	0.26	0.40	0.13
Finland	**0.16**	neg β1	-	-	**0.72**	-	**-29.71**	**-0.24**	0	0.25	*10.30*	0.67	0.34	0.95

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. No total non-domestic goods breakdown is available for Cyprus.

Table A.11 New orders for non-domestic goods (euro area)

	ECFIN	Δ ECFIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.25**	**0.35**	**0.48**	0	**0.30**	0	**-32.64**	**-0.30**	0	0.45	*2.45*	0.90	0.95	0.68
Belgium	0.14	0	-	-	0.08	0	-6.54	**-0.47**	0	0.25	*4.94*	0.94	0.62	0.41
Germany	**0.25**	0	**0.36**	0	**0.72**	(1-β5)	**-39.32**	**-0.31**	0	0.41	*4.53*	0.25	0.44	0.14
Estonia	0.10	**-0.17**	-	-	1.00	-	-6.93	**-0.23**	-0.10	0.67	*3.81*	0.71	0.57	0.88
Ireland	-	-	0.10	0	1.00	-	**-87.80**	0	0	0.89	*3.79*	0.42	0.25	0.00
Greece	**0.23**	0	**0.34**	0	**0.70**	(1-β5)	**-24.40**	**-0.35**	0	0.47	*8.27*	0.17	0.51	0.15
Spain	**0.20**	0	**0.38**	0	**0.86**	0	**-90.39**	0	0	0.48	*6.39*	0.79	0.40	0.80
France	**0.10**	0	0.25	**0.59**	**0.65**	(1-β5)	**-17.04**	**-0.68**	**-0.27**	0.51	*3.65*	0.82	0.95	0.98
Luxembourg	0.09	0	-	-	0.25	0	**-16.93**	**-0.36**	**-0.18**	0.20	*9.73*	0.65	0.65	0.19
Malta	0.02	0	-	-	**1.00**	-	**-8.34**	**-0.10**	0	0.88	*2.86*	0.01	0.03	0.88
Netherlands	**0.25**	0	0	0	**0.74**	(1-β5)	**-14.95**	**-0.41**	**-14.95**	0.45	*4.46*	0.52	0.77	0.22
Austria	**0.25**	0	**0.57**	0	**0.72**	0	**-87.07**	0	0	0.49	*4.82*	0.48	0.69	0.93
Slovenia	**0.10**	0	-	-	**0.35**	0	-4.44	**-0.26**	0	0.15	*4.30*	0.74	0.02	0.70
Slovakia	0.05	0	-	-	**0.89**	(1-β5)	**-26.67**	**-0.24**	0	0.61	*4.56*	0.16	0.25	0.12
Finland	**0.48**	**-0.34**	-	-	**0.42**	0	-4.00	**-0.57**	-0.06	0.27	*11.32*	0.77	0.98	0.14

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. The total non-domestic surveys are deployed throughout the estimation (for both ECFIN and PMI), as no euro area/non-euro area breakdown is available for survey statistics. A sufficient number of data observations for estimation is not available for Portugal, Cyprus, and Italy.

Table A.12 New orders for non-domestic goods (non-euro area)

	EC FIN	Δ EC FIN	Resid PMI	Δ Resid PMI	Turnover growth	Turnover growth (-1)	New order turnover ratio (-1)	Lagged dependent variable (-1)	Lagged dependent variable (-2)	Adj-R^2	*S. e. of reg*	p-value Q(4)	p-value Q(12)	p-value Wald χ
Euro area	**0.22**	**0.26**	**0.31**	0	**0.60**	0.31	**-35.67**	**-0.40**	**-0.35**	0.49	*2.98*	0.42	0.74	0.21
Belgium	0.05	0	-	-	0.15	0	-9.37	**-0.32**	**-0.11**	0.11	*21.91*	1.00	1.00	0.27
Germany	**0.29**	0	**0.23**	0	**0.80**	(1-β5)	**-54.57**	**-0.28**	**-0.20**	0.50	*3.71*	0.95	0.97	0.64
Estonia	**0.54**	0	-	-	**1.00**	-	-4.00	**-0.26**	-0.10	0.23	*18.84*	0.90	0.97	0.37
Ireland	-	-	0.10	0	1.00	-	**-21.37**	**-0.19**	0	0.77	*4.00*	0.17	0.07	0.24
Greece	0.25	0	0.44	0	**0.24**	0	**-14.23**	**-0.41**	**-0.28**	0.24	*12.41*	0.44	0.77	0.34
Spain	0.25	0	**0.26**	0	0.29	0.23	-5.42	**-0.50**	**-0.39**	0.23	*7.05*	0.78	0.70	0.27
France	0.13	0	0.46	0	0.20	0	**-18.25**	**-0.48**	**-0.32**	0.26	*10.67*	0.81	0.87	0.11
Luxembourg	0.20	0	-	-	**0.40**	0.12	-4.00	**-0.48**	**-0.24**	0.22	*18.21*	0.33	0.13	0.28
Malta	0.10	0	-	-	**0.46**	0	**-47.46**	0	0	0.38	*7.80*	0.14	0.08	0.22
Netherlands	0.25	0	0	0	**0.74**	(1-β5)	**-12.63**	**-0.34**	**-0.13**	0.42	*4.52*	0.86	0.70	0.39
Austria	**0.31**	0	**0.43**	0	**0.62**	0	**-77.35**	0	0	0.46	*4.79*	0.45	0.01	0.14
Slovenia	**0.24**	0	-	-	0.50	0	**-14.23**	**-0.36**	**-0.28**	0.25	*5.82*	0.63	0.25	0.23
Slovakia	0.10	0	-	-	0.50	0	-14.42	**-0.27**	0	0.07	*10.28*	0.94	0.81	0.13
Finland	**0.35**	-0.21	-	-	**0.90**	0	**-58.85**	0	0	0.31	*9.00*	0.33	0.20	0.20

Notes: The sample period depends on data availability, which varies across variables and countries. Bold denotes statistical significance at a confidence level of at least 5%. P-values Q (4) and Q (12) refer to the probability of residuals being serially correlated at lags 4 and 12, respectively. The total non-domestic surveys are deployed throughout the estimation (for both ECFIN and PMI), as no euro area/non-euro area breakdown is available for survey statistics. A sufficient number of data observations for estimation is not available for Portugal, Cyprus, and Italy.