Acta Montanistica Slovaca Volume **23** (2018), number **1**, 100-117

Exploring the Oil Supply-Demand Shocks and Stock market Stabilities: Experience from OECD Countries

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This paper explores the interactive relationships between oil price shocks and the stock market in 11 OECD countries using traditional cointegration test and look at the rolling window Granger causality effects with various predictive power contents running between the variables. Taking into account both world oil production and world oil prices in order to supervise for oil supply and oil demand shocks, strong evidence of the sensitivity of stock market returns to the oil price shock specifications is found in several sub-periods. As for rolling window causality tests, it is found that the impact of oil price shocks substantially differs along the different countries and that the results also differ among the various oil shock specifications. The overall finding suggests that oil supply shocks have a negative effect on stock market returns in the net oil importing OECD countries. Indeed, the stock market returns are negatively impacted by oil demand shocks in the oil importing OECD countries and positively impacted by the oil exporting OECD countries. Furthermore, these results will give a dimension for future undertaking studies with varying empirical findings.

Key words: *oil supply-demand shocks, rolling window, stock market returns*

Introduction

The oil price has experienced a series of shocks for more than fifteen years, and these shocks are not without impact on the industrial sector and therefore on economic growth and financial stock market development. More specifically stock market returns are highly sensitive to the oil price shocks. This sensitivity of stock prices to oil price shocks have been the subject of many works such as those of Jones and Kaul (1996), Sadorsky (1999), Huang et al. (1996), El-Sharif et al. (2005), Naifar and Al Dohaiman (2013), Chang and Yu (2013), Mohanty et al. (2011), and Nguyen and Bhatti (2012). While, Huang et al. (1996) results indicate non-significant sensitivity of stock returns to oil price shocks for some specific markets such as that of the S&P 500 stock market, several studies such as those of Nandha and Faff (2008), Sadorsky (1999), and Issac and Ratti (2009) shows a negative connection between stock returns and oil price increases. Among others, oil production is introduced as an explanatory variable by Kilian (2009), Kilian and Park (2009) and Güntner (2014). Bernanke et al. (1997) and Lee et al. (2012) introduced the short-term interest rate. Park and Ratti (2008) and; Cũnado and Perez de Gracia (2003; 2005; 2014) has developed models that associate the stock returns to the different macroeconomic variables.

Several studies have focused on the nature of the relationship between oil price changes and stock market returns. Bernanke (1983) and Pindyck (1991) argued that a higher change in energy prices creates uncertainty about future energy price and incites, consequently, firms to postpone irreversible investment decisions in reaction to the profit prospects. Ciner (2001) has introduced nonlinear effects and confirms the same results according to which there is a significant negative connection between oil price shocks and real stock returns. According to Basher and Sadorsky (2006), a rise in oil prices acts as inflation tax and increases risk and uncertainty, which lead to reduce wealth and affect the stock price seriously. While Jones and Kaul (1996) found a serious reaction of stock prices to oil price shocks in the US and Canada. Chen et al. (1986) found that the returns generated by oil futures are without significant impact on stock market indices such as S&P 500, and there is no gain in considering the risk caused by the excessive volatility of oil prices on stock markets. In the same line, Apergis and Miller (2009) obtained results that do not support a large effect of structural oil market shocks on stock price in eight developed countries. This result is in line with Park and Ratti (2008) findings, where oil price shocks exert a statistically significant impact on real stock returns.

Lee et al. (2017) has analysed the nexus between oil price shocks and country risks using Structural VAR (SVAR) estimates for oil importing and exporting countries and found that oil exporting country, such as Canada, indicates significant impact with economic and political risks on the supply-side, while the US with a

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specific demand shock as an oil-importing country. Reboredo and Rivera-Castro (2014) examined the connection between oil prices and stock market returns and the results of the wavelet multi-resolution analysis show that oil price changes have no much effect on stock market returns in the pre-crisis period at either the aggregate as well as the sectoral level. Bastianin and Manera (2017) found the dynamic response of oil price shocks with the aggregate oil-specific demand, along with supply-side shocks for the US. The finding also in line with Morana (2017) recent finding, where also reveals the same condition for Middle East countries. Naifar and Al-Dohaiman (2013) have investigated the impact of both change and volatility of oil price variables of stock market returns under regime shifts in the case of the Gulf Cooperation Council (GCC) countries. Their results show evidence supporting a regime dependent relationship between GCC stock market returns and OPEC oil market volatility with exception to the case of Oman. Aloui and Jammazi (2009) have developed a two-regime Markov-switching EGARCH model to examine the interdependence between crude oil shocks and stock returns. The main result of their study supports that net oil prices play a pivotal role in determining firstly the volatility of real returns and secondly the probability of transition across regimes. Hong et al. (2002) also confirm the significant negative connections between the lagged petroleum industry returns and the US stock market. Similarly, Issac and Ratti (2009) results confirm a clear long-run connection between oil price and real stock market returns supporting the negative reaction of real stock prices to the increase in oil prices.

The remainders of this paper proceed as follows. Section 2 is focused on the data and empirical analysis. In this section, we present the variable definitions and the modelling approaches. The discussion of empirical findings is the subject of Section 3, and finally, Section 4 concludes.

Data and Empirical Strategies

We collect data for real stock prices, real industrial production, nominal interest rates and oil prices over the period from January 1990 to December 2013. The countries included in our analysis are Canada, Czech Republic, Denmark, Hungary, Korea, Mexico, Norway, Poland, Sweden, UK and US. All data used in this article are monthly. Thus, the starting date of the sample period is determined by the availability of monthly data serving to compute our variables for each country. Other papers that also use monthly data are those of Sadorsky (1999), Park and Ratti (2008), Driesprong et al. (2008) and Lee et al. (2012). The real stock returns in each market, denoted R_t, are computed using the following equation: $R_t = \left(ln(P_t) - ln(P_{t-1})\right) \times 100$, where P_t represents the real stock market index at the time t. To avoid the impact of the inflation rate we use approximately the real stock returns instead of the returns calculated for each market. We also use the real national price for each country as a proxy for the oil price. The UK Brent nominal price is used as a proxy for the nominal oil price. This proxy is commonly used by several authors such as Cũnado and Perez de Gracia (2005) and Engemann et al. (2011) in order to investigate the type of interconnections between oil shocks and macroeconomic variables.

The data for the oil price and the oil production are obtained from the Energy Information Administration (EIA) Database and the International Financial Statistics from the International Monetary Fund. Finally, the data for the macroeconomic data (industrial production, producer price index, consumer price index, short-term interest rates and exchange rate) are compiled from the OECD database and the Global Financial Data (GFD). This relation specifies the oil price variations defined as the first log difference of real oil prices. The oil supply shocks (oss_t) and oil demand shocks (ods_t) will be computed respectively as follows.

$$\begin{cases} Oss_t = \Delta wop_t, & if \;\; sign(\Delta op_t) \neq sign(\Delta yOil_t), \\ \quad\quad = 0, & otherwise \end{cases} \tag{1}$$

$$\begin{cases} Ods_t = \Delta wop_t, & if \;\; sign(\Delta op_t) = sign(\Delta yOil_t), \\ \quad\quad = 0, & otherwise \end{cases} \tag{2}$$

In the first step, we use the conventional unit root tests of Dickey and Fuller (ADF), Phillips and Perron (PP) and Kwiatkowski et al. (KPSS) tests to verify the stationarity of all variables. In a second time, we apply the endogenous breaks LM unit root test of Lee and Strazicich (2003) to avoid spurious rejections from the conventional unit root tests. For each of the variables contains a unit root, we proceed with the second step to determine the lag length of the VAR version using the Akaike Information Criterion (AIC). Then, we apply the Johansen's cointegration test to determine the number of cointegrating vectors using two different likelihood ratio statistics (LR). First, we will look at the trace and the maximum eigenvalue statistics. In the second step, the Granger causality tests are performed. Finally, we analyse the impact of oil price changes on stock markets by examining the Granger causality tests obtained by estimating the rolling window parameters.

The likelihood ratio (LR) and the Lagrange Multiplier (LM) are commonly used in testing the Granger causality seems to have non-standard asymptotic properties once the variables used in the VAR equation system are integrated or cointegrated (Balcilar et al., 2010). A point of view commonly shared in this vein is that the modified Wald test based on a bootstrap distribution has better properties. To illustrate the bootstrap LR Granger causality let's consider the following bivariate VAR(p) specification

$$Y_t = \lambda_0 + \lambda_1 Y_{t-1} + \cdots + \lambda_p Y_{t-p} + u_t, with{:}\, t = 1, 2, \cdots, T \quad (3)$$

where, $u_t = (u_{1t}, u_{2t})$ corresponds to a zero-mean independent white noise process having a non-singular covariance matrix. P is a known lag length order determined based on the AIC. A simplified specification of the bivariate VAR(p) illustrated in eq. (4) process considering two variables $y_1$as dependent variable and y_2 as an independent variable can be presented as follows:

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \lambda_{10} \\ \lambda_{20} \end{bmatrix} + \begin{bmatrix} \lambda_{11}(L) & \lambda_{12}(L) \\ \lambda_{21}(L) & \lambda_{12}(L) \end{bmatrix} \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix} \quad (4)$$

where, $\lambda_{ij}(L) = \sum_{k=1}^{p} \lambda_{ij,k} L^k$, ij = 1, 2 and L is the lag operator defined as $L^k x_t = x_{t-k}$. Based on eq. (2), we can test the null hypothesis that the independent variable does not Granger cause the dependent variable by imposing the restriction of $\lambda_{12,i} = 0$, for I = 1, 2, ….., p. In the same way, we impose the restriction $\lambda_{21,i} = 0$ for I = 1, 2, ….., p. to test the null hypothesis that the dependent variable does not Granger cause the independent variable. As regards the rolling window based causality technique the tests proceed as follows. As a first step sets a rolling window of size T and we estimate than the Modified Wald (MWALD) causality test for the beginning sub-sample of T observations. In the next step, the first observation is removed from the sub-sample, and a new observation are included the estimation is performed once again. The same procedure continues subsequently by removing one observation from the beginning and including one new observation. The last step consists to normalise the generated χ^2-statistics by a certain level of significant level, and the null hypothesis is rejected if the normalized statistic is above one.

Empirical Results

For the 11 OECD countries, the outcome of ADF, Phillips-Perron and KPSS unit root tests in level and the first difference of the real stock prices, short-term interest rate, real industrial production and real oil (national and world) prices are presented in Table 1. The illustrated results in Table 1 show that about all variables are integrated of order one except the real oil price which seems, in a first look, to be trend stationary in level for Canada, Korea, Mexico, Poland and Sweden. However, this result can be carefully taken into account. In fact, the plot of real national oil price time series shows, for each country that the series are not really trending stationary in level. The history of the real national oil prices shown in Figure 1 until 11, which indicates a presence of breaks in all oil price series. The conventional unit root tests fail to reject the null hypothesis when structural breaks are present. These tests drive their critical values assuming no breaks under the null hypothesis. Consequently, in the presence of a unit root with a break, they tend to reject the null hypothesis suggesting that time series is stationary around trend when it is non-stationary with a break.

To avoid this problem and to examine the potential presence of breaks, we use the endogenous two-break LM unit root tests proposed by Lee and Strazicich (2003) This later seems to be unaffected by breaks under the null hypothesis. We find as anticipated significant structural breaks of real national oil prices of Canada, Korea, Poland and Sweden but not for Mexico (see Table 2). Meanwhile, for this last country, the time series of real national oil price seems to be a linear trend stationary potentially because of the shortness of data. Regarding the ADF, PP, KPSS and LM unit root tests, the results conclude in favour of unit root for all level series.

Assuming that all variables contain a unit root, we test them for cointegration in each VECM using both the trace and the maximum Eigenvalue tests. The results of applying the Johansen and Juselius (1990) approach are shown in Table 3. The Table includes the ranks given in the first line, the number of cointegration vectors in line 2 and eigenvalues and trace statistics for each selected country. The critical value is mentioned using asterisks, and the null hypothesis is that the number of cointegrating relationships is equal to r, which is given in the maximum rank observed in the first line of Table 3. The alternative is that there are more than the rank cointegrating relationships. We reject the null if the trace statistic is greater than the critical value. The existing of one or more cointegration vectors explains that the variables have a long run relationship. The results displayed in the first part (world oil prices) of Table 3 show that there is at least one cointegration vector with an intercept and/or trend in all countries except for the UK for which we find one cointegration vector without constant. Consequently, we can conclude that there is at least one cointegration vector for all selected countries. In the second part (national oil prices) of Table 3, the null hypothesis of no cointegration is not rejected only for the UK. Looking at the Johansen cointegration test results, we conclude that the VECM can be applied to all countries except for the UK (r=0) under the 'all shock' specification of world oil prices. To assess the effect of oil price shocks on stock returns for USA, UK, Canada, Czech Republic, Denmark, Hungary, Korea, Mexico, Norway, Poland and Sweden, we have estimated four different VECM processes for each of the selected OECD countries. As explained above and following Sadorsky (1999) and, Park and Ratti (2008), each process contains the variable stock prices, real industrial production indexes, short-term interest rates, and different specification for oil price shocks: (i) national real oil price; (ii) national oil price as defined in (1) and (2); (iii) world real oil price; (iv) world oil price as defined in (1) and (2). Using the above-estimated models, we continue by performing a Granger causality test as well as a rolling window approach for the full sample. Table 4 summarises the results of the Granger causality test to examine the linkages between oil supply and demand shocks and stock price considering both national and world oil prices.

We tested for the null hypothesis that oil price, as it is shown in Table 4. The results, for the national oil prices specification, seem to be classified into 5 categories. As regards the first class including Canada, Mexico, Norway, and Sweden, we find results confirming the rejection of the null hypothesis according to which oil price does not Granger cause stock price and this for the three specifications of oil price including op, oss and osd. Thus, results from sample bootstrap Granger causality tests indicate that oil price with its three specifications seems to have predictive power for stock price for each of these countries. For the second class, including Denmark, Hungary, Poland, and the UK, the results show the rejection of the null hypothesis for the oil supply and oil demand shocks. For the oil price, we cannot reject the null. This indicates that oil supply and demand shocks have predictive power for the stock price, whereas there is no predictive power between global oil price shocks and stock price. As regards the US case the results indicate that the null hypothesis is not rejected for the oil supply shocks, which appear without predictive power for the stock price. Oppositely, we reject the null hypothesis for both oil price and demand shocks. These two oil prices specifications seem to have significant predictive power. For the case of Korea, the oil supply shocks seem to be without significant predictive power for the stock price, whereas, oil price as well oil demand shocks appear as having significant predictive power. For the last class regroups the Czech Republic, only demand shocks do Granger cause the stock price. Neither oil price nor oil supply shocks have predictive power.

The results using world oil prices specification differ considerably to those discussed above. World oil price with its different specification appears as without predictive power in the cases of Hungary, Poland and UK. For all the rest of selected countries (except for Norway), the global oil price seems Granger cause stock price. As regards, oil price shocks, the results show that while oil supply shocks have a great predictive power for the stock price in only the case of Korea, the null hypothesis seems to be rejected in the cases of Czech Republic, Denmark, Norway, and the US. We notice here that the previous major studies on the linkages between oil price shocks and stock price used various approaches to supervise for autoregressive autocorrelation, long and short run among others. However, although the important results they found, they never examined the stability of the estimates. Structure changes induce changes in the parameters, and consequently, the pattern of the causal connection may vary in its turn over time. If the parameter constancy of the estimated model is violated, therefore the Granger causality tests will show sensitivity to both or each of sample period used and to the lag order of the selected model such as VAR or cointegration model.

Tab. 1. Conventional unit root tests.

	Stock prices			Real industrial productions			Short-term interest rates			Oil real prices		
	ADF	PP	KPSS	ADF	PP	KPSS	ADF	PP	KPSS	ADF	PP	KPSS
At level												
Canada	-1.417	-1.419	1.652***	-1.861	-1.834	0.603**	-3.729***	-2.619*	1.462***	-5.107***	-4.358***	1.924***
Czech Rep	-3.383*	-2.144	0.519**	-3.001**	-2.880*	0.148	-0.770	-1.324	1.521***	-1.605	-1.738	1.415***
Denmark	-2.572	-2.795	1.783***	-2.715	-2.404	0.756***	-1.681	-2.960	1.438***	-3.482**	-3.242*	1.760***
Hungary	-3.093**	-2.838*	1.575***	-3.369*	-3.264*	1.667***	-2.591	-2.616	1.484***	-2.965	-3.109	1.832***
Korea	-3.341*	-2.863	1.541***	-3.509**	-2.672	1.960***	-3.580**	-1.770	1.745***	-4.864***	-4.215***	1.950***
Mexico	-0.535	-0.522	1.735***	-2.785	-2.621	1.327***	-2.754	-1.980	1.310***	-3.514**	-3.658**	1.730***
Norway	-0.584	-0.679	1.799***	-2.268	-2.375	0.448***	-3.681**	-2.175	1.270***	-3.197*	-3.278*	1.847***
Poland	-2.891	-2.569	1.541***	-3.106	-3.110	1.973***	-2.384	-2.417	1.814***	-4.118***	-3.496**	1.960***
Sweden	-1.246	-1.059	1.644***	-1.690	-1.720	1.643***	-2.990	-2.807	1.621***	-4.089***	-3.501**	1.921***
UK	-1.440	-1.465	1.480***	-2.032	-2.181	0.379*	-2.684*	-2.613*	1.473***	-2.692	-2.809	1.738***
US	-2.769	-1.390	1.762***	-1.473	-1.482	0.416***	-1.683	-1.770	1.161***	-3.321*	-2.993	1.823***
World										-3.383*	-3.124	1.663***
At first differences												
Canada	-16.261***	-16.273***	0.132	-14.552***	-14.846***	0.445*	-4.514***		0.311		-13.301***	0.037
Czech Rep.	-11.238***	-11.366***	0.173	-18.147***	-18.139***	0.054	-10.872***		0.088		-13.513	0.033
Denmark	-12.691***	-13.106***	0.043	-19.815***	-22.422***	0.264	-10.604***		0.079		-13.394***	0.078
Hungary	-11.017***	-10.846***	0.398*	-17.810***	-17.844***	0.251	-13.144***		0.130		-14.277***	0.048
Korea	-11.540***	-10.874***	0.087	-12.750***	-14.456***	0.230	-10.512***		0.037		-12.726***	0.046
Mexico	-11.067***	-11.082***	0.114	-12.401	-12.422	0.065*	-11.040***		0.064		-12.942***	0.077
Norway	-13.995***	-14.094***	0.050	-16.445***	-22.631***	0.419*	-7.506***		0.075		-13.585***	0.082
Poland	-12.632***	-12.593***	0.059	-15.898***	-15.896***	0.031	-5.379***		0.265		-13.422***	0.029
Sweden	-11.331***	-11.309***	0.080	-18.927***	-18.850***	0.315	-18.089***		0.113		-13.131***	0.060
UK	-12.822***	-14.817***	0.071	-15.465***	-15.439***	0.060	-10.147***	-9.703***	0.198		-14.459***	0.133
US	-12.554***	-12.527***	0.061	-11.303***	-11.463***	0.135	-11.167***	11.677***	0.067		-11.926***	0.062
World											-12.566***	0.0915

*Note: ADF denotes Augmented Dickey-Fuller unit root tests, PP refers to the Phillips-Perron unit root tests, KPSS denotes Kwiatkowski–Phillips–Schmidt–Shin tests. *, ** and *** denote rejection of the null hypothesis at the 10, 5 and 1% levels of significance, respectively. The lag length in all the tests has been selected based on the Akaike Information Criteria (AIC).*

Tab. 2. Lee-Strazicich double breaks unit root tests.

	Single break				Double breaks					
	Model A		Model B		Model A			Model B		
	t-stat	Break	t-stat	Break	t-stat	Breaks		t-stat	Breaks	
National oil prices										
Canada	-5.456***	2000M4	-5.763***	1999M07	-5.785***	2000M04	2004M04	-6.559***	1997M10	1999M10
Czech Republic	-3.397*	1999M01	-3.489	2008M08	-3.617*	2000M04	2001M09	-4.031	1999M04	2001M08
Denmark	-2.606	2004M12	-4.631**	1999M05	-3.129	1993M11	2000M07	-5.290*	1998M04	1999M09
Hungary	-3.290*	2002M10	-3.748	2001M09	-3.553*	2001M09	2009M06	-4.058	2001M04	2005M03
Korea	-3.344*	1997M11	-6.163***	1995M09	-3.735*	1997M11	2008M04	-6.868***	1993M09	2007M12
Mexico	-1.990	1998M10	-3.930	2004M05	-2.146	1998M10	2004M04	-4.252	1999M08	2004M02
Norway	-2.853	2004M12	-3.938	1999M07	-3.771*	2000M07	2004M12	-5.534*	1999M05	2001M09
Poland	-4.422***	1999M10	-4.457**	1999M06	-4.644***	1998M05	1999M03	-5.113	1997M10	1999M06
Sweden	-2.831	1999M03	-5.193***	1999M07	-3.238	1999M03	2004M12	-5.631*	1999M10	2004M12
UK	-2.436	2004M12	-4.599**	1999M04	-2.614	2004M09	2004M12	-5.349*	1996M11	1999M04
US	-3.624**	2004M09	-5.851***	1999M05	-3.892**	2004M09	2005M02	-7.846***	1995M06	1997M03
World Oil Price	-2.567	2005M02	-4.939**	1999M05	-3.283	2004M09	2005M02	-5.639*	1997M12	2005M02

*Note: *, ** and *** denote rejection of the null hypothesis at the 10, 5 and 1 % levels of significance, respectively. Model A: change in the intercept. Model B: change in the intercept and trend. The critical values for the LS unit-root test with one break are tabulated in Lee and Strazicich (2004, Table 1). The critical values for the LS unit-root test with two breaks, tabulated in Lee and Strazicich (2003, Tab. 2), depending upon the location of the breaks. For λ_1 = 0.4 and λ_2 = 0.6, the critical values equal, respectively, -6.45 (1 % level), -5.67 (5 % level), and -5.31 (10 % level).*

Tab. 3. Johansen and Juselius cointegration test results.

	Statistics	*r* = 0		*r* ≤1		*r*≤2		*r*≤ 3	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
World oil prices									
Canada	Trace	49.614**	77.273***	23.530	43.710**	8.765	20.071	1.345	7.189
	Max-Eigen	26.084*	33.564**	14.765	23.639*	7.420	12.882	1.345	7.189
Czech Republic	Trace	45.787*	71.521***	27.333*	37.413	13.825*	19.596	2.228	7.543
	Max-Eigen	18.454	34.107**	13.508	17.818	11.597	12.053	2.228	7.543
Denmark	Trace	33.859	64.216**	19.041	33.486	8.097	18.868	0.000	8.030
	Max-Eigen	14.818	30.730*	10.945	14.619	8.096	10.837	0.000	8.030
Hungary	Trace	60.680***	71.223**	24,127	31.378	9.047	15.147	3.407	5.390
	Max-Eigen	36.553***	39.846***	15.080	16.230	5.641	9.757	3.407	5.390
Korea	Trace	64.941***	86.466***	22.755	32.775	10.436	17.878	2.789*	6.162
	Max-Eigen	42.186***	53.691***	12.318	14.898	7.647	11.715	2.789*	6.162
Mexico	Trace	48.829**	58.350	26.996	33.222	9.606	15.409	0.552	4.665
	Max-Eigen	21.833	25.128	17.390	17.813	9.054	10.744	0.552	4.665
Norway	Trace	60.686***	81.607***	30.416**	47.678**	9.220	23.332	0.198	8.798
	Max-Eigen	30.270**	33.929**	21.196**	24.346*	9.022	14.535	0.198	8.798
Poland	Trace	80.367***	95.461***	28.592*	38.655	9.751	19.163	3.709*	5.435
	Max-Eigen	51.775***	56.806***	18.841	19.493	6.043	13.728	3.709*	5.435
Sweden	Trace	42.604	66.744**	18.920	28.698	7.651	15.226	3.262*	4.368

	Max-Eigen	23.685	38.046***	11.269	13.472	4.389	10.858	3.262*	4.368
UK	Trace	32.586	49.473	17.323	24.870	6.897	12.910	1.868	3.671
	Max-Eigen	15.263	24.602	10.426	11.960	5.029	9.239	1.868	3.671
US	Trace	132.660***	149.850***	14.126	30.741	4.051	11.866	1.332	2.340
	Max-Eigen	118.540***	119.110***	10.075	18.875	2.719	9.524	1.332	2.340
National oil prices									
Canada	Trace	53.797**	83.459***	23.798	49.341**	9.047	20.626	1.094	7.556
	Max-Eigen	29.999**	34.118**	14.751	28.715**	7.953	13070	1.094	7.556
Czech Republic	Trace	46.456*	62.588*	25.536	30.349	10.713	15.440	2.819*	6.259
	Max-Eigen	20.920	32.239**	14.823	14.909	7.894	9.181	2.819*	6.259
Denmark	Trace	35.288	68.175**	19.982	35.213	7.688	19.945	0.035	7.653
	Max-Eigen	15.306	32.962**	12.294	15.268	7.653	12.292	0.035	7.653
Hungary	Trace	60.786***	70.783**	25.746	34.437	8.988	16.178	3.303*	5.308
	Max-Eigen	35.039***	36.345**	16.759	18.260	5.685	10.870	3.303*	5.308
Korea	Trace	62.243***	75.461***	23.093	30.184	11.429	18.333	2.962*	7.085
	Max-Eigen	39.149***	45.277***	11.665	11.851	8.467	11.248	2.962*	7.085
Mexico	Trace	50.686**	57.911	25.328	32.171	8.199	15.012	0.460	4.721
	Max-Eigen	25.360*	25.740	17.129	17.159	7.739	10.291	0.460	4.721
Norway	Trace	54.396***	77.325***	23.448	39.459	8.551	19.152	0.026	8.464
	Max-Eigen	30.949**	37.866***	14.896	20.307	8.526	10.688	0.026	8.464
Poland	Trace	52.029**	72.239***	23.549	43.475**	11.726	18.515	4.341**	6.701
	Max-Eigen	28.480**	28.763	11.822	24.959*	7.385	11.814	4.341**	6.701
Sweden	Trace	44.153	69.033**	18.860	31.685	6.970	16.576	2.238	4.687
	Max-Eigen	25.294	37.349**	11.890	15.108	4.732	11.889	2.238	4.687
UK	Trace	33.329	44.476	13.391	23.345	4.923	13.048	0.183	4.736
	Max-Eigen	19.938	21.131	8.468	10.297	4.740	8.312	0.183	4.736
US	Trace	98.789***	119.500***	14.654	33.663	4.517	12.502	1.083	2.998
	Max-Eigen	84.135***	85.835***	10.137	21.162	3.434	9.504	1.083	2.998

*Notes. (1) Model with an intercept. (2): Model with an intercept and a linear trend. and r represents the number of cointegrating vectors. *, ** and *** denote rejection of the null hypothesis at the 10, 5 and 1% levels of significance, respectively. In column 3 (r=0) we test the null hypothesis of no cointegration against the alternative of cointegration. In column 4 we test the null hypothesis of 0 or 1 cointegrating vector against the alternative of r=2. The lag length in all the tests has been selected according to the AIC, although a robustness analysis suggests that the results of these tests are robust to the chosen* lag length.

Tab. 4. Full sample bootstrap Granger causality test between oil price and real stock price series

Countries/	National oil price		World oil price	
Causality directions	LR-statistic	Bootstrap *p*-value	LR-statistic	Bootstrap *p*-value
Canada				
op −/→ rsp	8.654*	0.060	8.777*	0.060
osd −/→ rsp	60.210***	0.000	1.339	0.480
oss −/→ rsp	43.318***	0.000	1.682	0.270
Czech Republic				
op −/→ rsp	1.782	0.300	7.677**	0.020
osd −/→ rsp	0.154**	0.040	6.776**	0.020
oss −/→ rsp	0.154	0.750	0.013	0.940
Denmark				
op −/→ rsp	9.304	0.040	8.032*	0.050
osd −/→ rsp	10.726**	0.010	10.343**	0.020
oss −/→ rsp	17.515**	0.010	1.905	0.360
Hungary				
op −/→ rsp	3.762	0.270	4.505	0.240
osd −/→ rsp	6.827**	0.020	2.702	0.310
oss −/→ rsp	9.199**	0.020	1.293	0.430
Korea				
op −/→ rsp	8.226**	0.020	13.250***	0.000
osd −/→ rsp	2.160	0.300	1.729	0.500
oss −/→ rsp	11.023***	0.010	4.515*	0.080
Mexico				
op −/→ rsp	14.450***	0.000	12.139***	0.000
osd −/→ rsp	37.284***	0.000	0.694	0.710
oss −/→ rsp	44.770***	0.000	3.410	0.320
Norway				
op −/→ rsp	11.141***	0.000	8.514	0.110
osd −/→ rsp	43.096***	0.000	6.627*	0.080
oss −/→ rsp	57.284***	0.000	2.050	0.280
Poland				
op −/→ rsp	3.064	0.230	5.293	0.150
osd −/→ rsp	27.585***	0.000	1.854	0.490
oss −/→ rsp	25.314***	0.000	0.618	0.780
Sweden				
op −/→ rsp	8.740**	0.040	6.961*	0.090
osd −/→ rsp	45.978***	0.000	2.755	0.340
oss −/→ rsp	51.004***	0.000	2.458	0.360
United Kingdom				
op −/→ rsp	3.053	0.300	3.456	0.330
osd −/→ rsp	23.031***	0.000	1.695	0.450
oss −/→ rsp	10.983**	0.010	0.906	0.470
United States				
op −/→ rsp	25.43**	0.010	10.823***	0.000
osd −/→ rsp	3.733***	0.000	8.674**	0.020
oss −/→ rsp	3.733	0.150	1.446	0.460

*Note: *, **, and *** denote significance at 10, 5, and 1%, respectively. The p-values are obtained through 2000 Monte Carlo simulations.*

Since one of the main objectives of this study is to examine the stability of the oil price shocks, stock price causality test across the analysis period, we used a rolling window regression technique. This estimate approach is based on a changing sub-sample of fixed length that moves sequentially over the whole sample period. The results of rolling window estimates are illustrated in Figures 1 to 11. For each country, the rolling window results show for each of the oil price shock specifications the plots of the bootstrap p-values of the rolling test statistics as well as the magnitude of the effect between the series. For each oil prices specification, panel A and B show the bootstrap p-values of the rolling test statistics, which test the null hypothesis according to which the oil price does not Granger cause the stock price. Panel C and D show the bootstrap p-values of the rolling test statistics, testing the null hypothesis that the oil demand shocks do not Granger cause the stock price taking into account national and world specification, respectively. Finally, Panel E to F shows the bootstrap p-values of the rolling window null hypothesis that the oil supply shocks do not Granger cause the stock price taking into account national and world specification, respectively.

Fig. 1 indicates for Canada that the oil price (national, as well as world) have significant predictive power to stock prices over the sub-period from August 1995 to November 1996 and about over all the sub-period from June 2005 to December 2013. The sign of the impact of national oil price is positive for the period from August 1995 to November 1996 and negative in the other period. While the world oil price has positive predictive power for the stock price during the three sub-periods above. The national oil demand shocks impact negatively to stock price over the period from March 2010 to December 2013 and positively over the sub-periods from August 1998 to July 1999, from January 2001 to April 2002, From January 2005 to September 2009. The national oil supply shocks seem to impact the stock price negatively from August 2008 to October 2010 and a positive impact from this date to December 2013. As regards the world supply shocks the impact is significantly positive from April 2003 to August 2005 to become negative from this date to December 2013.

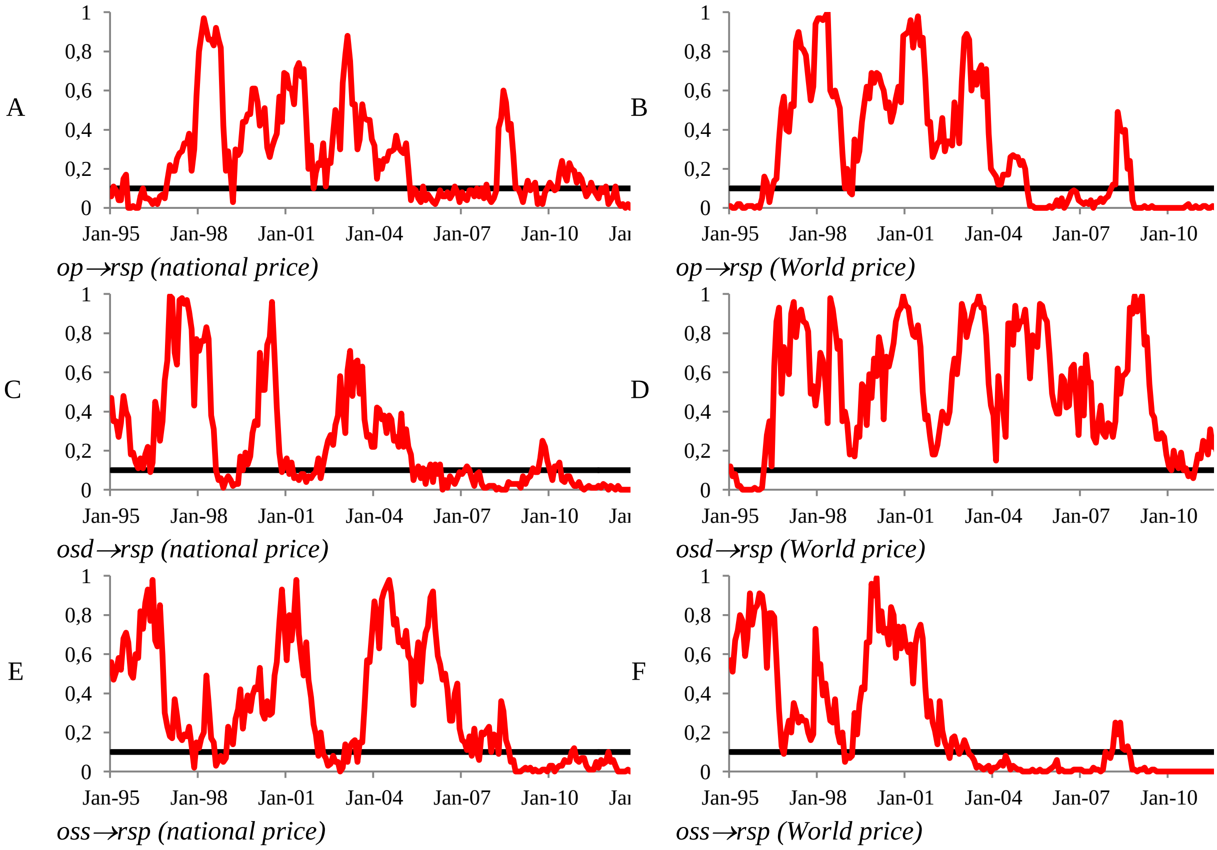


Fig. 1. Rolling estimation results for Canada.

Fig. 2 shows the following results for the Czech Republic. The null hypothesis that national oil price does not Granger cause stock price is rejected over about all the sub-period from September 2003 to November 2010, with a significant negative impact on stock price. While the world oil price presents a significant positive predictive power over the sub-period from April 2004 to March 2008. The national oil price demand does Granger cause the stock price over the following sub-periods September 1999 to May 2002 with a positive impact and from May 2009 to March 2012 with negative predictive power. The world oil demand shocks exert however a significant and negative impact on stock price over the sub-periods from February 2003 to January 2004, July and August 2006, from May 2007 to October 2007, and from November 2008 to September 2013. As for the world oil supply shocks the impact on the stock price seems to be significantly positive over the sub-periods from July 2009 to May 2001 and from January 2006 to March 2008. As regards Denmark, results in Fig. 3 shows that national oil price, world oil price, as well as national demand, shocks a positive impact over about the sub-period from May 2004 to January 2008. For the world oil demand shocks the impact is positive during the sub-periods from May 2005 to September 2005 and negative over the sub-periods from September 2008 to March 2008 and from February 2008 and from February 2009 to December 2013.

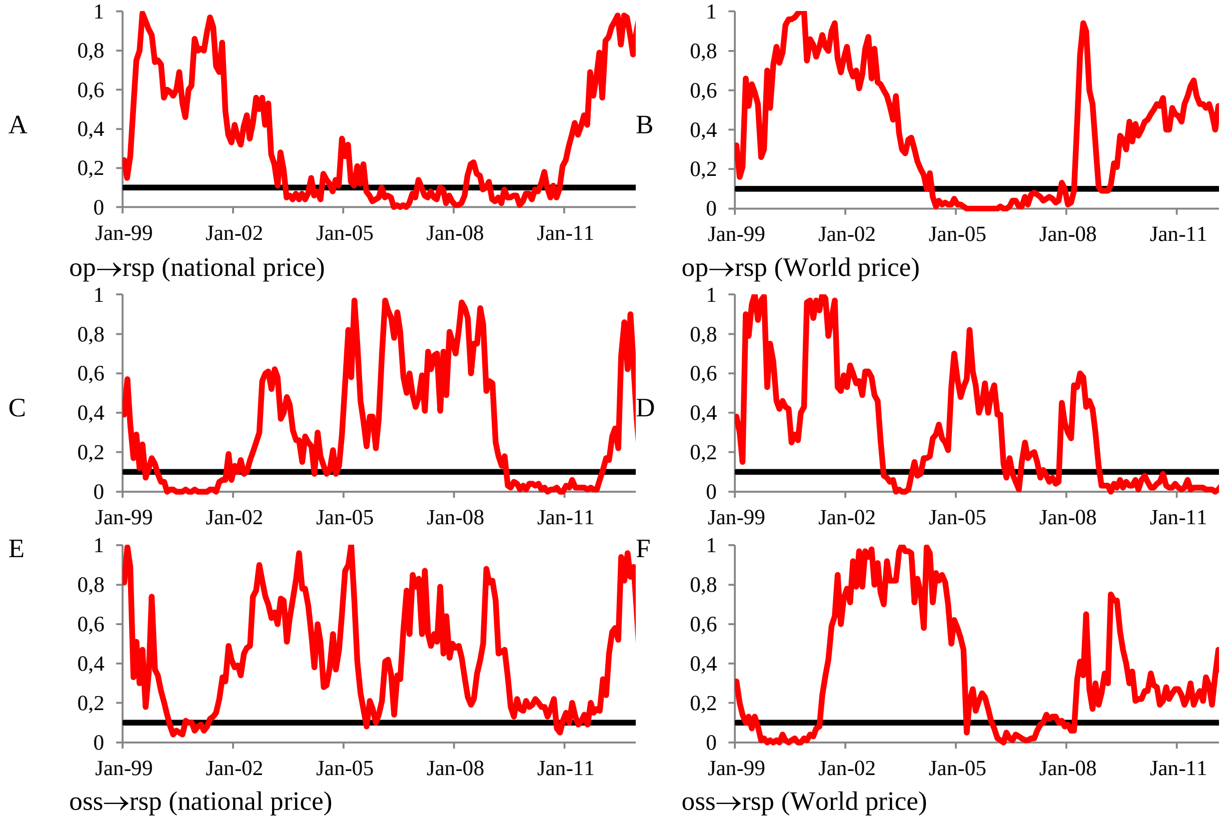


Fig. 2. Rolling window estimation results for the Czech Republic.

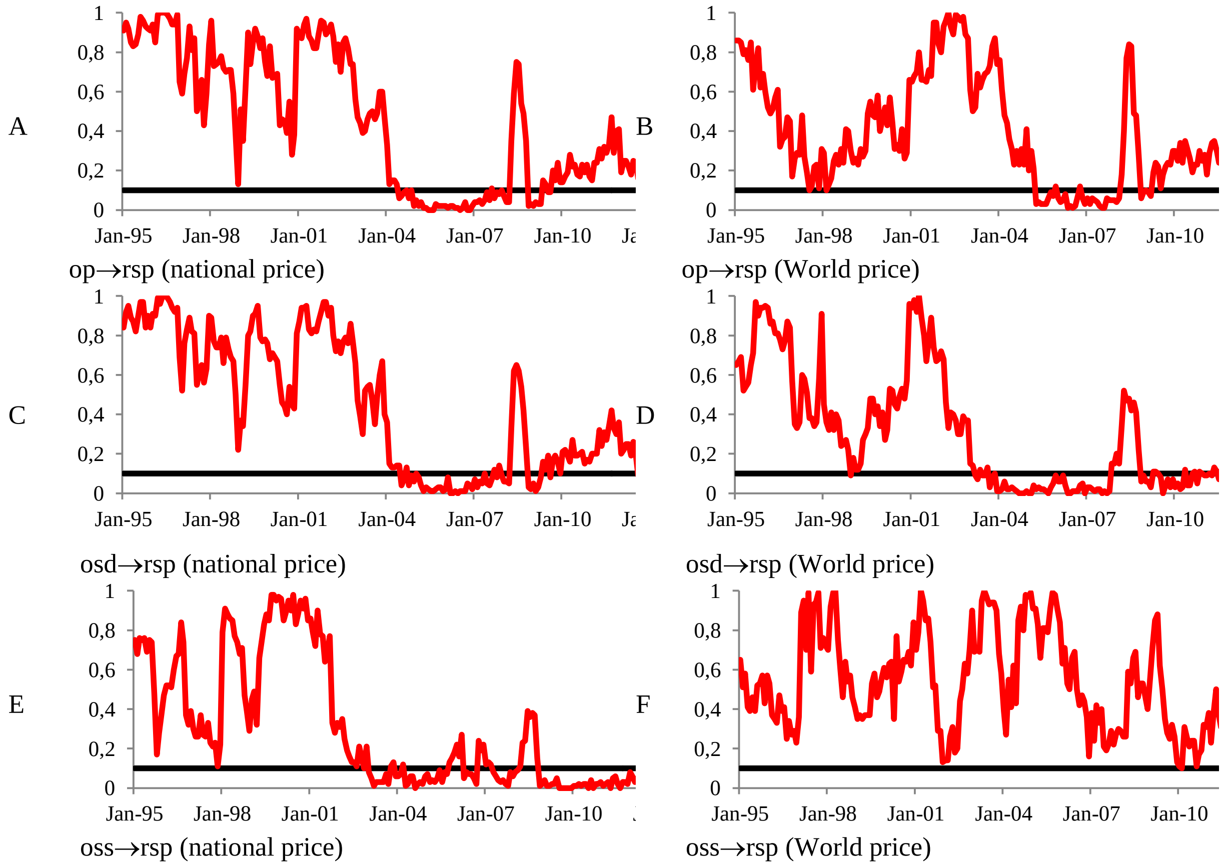


Fig. 3. Rolling window estimation results for Denmark.

The Fig. 4 shows the rolling window estimates for the Hungarian. The null hypothesis that oil price does not Granger cause the stock price can be rejected at the 10% significance level for the national as well as world oil prices specification during the sub-periods from about the end 2003 to April 2008 with a negative and positive predictive power, respectively. For South Korea, Fig. 5 shows a rejection of the null hypothesis for about the major sub-periods with negative impacts on the stock price. For the world oil price, the null hypothesis is clearly rejected during the sub-periods from January 1995 to March 1997 and from March 1998 to December 2006 and with the negative predictive power of world oil price for stock price over the different sub-periods. For the world oil demand shocks, the null hypothesis is rejected during the sub-periods from February 1997 to March 1999, from December 1999 to February 2005, and from July 2006 to January 2008 with negative impacts on stock price.

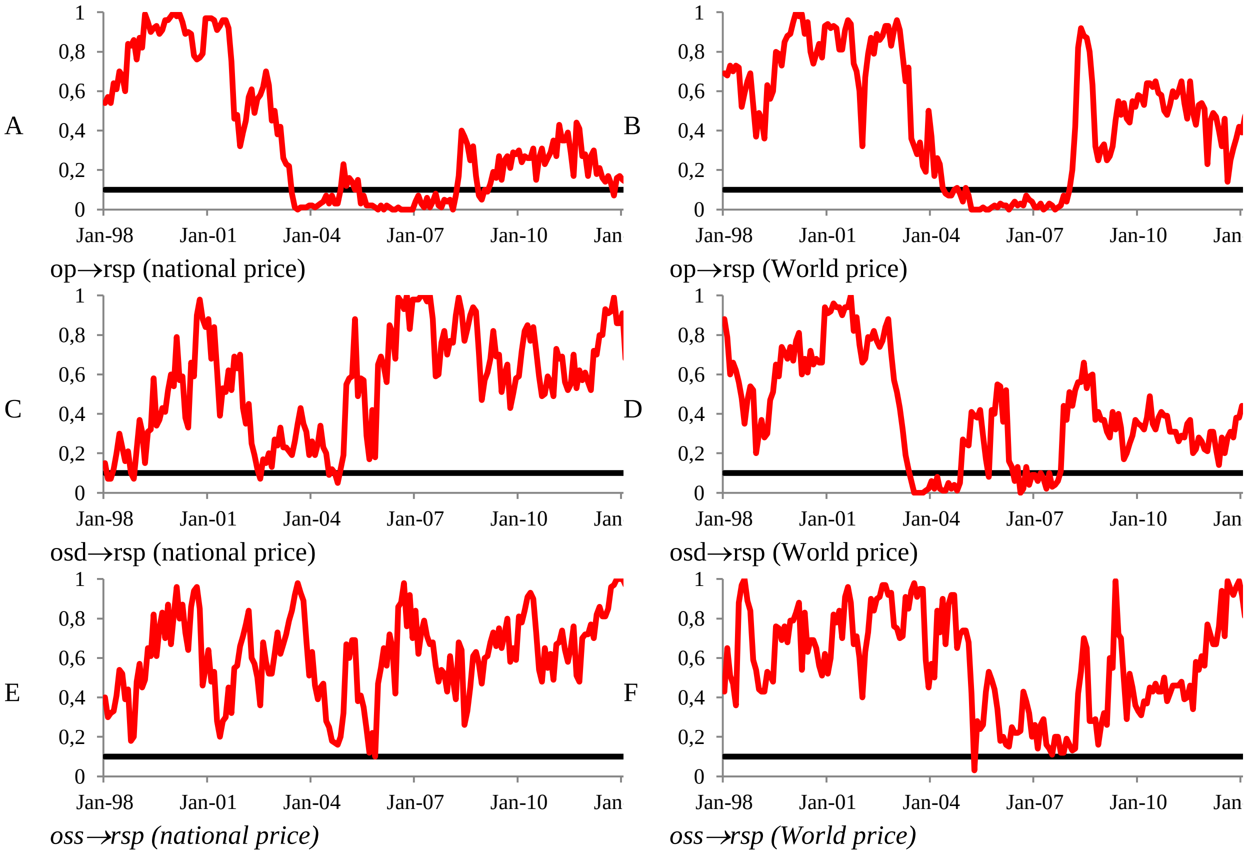


Fig. 4. Rolling window estimation results for Hungary.

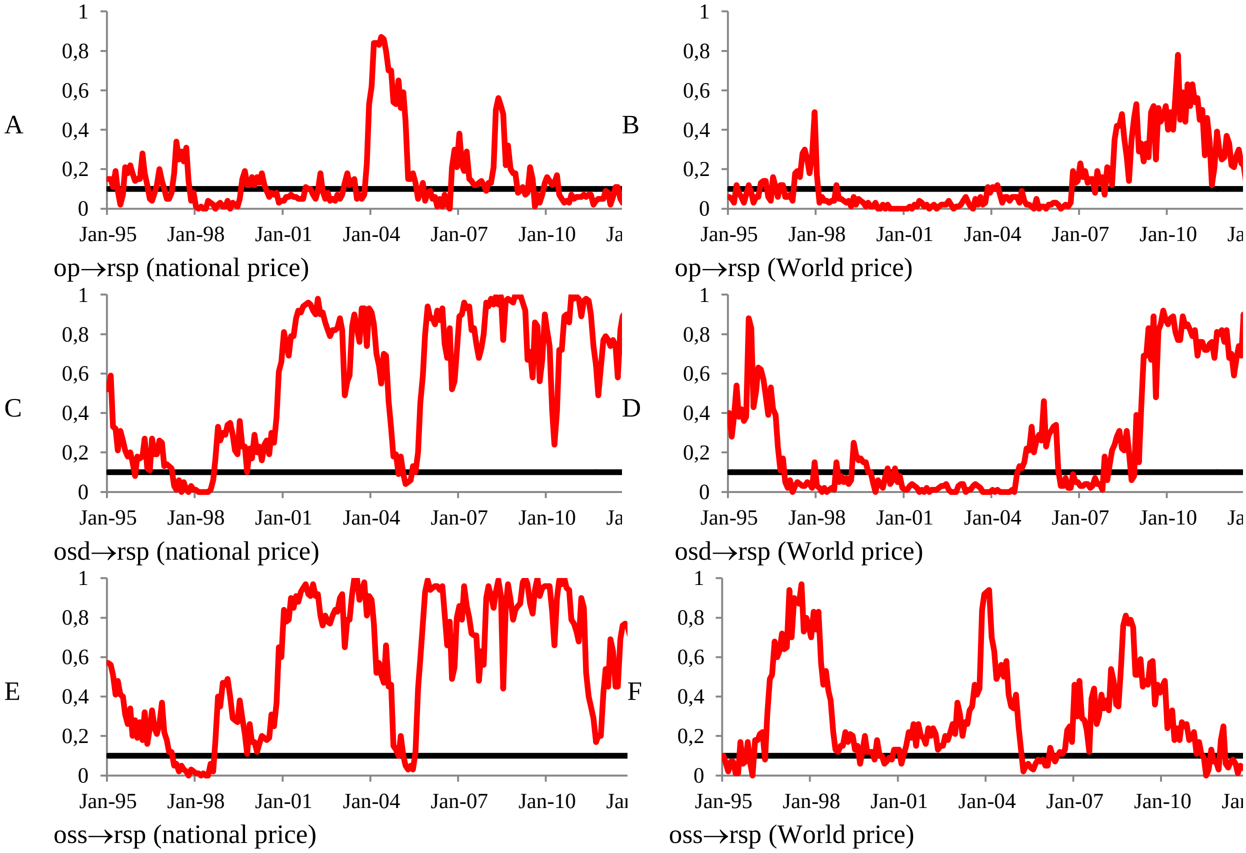
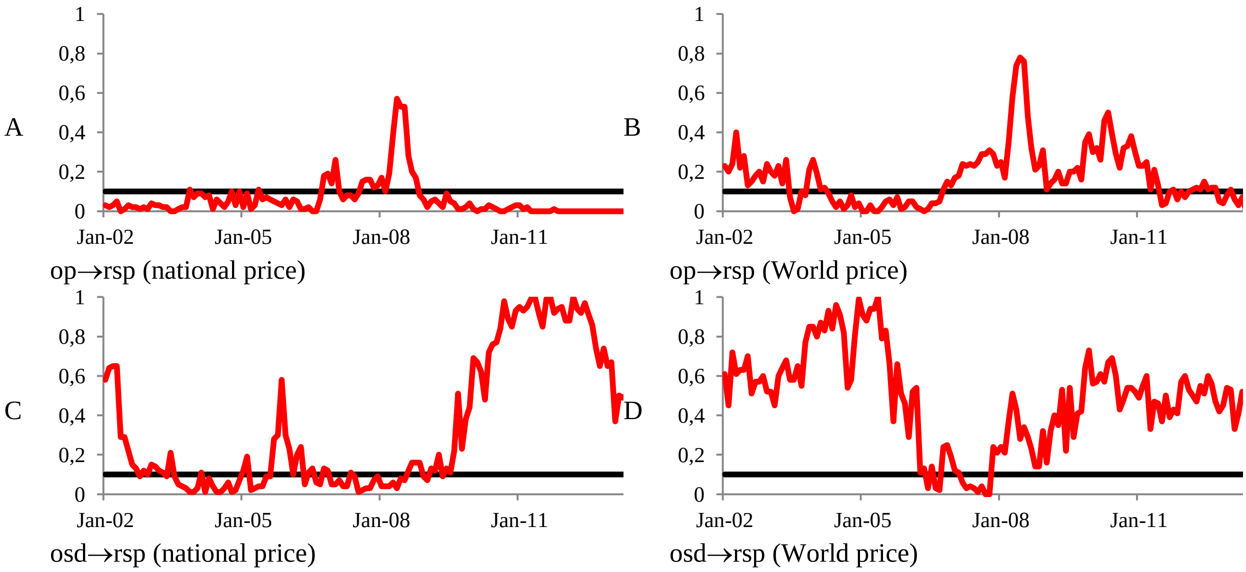


Fig. 5. Rolling window estimation results for South Korea.

In the case of Mexico, Fig 6 shows the following results. The null hypothesis that national oil price does not Granger cause the stock price is rejected over about the whole sample period, except the sub-period from November 2006 to October 2008 with a positive impact during the period starting January 2002 till the beginning 2007 and a negative impact during the remainder of the sample period. The national oil demand shocks do Granger cause stock price with a positive impact on the sub-period from July 2003 to October 2008 except the months from August 2005 to July 2006. As regards the national oil supply shocks the impacts seems to be significant during the sub-periods between March 2005 and October 2008 and between June 2013 and October 2013. The impact seems to be quite negative. While the world oil supply shocks do Granger cause the stock price with a positive impact during the sub-period from June 2011 to August 2013.



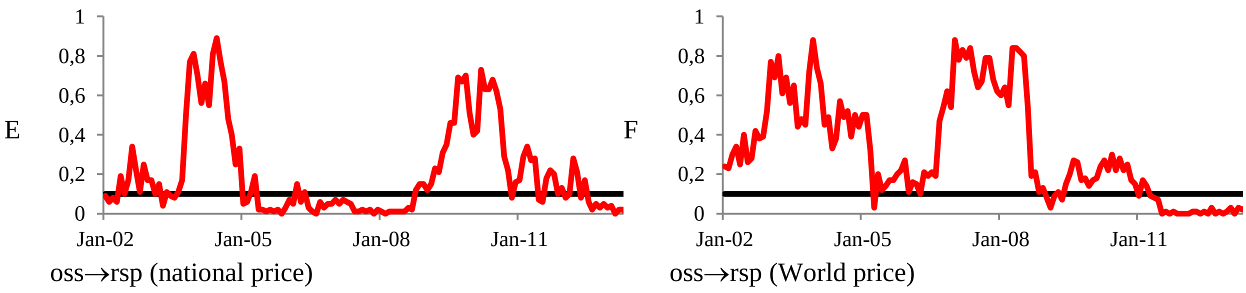


Fig. 6. Rolling window estimation results for Mexico.

For the case of Norway, Fig. 7 shows the following results. The national oil price does Granger cause the stock price during the sub-periods from April 2004 to February 2008 and from December 2011 to November 2013 with positive predictive power and during the sub-period from January 2009 to March 2010 with negative predictive power. The world oil price does Granger cause the stock price over the sub-periods from December 1995 to January 1997 and from October 2008 to March 2010 with a negative impact and during May 1997 to January 1999 and from June 2012 to October 2013 with positive predictive power. As regards the world oil demand shocks, the impact seems to be significant during the sub-period from September 2003 to March 2005 with positive predictive power and from March 2006 to November 2007 and from October 2008 to December 2013 with a negative impact.

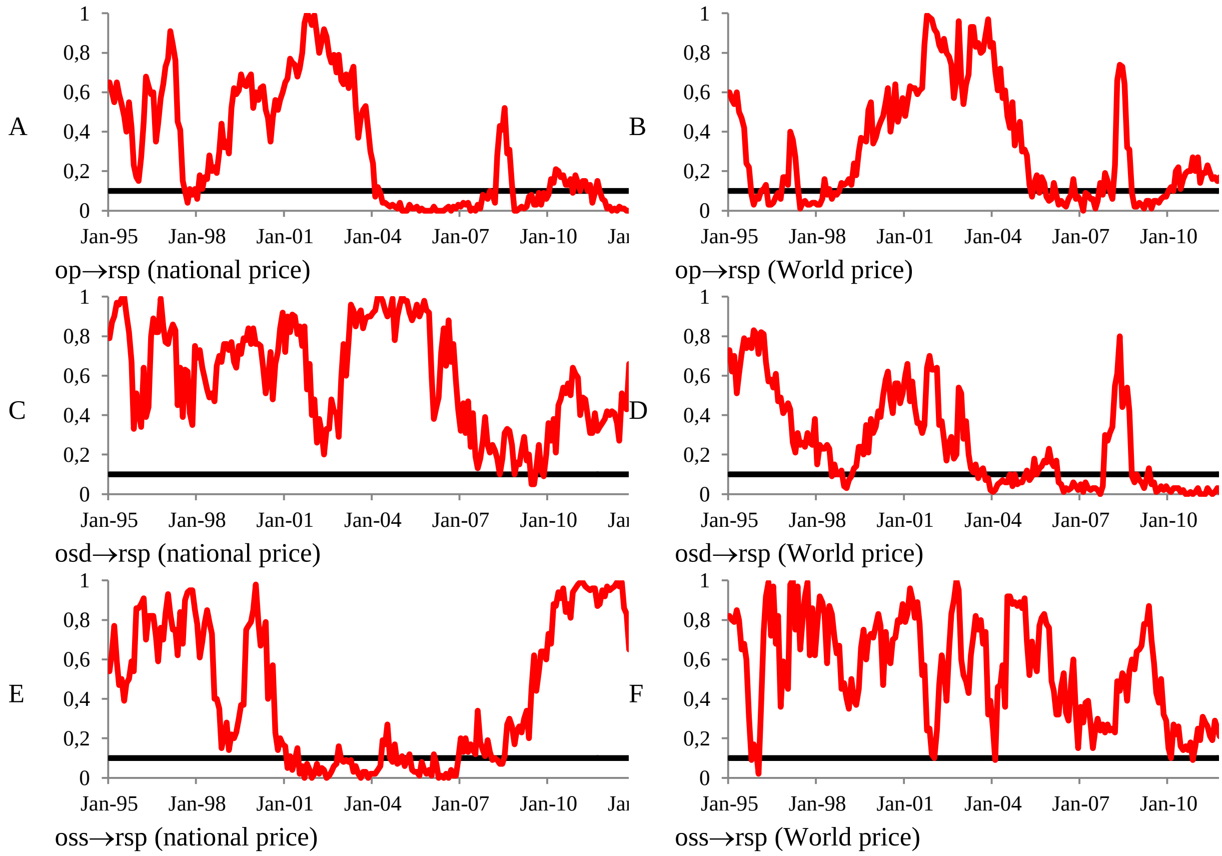


Fig. 7. Rolling window estimation results for Norway.

Fig. 8 shows the results for Poland. The national price does not Granger cause stock price with a quite positive predictive power during the sub-periods from January 2004 to February 2007 and from September 2012 to September 2013. However, the stock price over the sub-period spanning from May 2004 to July 2007 with a quite a negative impact on the stock price. While the oil supply shocks have a significant positive predictive power during the sub-periods from July 1998 to October 2000 and from October 2003 to February 2007. As regards the world oil price, the impact on stock price seems to be with a positive predictive power during the sub-periods from March 2004 to September 2006 and with a negative predictive power from August 2012 to

October 2013. Fig. 9 shows for the case of Sweden quite rare significant sub-periods in which stock price is Granger caused by some specifications of oil price supply and demand shocks.

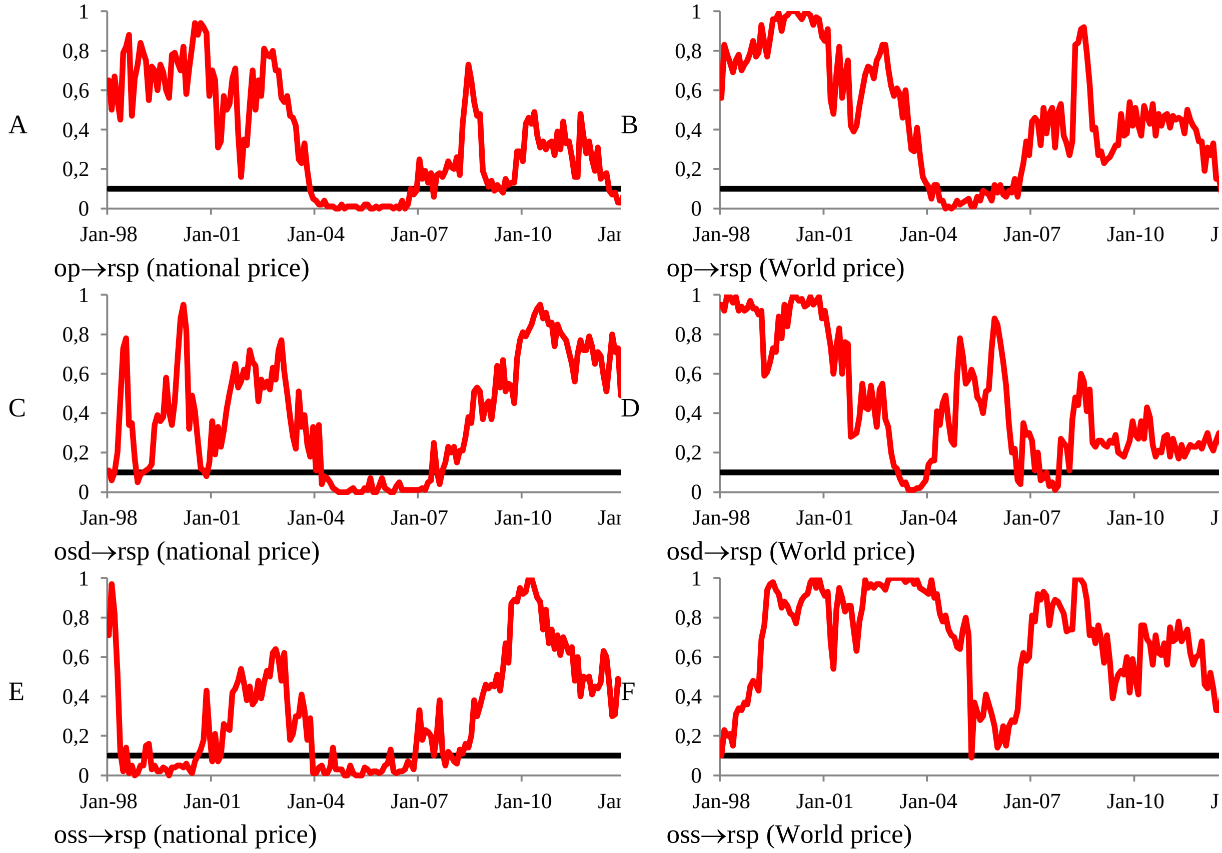


Fig. 8. Rolling window estimation results for Poland.

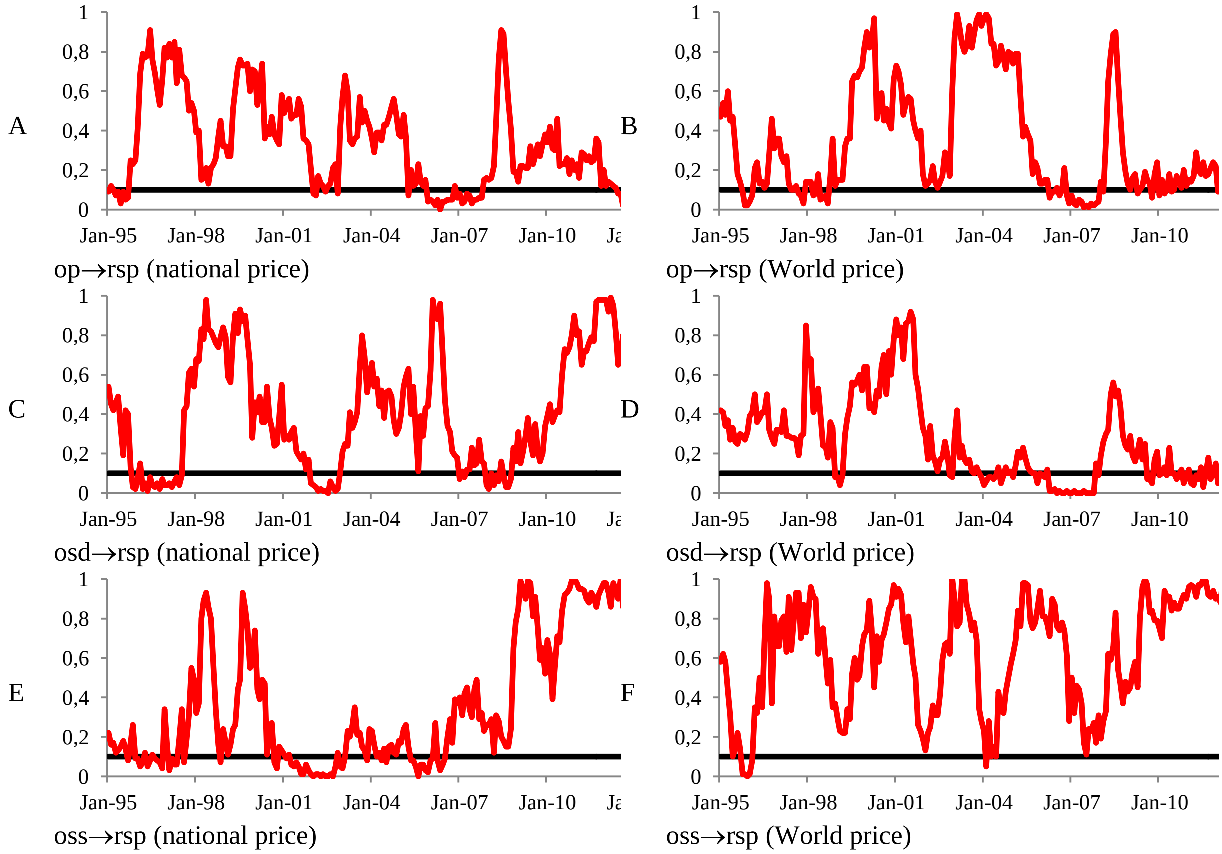


Fig. 9. Rolling window estimation results for Sweden.

Fig. 10 gives the results for the UK. National oil price does Granger causes the stock price during the sub-periods from October 1997 to May 1999, from April 2000 to November 2002, and from June 2012 to August 2013. During the first two sub-periods, the impact is negative, and over the latter sub-period, the impact is rather positive. The national oil demand shock exerts, however, a quite a significant positive impact, during the sub-periods from February 2001 to April 2002 and from January 2004 to February 2006. For the national oil supply shocks, a significant quite negative impact is observed over the sub-periods from February 2004 to March 2006 with exception to November and December 2004, from August 2008 to March 2010, and from July 2011 to December 2013. The world oil price does Granger cause the stock price over the sub-periods from January from April 2000 to October 2002, with a quite negative predictive power, and from May 1997 to September 1999, from August 2007 to October 2013 with a quite positive predictive power. For the world oil demand shocks, a quite negative predictive power is shown during the sub-periods from January 1995 to August 1995, from October 2005 to October 2007, and from February 2009 to April 2011.

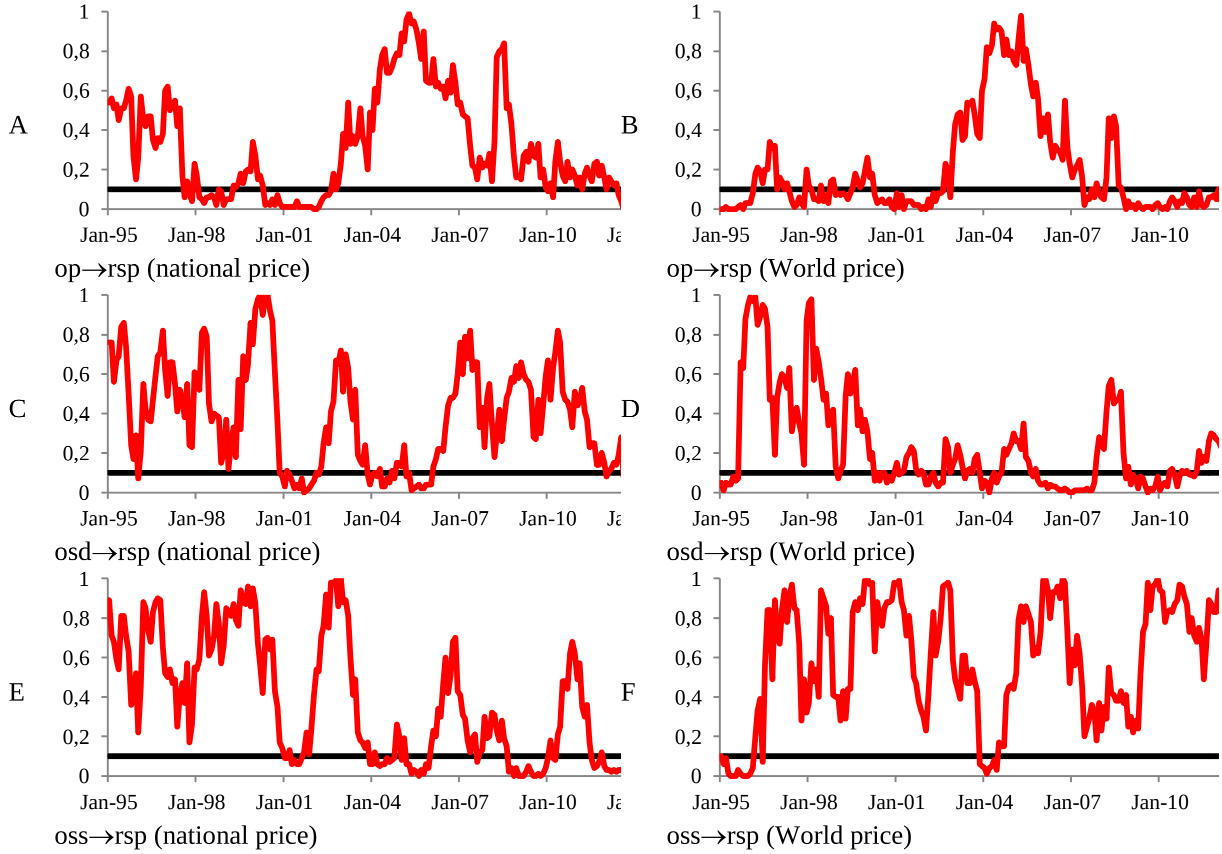


Fig. 10. Rolling window estimation results for the UK.

Finally, Fig. 11 shows the following results for the US. National oil price does Granger causes the stock price is rejected during the sub-periods from February 2005 to March 2008 and February 2012 to September 2013 with positive predictive power and from August 2008 to June 2010 with negative predictive power. For The national oil demand, shocks have a significant impact on the stock price over the sub-periods from September 2001 to June 2002 and from August 2007 to November 2013. The impact is negative until July 2008 and become positive after that. As regards the world oil price a significant Granger causality is shown during the sub-periods from March 2005 to March 2008 and from December 2011 to August 2013 with positive predictive power, and from October 2008 to May 2011 with negative predictive power. For the oil demand shocks, a smoothed negative predictive power is observed during the sub-periods from January 2002 and October 2004 while a negative predictive power is shown from October 2008 to June 2013.

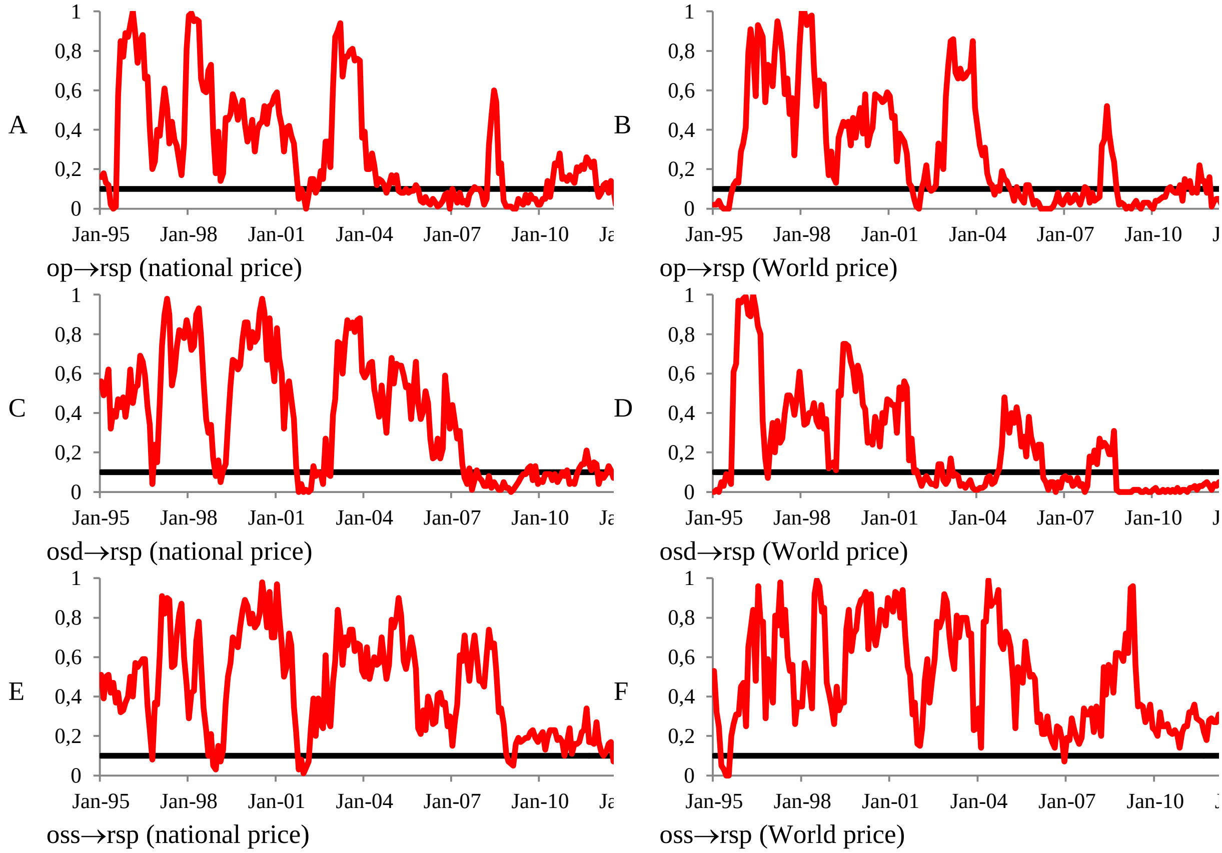


Fig. 11. Rolling window estimation results for the US.

Conclusion

The reaction of stock returns to oil shocks can be accounted for by their impact on current and expected future real cash flows. Oil price also acts as an inflationary factor since oil constitutes a substantial resource for industrial as well as the other sectors inducing an increase in operating costs and therefore an increase in prices. In fact, oil price can corporate cash flow since the oil price constitutes a substantial input in production. In addition, oil price changes can influence the supply and demand for output significantly, and, therefore, decrease the firm performance through its effect on the discount rate for cash flow because the direct effect that may exert on the expected rate of inflation and the expected real interest rate. The results in this paper show that the effect of real oil changes on real stock returns in the considered 11 OECD countries may differ depending on the nature of the oil shock. Our results show that the impact of oil price shocks substantially differs along the countries and that the significance of the results also differs along the oil prices specification. The finding suggests that oil supply shocks have a negative effect on stock market returns in the net oil importing OECD countries since oil represents an essential input and the increase in oil prices induce a rise in industrial costs. However, the stock markets are negatively impacted by oil demand shocks in the oil importing OECD countries due to higher energy costs and positively impacted by the oil exporting OECD countries due to the perspective of increasing world income and consumption. Finally, oil demand shocks have only a negative effect on stock markets in most of the net oil exporting and importing OECD countries. As predicted in previous theoretical works and empirical studies, the results we found the support that oil price shocks contribute significantly to systematic risk at the financial market level. The response of stock returns to oil price shocks can be attributed to their impact on current and expected future real cash flows.

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