The impact of world trade on the Port of Rotterdam and the wider region of Rotterdam-Rijnmond

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ABSTRACT

We study the economic impact of world trade on the throughput in the Port of Rotterdam and the regional economy of Rotterdam-Rijnmond. We use a two-step approach. In the first step we analyze the relationship between world trade and the port's throughput. In the second step we deal with the impact of the port's throughput on regional economic indicators like income and number of jobs. It appears that the global business cycle determines the port activities and that, in turn, the port activities are essential for the regional economic development, in this way linking the regional economy to the global business cycle. Diversification of the regional economy is recommended to make the regional economy more resilient.

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1. Introduction

World trade is increasing over the years (Krugman, 1995). The European Union is the world's largest importer and exporter of goods and services, responsible for almost 20 percent of total world trade (European Commission, 2012). Even though all EU countries individually are a member of the World Trade Organization they act as a single block. Market incentives dictate that a large part of EU's trade is concentrated in Europe's northern port ranges of which Rotterdam is by far the biggest (Bosch et al., 2011).

More and more large ports act as global hubs. Therefore, ports like Rotterdam are assumed to react more to global development than to the development of the hinterland only. World trade is a suitable indicator of the global business cycle.

The objective of this study is to analyse the economic impact of world trade on the port of Rotterdam and the regional economy of Rotterdam-Rijnmond. This is done in two stages. First, the impact of world trade on Rotterdam's port activity is assessed. Total world trade is assumed to be related to the throughput in the port.

The second part of the analysis deals with the influence of the port on the wider region of Rotterdam-Rijnmond in which the port is located. Much research has been done on the relationship between regional economic development and port activities and generally speaking the influence of the port on regional development is significant (Botasso et al., 2014). However, what is lacking in literature is the two-step-approach that we carry out in this paper (Grammenos, 2013; Coto Millán et al., 2010; Hensher and Button, 2007; Coppens et al., 2007).

Port related industry is overrepresented in Rotterdam-Rijnmond. In that respect Rotterdam-Rijnmond is representative for other regions in which a port is located (e.g. Antwerp, Hamburg), so there we may expect the same type of chain reactions as we find for Rotterdam.

In the final part of the paper we link the two steps by estimating the impact of world trade on regional economic development. We assume that for the development of regions like Rotterdam-Rijnmond international trade is of crucial importance. Therefore we hypothesize that a positive relation is to be found between total world trade and the activity of the port. Furthermore, we expect that some countries have a bigger impact on port activity than others. We also expect a positive relationship between port activity and regional economic growth.

2. Trade and throughput in the Port of Rotterdam

Fig. 1 shows the development of total world trade volume and Rotterdam throughput since 1975. One can spot a distinct downward movement in both graphs during the 1980s. This can
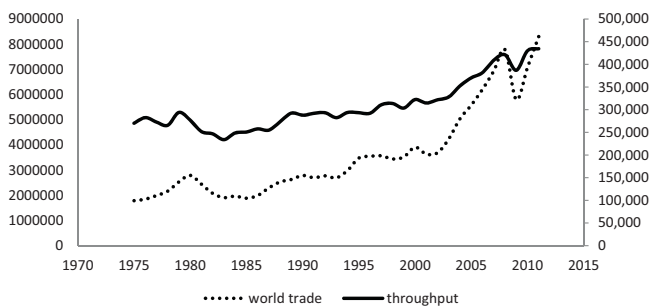
Fig. 1. World trade volume (in millions of 1975 dollars, left axis) and throughput in the Port of Rotterdam (millions of metric tons, right axis). Source: WTO (2012), Port of Rotterdam (2012a).

be contributed to the oil crisis of 1979 and the subsequent economic crises and political tensions. Furthermore the 2007 financial crisis leaves a dent in both graphs.

To assess more formally whether a relationship between world trade and Rotterdam throughput exists, we apply time-series analysis on the natural logarithms of both variables. First, it is assessed whether both series are stationary or not. Non-stationary series may have stochastic or deterministic trends in common that suggest a relationship that may not exist in reality. In other words, the upward-sloping trend that both series show in Fig. 1, does not necessarily mean there is a causal relation. Dickey-Fuller and KPSS tests (Verbeek, 2012, p. 292–294) show that both series are non-stationary and integrated of order one. This means that standard OLS on the observed values cannot be applied. Since both series have the same order of integration there could be a stable long-run co-integrating relation between world trade and Rotterdam throughput (e.g. Verbeek, 2012: p. 343–348). However, the Engle-Granger test and the CRDW test for co-integration both indicate that the series are not co-integrated, indicating absence of a long-run equilibrium relation between the series. Therefore, since both series are integrated of order one we proceed by estimating an equation in first-differences, resulting in Eq. (1):

$$\Delta(\ln TR_t) = \underset{-3.43}{-0.010} + \underset{3.77}{0.279}\,\Delta(\ln WT_t) \quad R^2 = 0.296 \quad N = 36 \tag{1}$$

Table 1
Share of the different groups of countries in the total world trade over the period 1994–2011.

Year	BRIC	OECD	LDC	ROTW
1994	0.073	0.476	0.006	0.444
1995	0.075	0.471	0.006	0.446
1996	0.076	0.477	0.006	0.438
1997	0.082	0.482	0.006	0.428
1998	0.080	0.500	0.006	0.412
1999	0.076	0.534	0.006	0.382
2000	0.083	0.525	0.006	0.384
2001	0.092	0.524	0.007	0.376
2002	0.097	0.519	0.007	0.375
2003	0.106	0.508	0.007	0.377
2004	0.118	0.497	0.007	0.376
2005	0.130	0.488	0.009	0.372
2006	0.140	0.480	0.009	0.369
2007	0.152	0.477	0.01	0.360
2008	0.166	0.484	0.011	0.337
2009	0.173	0.452	0.013	0.361
2010	0.190	0.439	0.012	0.355
2011	0.202	0.432	0.012	0.353

where *TR* stands for throughput in the port of Rotterdam, *WT* is world trade and Δ indicates first-differences. T-ratios are presented below the estimated coefficients. The regression results indicate that short-run shocks in world trade have a statistically significant impact on Rotterdam throughput. Since we use differences in natural logarithms this implies that the growth rate of the Rotterdam throughput between two years is a function of 0.279 times the growth rate of world trade. This makes sense because global trade rose faster than the port's throughput. This is also in line with Fig. 1. Analysis of the residuals using autocorrelation (AC), partial autocorrelation (PAC) and Ljung-Box tests (Verbeek, 2012, p. 306–310) showed that the residuals are white noise, so that higher order ARIMA terms are not required. The value of R^2 is reasonable given that the model is estimated in first-differences and since only world trade was included as regressor. Note that our goal is to test this relation, not to come up with a complete model explaining Rotterdam throughput.

Next, we consider four groups of countries: BRIC, OECD, LDC (Least Developed Countries) and ROTW (Rest of the World). Fig. 2 shows the trade volumes of the four groups and the throughput of the port. Data for this analysis was only available since 1994. One can observe the impact the 2007 financial crisis had on trade volumes, especially on the trade of OECD countries. The trade of
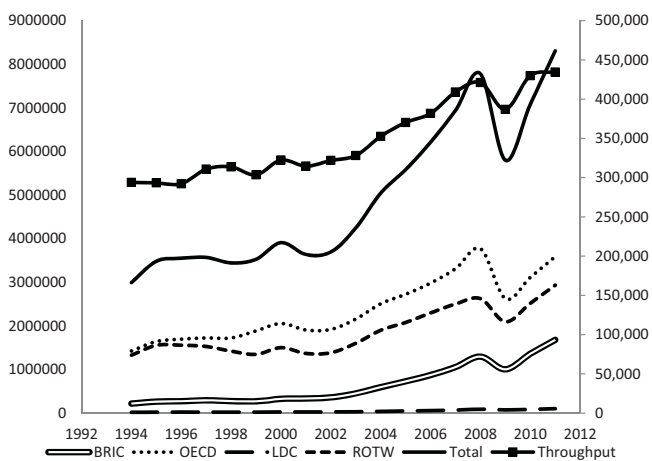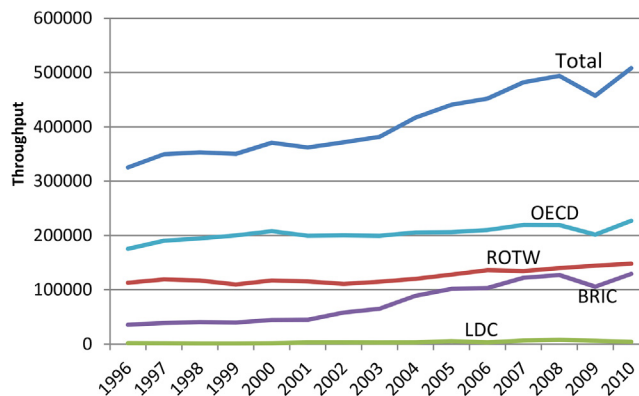

Fig. 2. Total world trade of the four groups on the left y-axis (millions of 1975 dollars). Throughput in the Port of Rotterdam on the right y-axis (millions of tons). Source: WTO (2012), Port of Rotterdam (2012a).

Fig. 3. Port's throughput of the four groups of countries 1996–2010 (millions of tons).