

# ECONOMIC AND BUSINESS REVIEW

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# IMPROVED HOLT-WINTERS METHOD: A CASE OF OVERNIGHT STAYS OF TOURISTS IN REPUBLIC OF SLOVENIA

LILJANA FERBAR TRATAR<sup>1</sup>

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**ABSTRACT:** *Exponential smoothing methods are very commonly used for forecasting demand because they are simple, fast and inexpensive. The Holt-Winters (HW) methods estimate three smoothing parameters, associated with level, trend and seasonal factors. The seasonal variation can be of either an additive or multiplicative form. The multiplicative version is used more widely and on average works better than the additive, but if a data series contains some values equal to zero, the multiplicative HW method may not be used. In this paper we propose an improved additive HW method and we treat the initial values for the level, trend and seasonal components as well as three smoothing constants as decision variables. Through our results we demonstrate that a considerable reduction in forecast error (mean square error) can be achieved. The presented new method is applied to the case of overnight stays of tourists in Republic of Slovenia and comparisons with other methods are made on this case study data.*

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**Keywords:** Demand forecasting, Holt-Winters method, Optimization

**JEL Classification:** C53, C61

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## 1. INTRODUCTION

Exponential smoothing is used frequently throughout the world, because the method is simple, fast and inexpensive. It is particularly suitable for production planning and stock control, where forecasts are made with large numbers of variables (stock accuracy forecasts are particularly important, because excessive forecasts lead to over-stocks and insufficient forecasts lead to stock shortages) (Holt, 2004).

Exponential smoothing methods are a class of methods that produce forecasts with simple formulae, taking into account trend and seasonal effects of the data. These procedures are widely used as forecasting techniques in inventory management and sales forecasting. Some papers (Koehler, Snyder & Ord, 2001; Ord, Koehler & Snyder, 1997) have stimulated renewed interest in the technique, putting exponential smoothing procedures on sound theoretical ground by identifying and examining the underlying statistical models.

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The HW method estimates three smoothing parameters, associated with level, trend and seasonal factors. The seasonal variation can be of either an additive or multiplicative form. The multiplicative version is used more widely and on average works better than the additive (Bermúdez, Segura & Vercher, 2006); of course, if a data series contains some values equal to zero, the multiplicative HW method may not be used. A problem which affects all exponential smoothing methods is the selection of smoothing parameters and initial values, so that forecasts better accord with time series data ("Author", 2010). We estimate smoothing (and initial) parameters in HW methods by minimising the mean square error (MSE). The minimising problem is solved by using Solver (Microsoft Excel 2007).

The aim of this paper is to introduce an improved forecasting method that will provide as good results as the multiplicative HW method and at the same time can be used for a time series containing zero values. In this paper we present an improved HW method and we show that this new method contributes to reduction in the MSE. From the results obtained from real data we prove that the proposed method is more efficient than the ordinary (additive and multiplicative) HW method and consequently we show that the new, improved HW method does not only achieve multiplicative HW method results but can give even better results in the measuring of the MSE.

The remainder of the paper is organized as follows. We begin with the description of a dataset included in our study (see Section 2). In Section 3 we describe Holt-Winters forecasting procedure and we present an improved Holt-Winters procedure. In Section 4, the presented new method is applied to the case of overnight stays of tourists in Republic of Slovenia and comparisons with other methods are made on this case study data. Finally, in conclusions we suggest some further steps of research.

## 2. EMPIRICAL DATA

The improved HW method was first tested on some examples, taken from the monograph *Forecasting: Methods and Applications* (Makridakis, Wheelwright & Hyndman, 1998). If we used the improved HW method instead of additive or multiplicative HW method, the MSE was reduced for all selected examples; especially, for time series with high variations in data.

For research we used quarterly data of overnight stays of domestic (D) and foreign (F) tourists in the Republic of Slovenia between 2000 and 2009, produced by the Statistical Office of the Republic of Slovenia (SI-STAT Data Portal – Economy – Tourism). We selected only those communities that represent time series with seasonality and/or trend and high variations in data. We dealt with 10 non zero time series and 6 intermittent time series for chosen Slovenian communities but in this chapter we will present only one (Medvode-F) in detail.

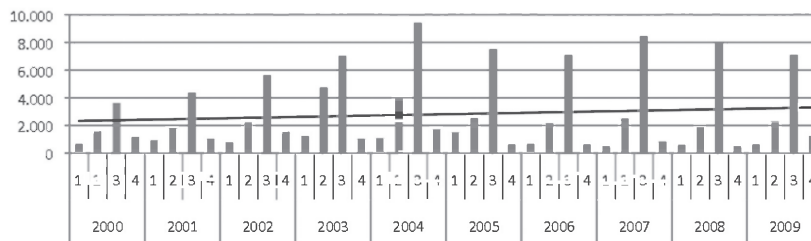
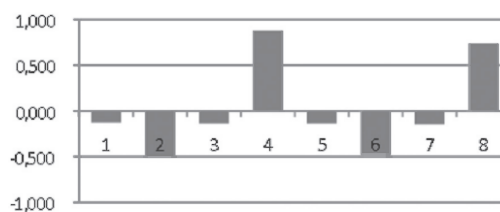
Figure 1: *Overnight stays of foreign guests (Medvode-F) with a trend line.*

Figure 1 represents the original data – the number of overnight stays of foreign guests in the community of Medvode between 2000 and 2009 – and the trend line that is slightly increasing.

Analysed time series exhibits clear seasonal effects. In the period 2000-2009, the demand reached its annual peak in the third quarter (in months of July, August and September) when it was 145% higher than quarterly average (seasonal factor=245). All other quarters were below the quarterly average. The bottom was touched in the first quarter (in months January, February and March) with demand being 69% below the quarterly average (seasonal factor=31). In the fourth quarter demand was 64% below the quarterly average (seasonal factor=36) and in the second quarter the demand was 11% below the quarterly average (seasonal factor=89).

Seasonal effects are also confirmed (see Figure 2) by a positive significant autocorrelation coefficient reaching maximum (0.878) at the lag of 4 quarters and by a negative significant autocorrelation coefficient reaching minimum (-0.505) at the lag of 2 quarters.

Figure 2: *Graph of autocorrelation coefficients.*

From Table 1 we can observe that analysed data represents a time series with relatively high variations in data. Coefficient of variation for original data equals 0.94, for seasonal adjusted series 0.35 and for trend-cycle it is still more than 0.26, which means that the time series includes large noise.

Table 1: Descriptive Statistics for Overnight stays of foreign guests (Medvode-F).

Time Series	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Coefficient of variation
Overnight stays (Medvode-F)	40	447.00	9,416.00	2,811.28	2,642.60	6,983,312.46	0.94
Seasonal adjusted series	40	1,245.24	5,323.49	2,817.80	981.97	964,273.56	0.35
Trend-cycle	40	1,603.95	4,348.79	2,807.34	732.39	536,398.74	0.26

As a result of such characteristics of the dataset the additive, multiplicative and the improved HW method for forecasting demand were used in our further analysis.

### 3. THE HOLT-WINTERS AND IMPROVED METHOD

The HW method of exponential smoothing involves trend and seasonality and is based on three smoothing equations: for level, for trend and for seasonality. The decision regarding which method to use depends on time series characteristics: the additive method is used when the seasonal component is constant, the multiplicative method is used when the size of the seasonal component is proportional to trend level (Chatfield, 1978).

#### Multiplicative HW method (MHW)

Fundamental equations for level, trend, seasonal factors and forecast are (Makridakis, Wheelwright & Hyndman, 1998):

$$(1) \quad L_t = \alpha \frac{Y_t}{S_{t-s}} + (1-\alpha)(L_{t-1} + b_{t-1})$$

$$(2) \quad b_t = \beta(L_t - L_{t-1}) + (1-\beta)b_{t-1}$$

$$(3) \quad S_t = \gamma \frac{Y_t}{L_t} + (1-\gamma)S_{t-s}$$

$$(4) \quad F_{t+m} = (L_t + b_t m) S_{t-s+m}$$

where  $\alpha$ ,  $\beta$ ,  $\gamma$  are smoothing parameters (which must lie in the interval  $[0,1]$ ),  $m$  is the number of forecast ahead,  $s$  is the length of seasonality (e.g., number of months or quarters in a year) and  $Y_t$  is the observed data at time point  $t$ .

Empirical study shows that the method used to designate the initial vector has very little effect on the accuracy of the predictions obtained (Bermúdez, Segura & Vercher, 2006). To initialize the level, we set  $L_s = (Y_1 + Y_2 + \dots + Y_s) / s$  (in our case  $s = 12$  (months)); to initialize the trend, we use  $b_s = (Y_s + 1 - Y_1) / s$ ; and for initial seasonal indices we calculate  $S_p = Y_p / L_s$ ,  $p = 1, 2, \dots, s$ .

**Additive HW method (AHW)**

Fundamental equations for level, trend, seasonal factors and forecast are:

$$(5) \quad L_t = \alpha(Y_t - S_{t-s}) + (1 - \alpha)(L_{t-1} + b_{t-1})$$

$$(6) \quad b_t = \beta(L_t - L_{t-1}) + (1 - \beta)b_{t-1}$$

$$(7) \quad S_t = \gamma(Y_t - L_t) + (1 - \gamma)S_{t-s}$$

$$(8) \quad F_{t+m} = L_t + b_t m + S_{t-s+m}$$

Equation (6) is identical to equation (2). The only differences in the other equations are that the seasonal indices are now added and subtracted instead of taking products and ratios. The initial values for level and trend are identical to those for the multiplicative method. To initialize the seasonal indices we use  $S_p = Y_p - L_p$ ,  $p = 1, 2, \dots, s$ .

**Improved HW method (IHW)**

The only difference between the AHW method and the improved additive HW method is in the equation (5) for level, which changes to equation (9), while the equations (6), (7) and (8) - for trend, seasonal factors and forecast - remain unchanged:

$$(9) \quad L_t = \alpha Y_t - S_{t-s} + (1 - \alpha)(L_{t-1} + b_{t-1})$$

For the improved HW method, in contrast to the AHW method, the smoothing parameter  $\alpha$  occurs only at observed data  $Y_t$  and not at seasonal factor  $S_{t-s}$ . This is done to de-seasonalise (eliminate seasonal fluctuations from) the smoothing value of  $Y_t$ . When  $\alpha Y_t > S_{t-s}$  (the smoothed value in period  $t$  is greater than the average in its seasonality in period  $t-s$ ) the level increases in comparison with the level in the earlier period; the opposite adjustment occurs when  $\alpha Y_t < S_{t-s}$ .

The initial values for level, trend and seasonal indices are identical to those for the AHW method.

**4. FORECAST CALCULATIONS AND RESULTS**

We calculate forecasts by using AHW, MHW and the improved HW method and compare results with each other. Regarding the Ferbar Tratar (2010) study we also calculate forecasts for all three methods with additional optimization – smoothing and initial parameters are estimated by minimising the MSE (we use the notation  $init$ ).

In the tables (2-7) we use the following notations:  $s = 4$ ,  $E^2 = (F_t - Y_t)^2$ ,  $MSE = \frac{1}{36} \sum_{t=5}^{40} E^2$ .

We use the first year (first four quarters) for initialization, the following nine years (periods from 5 to 40) represent test series, which is used for minimization of the MSE.

Tables 2 and 3 show calculations of forecasts for overnight stays of foreign guests in Medvode. In Table 2 forecasts are calculated using AHW method, where we estimated (only) smoothing parameters by minimising the MSE. In Table 3 forecasts are calculated using the AHW-init method, where smoothing and initial parameters are estimated by minimising the MSE.

Table 2: *Forecasts calculated with AHW method (Medvode-F).*

Year	T	$Y_t$	$L_t$	$b_t$	$S_t$	$F_t$	$E^2$
2000	1	656			-1,101.50		
	2	1,569			-188.50		
	3	3,628			1,870.50		
	4	1,177	1,757.50	66.25	-580.50		
2001	5	908	1,849.00	66.25	-958.18	722.25	34,503.06
	6	1,795	1,924.53	66.25	-135.84	1,726.75	4,657.76
	7	4,367	2,059.53	66.25	2,260.70	3,861.28	255,752.36
	8	1,020	2,054.37	66.25	-985.79	1,545.28	275,920.83
...	...	...	...	...	...	...	...
2009	37	616	3,481.17	66.25	-2,860.99	661.20	2,043.41
	38	2,297	3,572.38	66.25	-1,292.36	2,113.40	33,708.75
	39	7,093	3,482.52	66.25	3,716.68	8,241.37	1,318,742.51
	40	1,248	3,634.73	66.25	-2,933.07	615.70	399,806.21
					<b>alpha =</b>	<b>0.136</b>	
					<b>beta =</b>	<b>0.000</b>	
					<b>gamma =</b>	<b>0.893</b>	
					<b>MSE (5-40)=</b>	<b>818,375.50</b>	

Table 3: *Forecasts calculated with AHW-init method (Medvode-F).*

Year	T	$Y_t$	$L_t$	$b_t$	$S_t$	$F_t$	$E^2$
2000	1	656			-1,187.07		
	2	1,569			25.56		
	3	3,628			2,664.43		
	4	1,177	1,942.07	24.41	-1,318.35		
2001	5	908	1,986.14	24.41	-1,106.78	779.41	16,535.31
	6	1,795	1,973.68	24.41	-124.97	2,036.10	58,130.20
	7	4,367	1,952.91	24.41	2,479.93	4,662.52	87,332.14
	8	1,020	2,032.51	24.41	-1,092.94	658.96	130,346.79
...	...	...	...	...	...	...	...
2009	37	616	2,755.84	24.41	-2,150.62	567.61	2,341.88
	38	2,297	2,811.26	24.41	-559.45	2,094.15	41,149.72
	39	7,093	2,682.52	24.41	4,633.65	8,094.74	1,003,487.05
	40	1,248	2,820.77	24.41	-2,203.56	503.36	554,481.96
					<b>alpha =</b>	<b>0.153</b>	
					<b>beta =</b>	<b>0.000</b>	
					<b>gamma =</b>	<b>0.737</b>	
					<b>MSE (5-40)=</b>	<b>770,745.12</b>	

As is evident from the results (Tables 2 and 3), better results are gained with the AHW-init method in comparison to the AHW method: the MSE for AHW-init method equals 770,745.12; for the AHW method 818,375.50. This means that the MSE is reduced by almost 6% (see also Table 8).

In Table 4 and 5 we present the forecasts, calculated with the MHW method and MHW-init method respectively.

Table 4: Forecasts calculated with MHW-method (Medvode-F).

Year	t	$Y_t$	$L_t$	$b_t$	$S_t$	$F_t$	$E^2$
2000	1	656			0.37		
	2	1,569			0.89		
	3	3,628			2.06		
	4	1,177	1,757.50	66.25	0.67		
2001	5	908	1,989.28	80.30	0.39	680.73	51,652.42
	6	1,795	2,053.56	78.94	0.89	1,847.60	2,766.97
	7	4,367	2,127.87	78.55	2.06	4,402.10	1,231.90
	8	1,020	2,020.65	62.78	0.63	1,477.64	209,435.19
...	...	...	...	...	...	...	...
2009	37	616	1,970.04	-40.78	0.32	941.33	105,839.51
	38	2,297	2,042.17	-31.20	1.02	2,911.95	378,168.13
	39	7,093	2,158.83	-18.65	2.90	8,251.83	1,342,886.10
	40	1,248	2,533.41	14.73	0.38	1,034.21	45,708.23
						<b>alpha =</b>	<b>0.272</b>
						<b>beta =</b>	<b>0.085</b>
						<b>gamma =</b>	<b>0.251</b>
						<b>MSE (5-40) =</b>	<b>741,763.48</b>

Table 5: Forecasts calculated with MHW-init method (Medvode-F).

Year	T	$Y_t$	$L_t$	$b_t$	$S_t$	$F_t$	$E^2$
2000	1	656			0.41		
	2	1,569			0.89		
	3	3,628			2.32		
	4	1,177	1,880.78	-7.32	0.34		
2001	5	908	1,948.98	-7.32	0.41	768.12	19,566.57
	6	1,795	1,958.23	-7.32	0.89	1,728.36	4,441.29
	7	4,367	1,935.69	-7.32	2.32	4,526.64	25,484.75
	8	1,020	2,157.58	-7.32	0.34	663.63	126,998.80
...	...	...	...	...	...	...	...
2009	37	616	2,084.40	-7.32	0.41	1,246.87	397,991.74
	38	2,297	2,188.51	-7.32	0.89	2,707.05	168,139.04
	39	7,093	2,375.04	-7.32	2.32	7,056.24	1,351.49
	40	1,248	2,646.32	-7.32	0.34	1,046.58	40,570.42
						<b>alpha =</b>	<b>0.221</b>
						<b>beta =</b>	<b>0.000</b>
						<b>gamma =</b>	<b>0.000</b>
						<b>MSE (5-40) =</b>	<b>547,269.28</b>

From Table 4 and 5 we can observe that better results are gained by using the MHW-init method compared to the MHW method: the MSE for MHW-init method equals 547,269.28; for MHW method 741,763.48. This means that the MSE is reduced by more than 26% (see also Table 8).

In Table 6 and 7 we present the forecasts, calculated with the improved HW method (IHW) and with IHW-init method respectively.

Table 6: Forecasts calculated with IHW method (Medvode-F).

Year	t	$Y_t$	$L_t$	$b_t$	$S_t$	$F_t$	$E^2$
2000	1	656			-1,101.50		
	2	1,569			-188.50		
	3	3,628			1,870.50		
	4	1,177	1,757.50	66.25	-580.50		
2001	5	908	2,663.22	66.25	-1,227.35	722.25	34,503.06
	6	1,795	2,650.59	66.25	-316.92	2,540.97	556,477.80
	7	4,367	1,318.50	66.25	2,097.27	4,587.34	48,550.22
	8	1,020	1,860.89	66.25	-630.63	804.25	46,545.99
...	...	...	...	...	...	...	...
2009	37	616	4,938.68	66.25	-3,209.82	-167.19	613,393.95
	38	2,297	5,758.00	66.25	-1,900.03	1,249.42	1,097,421.23
	39	7,093	991.56	66.25	5,370.08	7,973.04	774,469.50
	40	1,248	2,683.90	66.25	-1,545.54	1,205.65	1,793.88
<b>alpha =</b>							<b>0.286</b>
<b>beta =</b>							<b>0.000</b>
<b>gamma =</b>							<b>0.193</b>
<b>MSE (5-40)=</b>							<b>621,079.87</b>

Table 7: Forecasts calculated with IHW-init method (Medvode-F).

Year	T	$Y_t$	$L_t$	$b_t$	$S_t$	$F_t$	$E^2$
2000	1	656			-1,145.02		
	2	1,569			-214.40		
	3	3,628			2,590.31		
	4	1,177	1,684.60	89.10	-939.83		
2001	5	908	2,492.87	89.10	-1,235.64	628.68	78,021.67
	6	1,795	2,409.25	89.10	-296.78	2,367.57	327,831.12
	7	4,367	827.25	89.10	2,785.93	5,088.66	520,793.34
	8	1,020	1,907.17	89.10	-928.98	-23.47	1,088,836.52
...	...	...	...	...	...	...	...
2009	37	616	3,964.71	89.10	-2,708.77	131.33	234,908.30
	38	2,297	4,059.52	89.10	-1,053.82	1,804.12	242,933.87
	39	7,093	-29.80	89.10	5,935.04	8,300.85	1,458,893.37
	40	1,248	2,197.27	89.10	-1,428.79	1,120.81	16,177.24
<b>alpha =</b>							<b>0.492</b>
<b>beta =</b>							<b>0.000</b>
<b>gamma =</b>							<b>0.206</b>
<b>MSE (5-40)=</b>							<b>535,270.19</b>

From Table 6 and 7 we can observe that better results are gained with the IHW-init method compared to the IHW method: the MSE for the IHW-init method equals 535,270.19; for the IHW method 621,079.87. This means that the MSE is reduced by almost 14% (see also Table 8).

If we compare the improved HW method with the AHW (MHW) method, MSE is reduced by more than 24% (16%). So, if we use the improved HW method with initial optimization (IHW-init) instead of the AHW (MHW) method, the MSE can be reduced by more than 34% (27%) (see also Table 8).

Table 8: Review of results for different communities (none zero time series).

Community	MSE	Improvement (in %)			
		IHW/ A(M)HW	A(M,I) HW-init/ A(M,I)HW	IHW-init/ A(M)HW -init	IHW-init/ A(M)HW
Brda-AHW	35,676.22	-15.77%			36.28%
Brda-AHW-init	25,676.77		28.03%	11.46%	
Brda-MHW	50,925.71	16.83%			55.36%
Brda-MHW-init	22,782.78		55.26%	0.22%	
Brda-IHW	42,355.00				
Brda-IHW-init	22,733.75		46.33%		
Dobrna-AHW	6,116,327.74	8.64%			49.09%
Dobrna-AHW-init	3,955,478.85		35.33%	21.28%	
Dobrna-MHW	4,497,040.04	-19.52%			30.76%
Dobrna-MHW-init	3,146,752.41		30.03%	1.05%	
Dobrna-IHW	5,587,653.21				
Dobrna-IHW-init	3,113,754.61		44.27%		
Hrpelje-Kozina-AHW	575,116.75	8.22%			30.56%
Hrpelje-Kozina-AHW-init	420,002.10		26.97%	4.91%	
Hrpelje-Kozina-MHW	530,708.52	0.54%			24.75%
Hrpelje-Kozina-MHW-init	404,106.56		23.86%	1.17%	
Hrpelje-Kozina-IHW	527,836.82				
Hrpelje-Kozina-IHW-init	399,371.55		24.34%		
Komen-AHW	6,197.67	14.93%			35.65%
Komen-AHW-init	4,037.17		34.86%	1.21%	
Komen-MHW	8,573.13	38.50%			53.48%
Komen-MHW-init	4,286.47		50.00%	6.95%	
Komen-IHW	5,272.29				
Komen-IHW-init	3,988.42		24.35%		
Kranj-AHW	306,279.15	-15.82%			38.65%
Kranj-AHW-init	198,239.33		35.27%	5.21%	
Kranj-MHW	278,940.20	-23.34%			32.64%
Kranj-MHW-init	195,502.81		29.91%	3.89%	
Kranj-IHW	363,852.42				
Kranj-IHW-init	187,903.88		48.36%		



Community	MSE	Improvement (in %)			
		IHW/ A(M)HW	A(M,I) HW-init/ A(M,I)HW	IHW-init/ A(M)HW -init	IHW-init/ A(M)HW
Litija-TUJ-AHW	8,697.44	5.17%			38.28%
Litija-TUJ-AHW-init	5,658.42		34.94%	5.14%	
Litija-TUJ-MHW	8,385.01	1.64%			35.98%
Litija-TUJ-MHW-init	5,815.28		30.65%	7.70%	
Litija-TUJ-IHW	8,247.62				
Litija-TUJ-IHW-init	5,367.79		34.92%		
Ljutomer-TUJ-AHW	192,437.24	5.40%			43.68%
Ljutomer-TUJ-AHW-init	165,449.84		14.02%	34.49%	
Ljutomer-TUJ-MHW	195,915.75	7.08%			44.68%
Ljutomer-TUJ-MHW-init	129,297.45		34.00%	16.18%	
Ljutomer-TUJ-IHW	182,037.82				
Ljutomer-TUJ-IHW-init	108,380.96		40.46%		
Lukovica-TUJ-AHW	68,916.47	-27.11%			21.55%
Lukovica-TUJ-AHW-init	56,963.49		17.34%	5.09%	
Lukovica-TUJ-MHW	74,524.53	-21.17%			27.45%
Lukovica-TUJ-MHW-init	57,141.52		23.33%	5.38%	
Lukovica-TUJ-IHW	94,544.19				
Lukovica-TUJ-IHW-init	54,064.82		42.82%		
Maribor-AHW	1,262,288.67	7.55%			30.25%
Maribor-AHW-init	937,201.44		25.75%	6.05%	
Maribor-MHW	1,246,297.47	6.36%			29.35%
Maribor-MHW-init	1,075,392.58		13.71%	18.13%	
Maribor-IHW	1,166,998.83				
Maribor-IHW-init	880,456.62		24.55%		
Medvode-TUJ-AHW	818,375.50	24.11%			34.59%
Medvode-TUJ-AHW-init	770,745.12		5.82%	30.55%	
Medvode-TUJ-MHW	741,763.48	16.27%			27.84%
Medvode-TUJ-MHW-init	547,269.28		26.22%	2.19%	
Medvode-TUJ-IHW	621,079.87				
Medvode-TUJ-IHW-init	535,270.19		13.82%		
	<b>Average</b>	<b>1.53%</b>	<b>25.83%</b>	<b>12.54%</b>	<b>35.86%</b>
		<b>2.32%</b>	<b>31.70%</b>	<b>6.29%</b>	<b>36.23%</b>
			<b>34.42%</b>		

From Table 8 we observe the following:

- AHW-init can reduce MSE on average by almost 26% in comparison with AHW
- MHW-init can reduce MSE on average by more than 31% in comparison with MHW
- IHW-init can reduce MSE on average by more than 34% in comparison with IHW
- IHW-init can reduce MSE on average by more than 12% in comparison with AHW-init

- IHW-init can reduce MSE on average by more than 6% in comparison with MHW-init
- IHW-init can reduce MSE on average by 35.86% in comparison with AHW and
- IHW-init can reduce MSE on average by 36.23% in comparison with MHW

In some cases (Brda, Dobrna, Kranj, Lukovica) we can see that the IHW method yields worse results than the AHW and/or the MHW method but when we use the IHW-init method on these time series the results are better than results obtained with the AHW and the MHW method. Even more, if we use the IHW-init method the results are better than results obtained with the AHW-init and the MHW-init method. So, we can conclude: if we use the IHW-init method instead of AHW or MHW method, the MSE is reduced for all cases.

Our goal was to find an improved method that will provide as good results as the multiplicative method and at the same time can be used for time series containing zero values. We showed in cases that the improved HW method does not only achieve multiplicative methods results but in the sense of measuring forecasting errors (MSE) can provide even better results: the IHW-init provides better results than the MHW (MHW-init) on average by more than 36% (6%).

In Table 9 we present results of forecasting for 6 intermittent time series. The table shows the percentage of improvement of the MSE, calculated by using the improved HW (init) method compared to the AHW (init) method (forecasting with the MHW method is not possible, because these time series contain zero values). It is obvious that if we treat the initial values for the level, trend and seasonal components as well as three smoothing constants as decision variables with the improved HW method a considerable reduction in MSE can be achieved.

Table 9: Review of results for different communities (intermittent time series).

Community	MSE	Improvement (%)				
		IHW/ AHW	AHW-init/ AHW	IHW-init/ IHW	IHW-init/ AHW-init	IHW-init/ AHW
Komenda-D-AHW	5,699.55					
Komenda-D-AHW-init	3,605.81		36.74%			
Komenda-D-IHW	6,255.00	-8.88%				
Komenda-D-IHW-init	3,455.36			44.76%	4.17%	39.37%
Komenda-F-AHW	42,076.54					
Komenda-F-AHW-init	41,395.41		1.62%			
Komenda-F-IHW	42,138.34	-0.15%				
Komenda-F-IHW-init	40,730.58			3.34%	1.61%	3.20%
Logatec-F-AHW	1,020,874.68					
Logatec-F-AHW-init	987,429.14		3.28%			
Logatec-F-IHW	943,746.05	7.56%				
Logatec-F-IHW-init	823,322.34			12.76%	16.62%	19.35%
Lovrenc na Pohorju-D-AHW	106.30					
Lovrenc na Pohorju-D-AHW-init	64.99		38.86%			
Lovrenc na Pohorju-D-IHW	109.93	-3.30%				

Community	MSE	Improvement (%)				
		IHW/ AHW	AHW-init/ AHW	IHW-init/ IHW	IHW-init/ AHW-init	IHW-init/ AHW
Lovrenc na Pohorju-D-IHW-init	57.37			47.82%	11.73%	46.04%
Miren-Kostanjevica-D-AHW	11,731.89					
Miren-Kostanjevica-D-AHW-init	10,200.77		13.05%			
Miren-Kostanjevica-D-IHW	11,158.74	4.89%				
Miren-Kostanjevica-D-IHW-init	9,335.60			16.34%	8.48%	20.43%
Miren-Kostanjevica-F-AHW	14,913.19					
Miren-Kostanjevica-F-AHW-init	10,952.78		26.56%			
Miren-Kostanjevica-F-IHW	13,645.80	8.50%				
Miren-Kostanjevica-F-IHW-init	10,605.29			22.28%	3.17%	28.89%
		<b>Average</b>	<b>20.02%</b>	<b>24.55%</b>	<b>7.63%</b>	<b>26.21%</b>

From Table 9 (results for the intermittent demand) we observe the following:

- AHW-init can reduce MSE on average by 20% in comparison with AHW
- IHW-init can reduce MSE on average by more than 24% in comparison with IHW
- IHW-init can reduce MSE on average by 7.63% in comparison with AHW-init
- IHW-init can reduce MSE on average by more than 26% in comparison with AHW

## 5. CONCLUSION AND FURTHER RESEARCH

Demand forecasting is used throughout the world more often because of proper source management and a rising need to plan. Which method is going to be used depends on multiple factors: demanded comprehension of forecasts, further use of forecasts, and available data and price. One of the most commonly used forecasting techniques is exponential smoothing, which is relatively inexpensive, fast and simple and does not require special software. There has been a lot of attention given to the Holt-Winters forecasting procedure in recent years. Researchers have discovered new ways to improve the method itself, especially in dealing with more seasonal cycles and forecasting intervals.

The aim of this paper was to find an improved forecasting method that will provide as good results as the multiplicative method and at the same time may be used for time series containing zero values. We proposed an improved HW method and we showed that a reduction in the forecast error (MSE) can be achieved. We dealt with 10 non zero time series and 6 intermittent time series for chosen Slovenian communities. We calculated forecasts by using AHW, MHW and the improved HW method and compare results with each other. We also calculate forecasts for all three methods with additional optimization – smoothing and initial parameters were estimated by minimising the MSE. We showed in cases that the improved HW method does not only achieve MHW method results but in the sense of measuring MSE can provide even better results. From the results obtained from the real data we proved that the proposed IHW-init method is more efficient than the AHW (MHW) method, on average by more than 35% (36%) for nonzero time series and more than 26% for time series containing zero values.

As is obvious from the given cases, the improved HW method yields good results for data with large fluctuations, therefore it would make sense to examine new methods for time series with multiplicative seasonal fluctuations and/or multiplicative trend. Further research includes a detailed study of the improved HW method for demand patterns with multiplicative trend and seasonality.

## REFERENCES

- Bermudez, J.D., Segura, J.V. & Vercher, E. (2006). A decision support system methodology for forecasting of time series based on soft computing. *Computational Statistics & Data Analysis*, 51, 177 – 191.
- Chatfield, C. (1978). The Holt-Winters Forecasting Procedure. *Journal of the Royal Statistical Society*, 27 (3), 264–279.
- Ferbar Tratar, L. (2010). Joint optimisation of demand forecasting and stock control parameters. *International Journal of Production Economics*, 127 (1), 173–179.
- Holt, C. C. (2004). Author's retrospective on 'Forecasting seasonals and trends by exponentially weighted moving averages'. *Foresight: International Journal of Forecasting*, 20 (1), 11–13.
- Koehler, A.B., Snyder, R.D. & Ord, J.K. (2001). Forecasting models and prediction intervals for the multiplicative H–W method. *Int. J. Forecasting*, 17, 269–286.
- Makridakis, S., Wheelwright, S.C. & Hyndman, R.J. (1998). *Forecasting: methods and applications*. United States of America: John Wiley & Sons, Inc.
- Ord, J.K., Koehler, A.B. & Snyder, R.D. (1997). Estimation and prediction for a class of dynamic nonlinear statistical models. *J. Am. Statist. Assoc.*, 92, 1621–1629.



# OVERCOMING SMES CHALLENGES THROUGH CRITICAL SUCCESS FACTORS: A CASE OF SMES IN THE WESTERN CAPE PROVINCE, SOUTH AFRICA

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**ABSTRACT:** *SMEs comprise over 90% of African business operations and contribute to over 50% of African employment and Growth Domestic Product (GDP). SMEs sector has shown positive signs in South Africa, Mauritius and North Africa. In South Africa, SMEs constitute 55% of all jobs. Research of Bowler, Dawood and Page (2007) reveal that 40% of new business ventures fail in their first year, 60% in their second year, and 90% in their first 10 years of existence. It seems that a number of challenges have been identified as contributing to the failure of SMEs in South Africa and worldwide. The purpose of this paper is to identify some of the critical success factors for the SMEs to improve their performance in order to overcome the challenges they are faced within the competitive market environment. The research problem of this study emanates from the current high business failure rate. The research investigates what are the critical success factors that can help these SMEs to be sustainable and have positive growth so to limit the high business failure rate in South Africa. The research established that attracting repeat customers and the performance of the product are the critical success factors that can lead to the sustenance of these SMEs. The study concluded that the resource-constraint SMEs need to focus on critical success factors to build competitive advantage to stay competitive amidst the challenges from globalisation and liberalisation. This study will make further contribution on understanding these critical success factors as they are central to business success, especially in South Africa where it is estimated that the failure rate of small, medium and micro enterprises (SMEs) is between 70% and 80% (Brink and Cant, 2009).*

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**Keywords:** *SME, Critical Success Factors, South Africa*

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## 1. INTRODUCTION

Small and Medium Enterprises (SMEs) play a vital role in economic development as they have been the main source of employment generation and output growth, both

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in developing as well as in developed countries (Love and Roper, 2013). In developing countries, the roles of SMEs become more crucial as they have potential to improve income distribution, create new employment, reduce poverty and facilitate export growth. SME foster development of entrepreneurship, industry and the rural economy (Love and Roper, 2013). It is not only the fact that high rates of economic growth contribute to economic and social development and poverty reduction. Studies show that economic growth of any country is closely linked with SME development. For example, as noted by Mahmood (2008) there is a robust, positive relationship between the relative size of the SME sector and economic growth. Also as noted by Bouri et al (2011), the contribution of SMEs to the economy is high, contributing to almost 50 percent of Growth Domestic Product (GDP) on average. It is also important to note that majority of employment generation is through the growth of SME sector only (Ardic, Mylenko & Saltane, 2011). Though it is observed that the role of SMEs is increasing significantly in respective national economies, SMEs are generally underrepresented in world trade (OECD, 2007) and measures are required to be taken to make its share significant.

South Africa is facing an unemployment crisis; at least 25 percent of the population is jobless, with the number increasing to nearly 40 percent if one includes those that have given up the active search for work (Morgan, 2012). According to the Finscope 2010 study, the SME sector has an estimated 5.6 million small businesses operating in South Africa, creating 11.6 million total employment opportunities which equates to six million jobs excluding the small business owners themselves. Micro and small businesses in South Africa are not achieving the growth required for increased job creation, due to a number of challenges. To fully realise the potential of SMEs, the sector needs to be approached with a fresh perspective attuned to the challenges it faces. There is a need for the focus to shift from the available collateral in the business to the viability of the business and the ability of the entrepreneur. Each business needs finance tailored to their unique challenges. In addition to this, the business owner needs access to the expertise and market knowledge required to make their business a success.

## 2. AIMS AND OBJECTIVES OF THE STUDY

The purpose of this paper is to identify critical success factors for the SMEs to improve their performance in order to overcome the challenges they are faced with within the competitive market environment. Therefore, this paper develops a framework for explaining the challenges and success factors of SMEs in South Africa. The sample of the study was drawn from the SMEs who participated in the Swedish Trade Council (STC) and Small Enterprise Development Agency (SEDA) program of advanced small business development and management in the Western Cape Province, South Africa in 2012. The research questions aimed to identify factors that were considered critical for success by the selected SME owners/managers in the Western Cape Province of South Africa, namely:

- What factors are considered critical for SMEs success by those that attended the program?

- What are the challenges that these SMEs owners are faced with?
- What are the possible solutions to these challenges?

The overall value of this research is to further contribute to the existing literature around the understanding of drivers of SMEs growth.

A limitation of this study is the small sample size due to the criterion that was used to select the participants. It is important to note here that SMEs participation in the SME development and management program was based on the available budget which was able to cover only 16 SME owners/managers and the criterion that was set by the main sponsors of the program which are SEDA and STC. The criterion were that the SME must be registered on SEDA database, SME should have participated in the Export development orientation program and exported a product or service in the last five years. The SME's that were left out of the program were those who did not have a product that have a potential to be exported or exported a product or service in the past five years and those that have not participated in the export development orientation program even though they were registered on the SEDA database.

### 3. SMALL AND MICRO ENTERPRISES IN SOUTH AFRICA

An SME is described by the National Small Business Act of South Africa of 1996, as amended in 2003, as a separate distinct entity including cooperative enterprises and non-governmental organisations managed by one owner or more, including branches or subsidiaries if any is predominately carried out in any sector or subsector of the economy mentioned in the schedule of size standards and can be classified as SME by satisfying the criteria mentioned in the schedule of size standards (Government Gazette of the Republic of South Africa, 2008). The Department of Trade and Industry (DTI) (2012) of South Africa suggests that there are more than 800 000 SMEs and have estimated the total economic output of SMEs in South Africa to be 50% of GDP and it is also estimated that they provide employment to about 60% of the labour force. SMEs are therefore an important contributor to the economy and are considered a driver for reducing unemployment, given that the formal sector continues to shed jobs. South Africa is facing an unemployment crisis; at least 25% of the population is jobless, with the number increasing to nearly 40 percent if one includes those that have given up the search for work. At the same time, the level of entrepreneurial activity is low in South Africa when compared to other emerging markets. According to the Global Entrepreneurship Report (2006), the level of early-stage entrepreneurial activity is directly related to per capita income. In 2010, South Africa ranked 35<sup>th</sup> out of 54 profiled countries, ranging in income levels and regions, in terms of total entrepreneurial activity and was below the average for all participating countries. The report shows that the level of early-stage entrepreneurial activity is strongly related to per capita income. It was well behind countries such as Ghana, Zambia, Brazil and Chile in its ability to foster successful new businesses (Herrington, Kew, & Kew, 2010).

According to Finscope study (2010) the SME sector has an estimated 5.6 million small businesses operating in South Africa, creating 11.6 million total employment opportunities



– that is six million jobs excluding the small business owners themselves. However, the sector is heavily skewed towards micro-enterprises, with 82% of South African enterprises being micro or very small (as defined by the National Small Business Act). These businesses are often survivalist or lifestyle businesses. Two in three business owners operate their own businesses and do not have any employees. Only 300,000 of the country's businesses employ five or more employees. While medium-sized firms may not produce the bulk of output or production, they generally hire most people in an economy (National Planning Commission, 2011). Micro and small businesses in South Africa are not achieving the growth required for increased job creation, due to a number of challenges.

### **3.1. South Africa's policy and institutional framework for SMEs**

For the past fifteen years, the South African Government has invested in a plethora of initiatives aimed at supporting and growing the SME sector. South Africa's small business policy was principally informed by the 1995 "White Paper on National Strategy on the Development and Promotion of Small Business in South Africa (Timms, 2011). The 1995 White Paper outlined, among other things, the need for the Government to create an enabling legal framework, facilitate access to information and advice, boost procurement from small firms and to improve access to finance and affordable physical infrastructure. On the policy front, the NSB Act was passed in 1996, and stipulations pertaining to the sector were built into the Broad Based Black Economic Empowerment (BBBEE) Codes of Good Practice (SBP, 2009a). The objectives of the 1995 White Paper now finds practical expression in the Integrated Small Business Development Strategy for 2005 to 2014. The strategy is based on three pillars:

- Increasing the supply of financial and non-financial support;
- Creating demand for SMME products/services; and
- Reducing regulatory constraints.

### **3.2. SMEs are important for job creation in South Africa**

According to SBP Alert (2013) with good reason, SMEs are viewed as lynchpins of successful employment strategies. SMEs tend to be labour rather than capital intensive. In fact, in the South African context, the social impact of SME hiring is underappreciated. This is because small firms employ people whose labour market characteristics make them most likely to be unemployed and marginalised. The SME Growth index found a strong bias in SMEs' hiring patterns towards unskilled employees (SBP Alert, 2013). Unemployment is most severe among Africans, women and those with educational qualifications below a matric (in other words, the low-skilled). If employed, however, people from these groups are disproportionately likely to be employed in SMEs. In particular, those without matric qualifications are statistically far more likely – some 19 percentage points more likely – to be employed by SMEs than those holding higher qualifications (Wadhwa, Aggarwal, Holly and Salkever, 2009).

A final important feature concerns age. Chronic unemployment among the country's youth has come to the fore as one of the most serious problems facing South Africa; unaddressed, it could be a permanently destabilising factor. It is in this respect that SMEs might offer their most compelling attraction. SMEs are more likely to employ young (and older) work seekers than those in middle age. Relative to a 35 year old, a 20 year old is almost 4 percentage points more likely to be employed in a small firm (SBP Alert, 2013). There is, however, an important nuance. Whether or not firms are adding to employment seems to be related to the ratio of skilled to unskilled workers. Firms with a larger proportion of unskilled staff are less likely to be growing than those with smaller proportions. It seems that unskilled employment has an indirect link to the availability of skills, and by implication, the efficiencies and productivity gains that they bring. Seen from this perspective, the imperatives of competitiveness and employment are linked rather than incompatible. Unfortunately, this also means that there is a limited capacity for absorbing unskilled labour and that this is compounded by the shortage of skilled labour (Love and Roper, 2013).

Finally, SMEs are most likely to employ staff on a fixed term or temporary basis. According to SBP Alert (2013) data from Statistics South Africa shows a clear correlation between the size of firms and the use of such labour (as a proportion of overall employment in the various size categories). The smallest firms are most prone to using such labour, closely followed by SMEs of the Panel's size: 10 - 49 people. In each case, around one in five employees holds his or her position on a temporary or part time basis. This is substantially above the proportion employed in this way in larger firms (SBP Alert, 2013).

### **3.3. SMEs in the South African economy**

According to SBP Alert (2013) SMEs' potential to create jobs is accepted as axiomatic and unfortunately, this is not happening at present. Between 2011 and 2012, the Panel reported an aggregate 6% decline in permanent employment and this has a broader context. Over the past decade, a major change has taken place in the distribution of employment across the economy. Data from Statistics South Africa shows that firms employing fewer than 10 people provide the largest share of employment throughout this period – many of these being very small, in the informal sector, with little potential for growth. Perhaps more telling is the interplay between the group matching the SME Growth Index panel (in other words, those with 10-49 employees, those upon whom a special hope for growth and job creation rest) and their larger counterparts. They start off evenly proportioned, each at around 27% of the total (National Small Business Association, 2013). As the decade progresses, the 10-49 category accounts for an increasing share of the total, reaching a high of some 37% in 2007. At this point – more or less equivalent with the global economic crisis, the share of employment in these SMEs falls sharply, and it is superseded by that in the larger firms (Ayyagari, Demirguc-Kunt and Maksimovic, 2011).

#### 4. SMES SUCCESS FACTORS

Kuratko and Hodgetts (1995) believe that four factors help account for business success—firstly, the existence of a business opportunity. It is fair to believe that there is a target market in the marketplace who wants to buy the goods and services on offer. One of the main factors in the success of any small business is the existence of a real business opportunity. It is not enough that the business opportunity exist, but of more importance is the manner in which the opportunity is exploited or seized.

The second factor is the management ability. The ability of the owner/manager to allocate scarce resources effectively and efficiently is a question of management's abilities. Researchers such as Kuratko and Welsch (2004), Rwigema and Venter (2004), Megginson, Byrd and Megginson (2003) have all reported the lack of management ability as the most common reason for small business failure.

Another factor is adequate capital and credit. Kuratko and Hodgetts (1995) believe that the greater the amount of capital the owners invest in a business, the greater the chances of survival and vice versa. They go on to mention that banks are generally risk adverse when small business owners require loans. Ndwandwe (1998) reports that South African banks continue to display a crippling preoccupation with avoiding risk when dealing with loan applications from small businesses. Small businesses rely on their suppliers to provide them with credit for periods of up to 60 days. This arrangement ensures the survival of small businesses (Kuratko and Hodgetts, 1995). Under-capitalization is a problem synonymous to small businesses, in other words, lack of capital invested in a business on the part of the owner or owners. Those businesses which are under-capitalized and expanding too fast find themselves running into serious financial difficulties.

The final factor is the existence of modern business methods. According to Kuratko and Hodgetts (1995) firms must endeavour to use modern business methods, efficient equipment and procedures where available. Making use of modern business methods will ensure that small businesses remain competitive and efficient relative to its competitors.

#### 5. CHALLENGES FACING SMES SUCCESS IN SOUTH AFRICA

SMEs in South Africa face a number of challenges the most important of which have been reported by a number of organisations including Ntsika (2011) and the Department of Trade and Industry (2012) to be:

- a lack of management skills
- finance and obtaining credit
- access to markets and developing relationships with customers
- appropriate technology and low production capacity
- a quality product
- support for the role that they play in economic development

Other challenges faced by SMEs include access to finance, market access, skills and networks, and the enabling environment. Many businesses face financial constraints and cash flow uncertainty. Businesses often lack the collateral and financial records (e.g. audited financial statements) required for loans from commercial banks. Application processes tend to be bureaucratic. There are high transaction costs and a lack of awareness about the procedures involved in gaining financing. These challenges are evident in the fact that 75% of applications for credit by new businesses are rejected and only two percent of new SMEs are able to access loans (Finscope, 2010), whilst only 2% of businesses seeking private equity are successful. According to Fatoki and Garwe (2010), the lack of capital seems to be the primary reason for business failure and is considered to be the greatest problem facing agri-business, small and micro business owners. This was supported by Shafeek (2009) where he says: from a business viewpoint without adequate financing, the business will be unable to maintain and acquire facilities, attract and retain capable staff, produce and market a product, or do any of the other things necessary to run a successful operation. Stokes and Wilson (2006) also add on to say that financial difficulties of SMEs arise, either because of an inability to raise sufficient funds to properly capitalise the business, or a mismanagement of the funds that do exist or a combination of both. He further explains that, access to external funds may be difficult to achieve for new or young SMEs with no track record, especially for owners without personal assets to offer as security. Stokes and Wilson (2006) go on to stress that many new owner managers, having received funds, misuse them; small businesses are notorious for their lack of proper financial controls and information. While it is true that capital is essential and plays a key role in the ability of a business to progress, it is not the only necessary ingredient for success. There are non-financial barriers for SMMEs in South Africa which hinder growth.

The enabling environment is a key barrier to growth. Crime and theft ranked as the third highest obstacle to growth for business owners in the Finscope survey (2010). Other factors classified under “*red tape*” include labour regulations that are inflexible, imposing a high minimum wage for staff and often result in difficulties with unions and strikes. Poor infrastructure is often a constraint, with issues such as high energy costs and lack of consistent electricity supply, high cost and/or limited availability of transport.

Also, businesses often lack the necessary knowledge and networks required to be successful in a particular market or industry. They are unsure of what product or service should be sold in the market, and do not know how to attract and retain a sufficient customer base.

## 6. IMPORTANCE OF SMES TO THE ECONOMY

Small enterprises comprise between five and 100 formally employed persons. Employees are employed on a full-time basis. According to the Department of Trade and Industry, a small business is owner managed, registered with local authorities and business activities are conducted from fixed premises (Republic of South Africa, 2005). Medium enterprises constitute between 100 and 200 formal employees (Cronje et al., 2004: 5). Such businesses have vast potential of growing into large businesses, should capital injections be obtained.

Often they are characterised by a decentralisation of power to a new management layer (Falkena, 2000) between the SME operator and employees.

SMEs are considered the “lifeblood of modern economies” (Rao, Metts & Monge, 2003: 13), creating far more jobs than those created by large businesses and contributing 37% to employment in South Africa (Soontiens, 2002: 712; Barry & Milner, 2002: 316). SMEs provide a variety of goods and services for customers to choose from, some of which might otherwise not be provided by large businesses (Jackson, 2004: 6). SMEs act as catalysts for economic growth as well as for the development of the arts, human resources, manufacturing and sport sectors (Cronje et al., 2004: 6). Studies conducted by Moodley (2002: 37) from a development perspective reported that SMEs are important because of their potential for job creation and distribution of wealth which results in a multiplier effect on the socio-economic activities of a country which in turn creates developmental activities of a country.

SMEs are flexible and can also act as subcontractors to most large enterprises in the economy, ultimately leading to equitable distribution of income (Lloyd 2002). The Department of Trade and Industry report (2009) indicates that SMEs provide personalised services and also make a positive contribution to wealth creation in the South African economy. They are breeding incubators for entrepreneurial talent and a testing ground for new products (Chaston, 2000). They are agents of change, widely facilitating innovation and competition within various national economies (Barry & Milner, 2002).

The importance of small businesses is recognised in numerous African countries such as Togo, Uganda, Ghana, Cote d’Ivoire, Nigeria, Kenya, Malawi, Burkina Faso, as well as others (Brinders, Memela, and Mlosy, 2003). According to Rwigema and Karungu (1999), SMEs are dominant in numbers in most economies. In First World countries like the United States of America and the United Kingdom, SMEs play an important role in the economy, accounting for an estimated one third of industrial employment and a lower percentage of output. In Third World countries where SMEs dominate economically active enterprises, the SMEs’ prosperity is considered far more important than in First World countries (Rwigema and Karungu, 1999). The activities of SME enterprises in Africa (Rogerson, 2001a), is of vital importance for the promotion of economic growth, job creation and the mitigation of poverty. However, research conducted on SMEs in Africa by Mead and Liedholm (1998) confirmed that on average, there are more SMEs closures than expansions. It has long been debated that SMEs are pivotal to employment creation and economic growth, particularly in countries such as South Africa that has a high unemployment rate, estimated at up to 40% (Friedrich, 2004; Watson, 2004). Upgrading the roles of the SME sector in the South African economy to improve economic growth through increasing competitiveness, and by generating employment and redistributing income (Rogerson, 2004, 2006), has been the focus of new development policies since the democratic transition (Berry et al., 2002; GCIS, 2002). In order to aid in the facilitation of the SME environment, the South African government tabled the National Small Business Act of 1996 amended with Act 29 of 2004 to provide equal standing to SME enterprises (Rwigema and Venter, 2004; Ntsika, 2001) in South Africa’s economy. The vital role the

SME sector plays in the South African economy in addressing sustainable development, was highlighted by the 2003 Human Development Report (UNDP, 2003) for South Africa (Rogerson, 2004).

## 7. RESEARCH METHODOLOGY

According to Altinay & Paraskevas (2008) surveys are a commonly used for collecting data as far as the SMEs are concerned. For purposes of this research, a descriptive survey was conducted. According to Altinay & Paraskevas (2008), descriptive surveys are concerned with particular characteristics of a specific population and are predominantly used to gather information about what people do or think. In terms of this research this strategy proved the most useful to determine how the SME owners rate the importance of the critical success factors for the success of their business. The survey units extended across the SMEs owners who participated in the advanced training on SME management and development of 2012. These SME owners were selected through an interview process conducted by the Swedish Trade Council (STC) and the Small Enterprise Development Agency (SEDA) in the Western Cape Province, South Africa. The selection criterion was that these SMEs should be registered on the SEDA database and had to go through two stages of interview assessments. The reason for the client to be registered in the database was due to the fact that STC and SEDA wanted to deal with clients that had a working relationship with them and hence no SME that was not registered was considered for this training program. The first assessment was the evaluation of the business operation and its potential to export its products and the second being the face-to-face interview with the owner of the business who will participate in the program. The export potential of the SMEs was measured by two factors, first that the SME owner should have attended the Small Enterprise Development Export Orientation course offered by SEDA and the second being that the SME should have at least exported its products and services in the past five years. Two representatives from STC and one from SEDA conducted the face-to-face interviews. After the two assessments were conducted, only sixteen (16) SMEs met the criterion required. It is for this reason that the population sample of this study was very small. Another reason for the small sample was based on the cost for participating in the program. Each participant's overall cost was R50 000.00 and therefore the available budget could only cater for sixteen participants. This of course leads directly to a small sample size and unfortunately, the selected sample was dominated by the SMEs from the manufacturing sector. It is also important to emphasise at this stage that due to the small sample, the SMEs economic sectors were clustered into two to ensure reliable statistical analysis. A questionnaire was developed based on literature survey and was distributed amongst these SME owners during the training period. The first training took place in George, Western Cape for two weeks during June – July in 2012. The second training took place in Stockholm; Sweden for two weeks in September 2012. No requirements were set prior to completion of the questionnaire as all the SME owners participated in the survey. The questionnaire consisted of two sections, the first being the economic sector and the number of years in business and the second being the analysis of the critical success factors using the Likert scale. The processing of the data, ranging from checking to coding,



data capturing and analysis was undertaken using both the Microsoft Excel and Statistica software programme version 10. The results of the study are reported using frequency tables, descriptive statistics and Mann-Whitney U Test.

### 7.1. Survey results and discussion

In this section, the results of SME owners are discussed in terms of the SMEs types, the number of years of operation by the SMEs and importance of critical success factors for the success of these SMEs as evaluated by the participants in the program. The critical success factors used in this study were the following:

- The ability of the SME to generate enough cash;
- The ability of the SME to attract repeat customers;
- Competitive pricing;
- Advertising and promotion;
- Skilled workers; and
- Product performance

Table 1: *Frequency of industries*

	Count	Percent
Manufacturing	8	50
Agri-processing	1	6.25
Fashion design	3	18.75
Art and craft	1	6.25
Education resources	1	6.25
Sales services	1	6.25
Pharmaceutical products	1	6.25

Table 1 shows the frequency of the industries that were represented in the training programme by SME owners. The manufacturing industry accounted for half the industries while the remaining half was a distribution across various industries. The nature of the training programme and the selection process, as explained under the research methodology section, resulted in low numbers of representation of the industries and it is for this reason that the other industries were combined together to obtain a meaningful analysis. Therefore the industries will be categories as **Manufacturing and Other**. This therefore means that the sample for both (Manufacturing and Other) are not representative of all SMEs in the Western Cape Province but are representative of the sample in the SEDA database of only those SMEs that met the selection criterion set by SEDA and STC.

Table 2: *Number of years of business operations*

Numbers of years in operation								
	Valid N	Mean	Median	Mode	Frequency of mode	Minimum	Maximum	Std. Dev.
Number of years	16	2.94	2	2	6	1	7	2.11

The results of table 2 above infer that the shortest time that the SMEs have been in business is one year and the longest is seven years.

Table 3: *Observed frequencies on the critical success factors*

Industry	Very important	Important	Neutral	Not important	Not important at all
<b>The ability of the SME to generate enough cash</b>					
Manufacturing	4	4	0	0	0
Other	6	2	0	0	0
<b>The ability of the SME to attract repeat customers</b>					
Manufacturing	7	1	0	0	0
Other	8	0	0	0	0
<b>Competitive pricing</b>					
Manufacturing	2	3	3	0	0
Other	1	2	5	0	0
<b>Advertising and promotion</b>					
Manufacturing	4	1	3	0	0
Other	2	4	2	0	0
<b>Skilled workers</b>					
Manufacturing	3	4	1	0	0
Other	4	1	2	1	0
<b>Product performance</b>					
Manufacturing	8	0	0	0	0
Other	4	3	1	0	0

Table 3 shows the results of SMEs owner's views of the importance of critical success factors for their SMEs. The results infer that there were similar patterns of opinions as far as these factors were concerned. In all six critical factors, none of the SME owners viewed them as not important or not important at all with very few of them seen as neutral. The most prominent factor as far as its importance to the success of SMEs as inferred by the results was the ability of the SME to attract repeat customers amongst the two groups of SMEs. The results infer that 44% of those in manufacturing sectors see the ability of the SME to attract repeat customers as very important while 50% of the other economic sectors also see it as very important. The results also show that 6% from the manufacturing sector see this critical factor as important.

The second highest ranked critical success factor by both SMEs was product performance with 50% of those from the manufacturing SMEs viewing it as very important with 25% from other SMEs viewing it as very important as well. The results also infer that 19% from the other SMEs view this critical success factor as important.



The ability of the SMEs to generate enough cash was also seen as very important and important by both SME owners from the different sectors. The results infer that 25% of manufacturing SMEs view this critical success factor as very important while 38% of those other SMEs view it as very important as well.

The results show that competitive pricing was the lowest ranked factor as far as its importance is concerned. This was confirmed by a high number of SMEs who were neutral in viewing this critical success factor. The results infer that 19% of SMEs from Manufacturing and 31% from the other SMEs view it as a neutral factor.

Table 4: *Mann-Whitney U Test*

<b>Mann-Whitney U Test</b>				
	<b>Rank Sum</b>	<b>Rank Sum</b>	<b>U</b>	<b>2-sided</b>
	<b>Manufacturing</b>	<b>Other</b>		<b>exact p</b>
Generate enough cash	76	60	24	0.4418
Attract repeat customers	72	64	28	0.7209
Competitive pricing	59.5	76.5	23.5	0.3823
Advertising & promotion	65	71	29	0.7984
Skilled workers	66	70	30	0.8785
Product performance	52	84	16	0.1049

Table 4 shows results of the Mann-Whitney U Test, which is the non-parametric equivalent to the t-test to compare differences on an ordinal or interval/ratio scale variable between two groups. Since the test makes use of the ranks of the data, and not the actual data values, the results are interpreted in terms of median differences. The results as shown in Table 4 infer that since all the p-values are greater than 0.05, it means that in all cases, the data do not provide sufficient evidence to conclude that the medians of the two groups (Manufacturing and Other) are different. In other words the medians of the two groups do not differ statistically significantly. This pattern can be attributed to the low number of the SME owners who participated in this research as a direct result of the criterion set by the STC and SEDA.

The literature review has identified challenges facing SMEs in their growth and they included amongst others: a lack of management skills, finance and obtaining credit, access to markets and developing relationships with customers, appropriate technology and low production capacity, and support for the role that they play in economic development. In relation to the findings of this study, the results show a strong link between developing a literature review finding of relationships with customers with the finding of attracting repeat customers. The results of this study show that the SMEs involved in this research highlighted the importance of attracting repeat customers. Given the results of the study, it is quite clear that the SMEs involved in the study do agree that it is a challenge and hence the need to have more focus on attracting repeat customers to create stability of the business. Repeat customers are a solid base for customer loyalty and for customers to be loyal; they require a quality product that satisfies their need. Another identified challenge from literature review was quality products and the SMEs involved in this study identified

product performance as a key success factor for their businesses. Linking the performance of the product with repeat customers, it is quite clear that customers will only come back if they are satisfied with the quality of the product. The findings of the study in relation to product performance may be inferred as a direct result of the sample that participated in the study. Majority of the participants were from the manufacturing sector where they deal with products. Their views were that, for their SME's to grow, the product they offer should be of high quality with good performance. It also therefore means that the participants from the group called "Other" do not have products but deal with services. For them, it means that the quality of the service is what matters rather than the quality of the product. This finding is supported by (Reed, Lemak, & Mero, 2000) who states that around the world a growing number of organizations use quality management as a strategic foundation for generating a competitive advantage and improving firm's performance.

The results of the study also show that the SMEs involved in this research did not see competitive pricing, advertising and promotion and skilled workers as key compared to attracting repeat customers and product performance. This finding may infer that they believe that product performance and attracting repeat customers can overcome these other factors. Research has indicated that customers are willing to pay more for a quality performing product and therefore a quality performing product does not require aggressive advertising and promotion.

Finally the results of this study also confirm that skilled workers are not seen as a challenge in the SME sector as this sector is dominated by low-skilled work-force in South Africa. The dire skill shortage in South Africa makes it difficult to both attract and retain skilled talent and SMEs are generally labour-intensive and provide employment opportunities for low-skilled labour force.

## 8. FRAMEWORK FOR ADDRESSING SME'S CHALLENGES

In the introduction, it was mentioned that a framework for addressing challenges facing SMEs will be established. Below is the suggested framework to help minimise the challenges faced by SMEs in their growth:

**Developing country specific strategies** - The development of an effective SME finance strategy for an individual country should ideally be based on a comprehensive diagnostic of its SME finance gap and the quality of its SME finance architecture.

**Developing a supporting legal and regulatory framework** - An effective legal and regulatory framework promotes competition by avoiding overly restrictive licensing requirements and allows international and regional banks with better SME lending tools to enter the market. Competition among financial sector players can be promoted further by introducing technological platforms in key areas, facilitating a variety of financial products and services, driving down the costs of financial access, and reaching previously untapped markets.

**Strengthening the financial infrastructure** - Establishing a solid financial infrastructure (auditing and accounting standards, credit registries/bureaus, collateral, and insolvency regimes) should be a priority in financial development. The aim should be to develop a comprehensive credit reporting system that covers both personal and commercial credit information, and help lenders better manage credit risk and extend access to credit. Some countries, such as India, have introduced SME rating agencies as an additional institution designed to provide more information to prospective lenders. Moreover, a well-functioning collateral regime characterized by a wide range of allowable collaterals (immovable and movables), the establishment of clear priority rankings of claims over collateral, efficient collateral registries making priority interests publicly known, and effective enforcement of collateral in the case of default can further enhance risk acceptability of SME customers for financial institutions.

**Effective government support mechanisms** - In all cases, government interventions should be carefully designed and better evaluated with a view to accurately measure their achievements in terms of outreach and leverage. Partial credit guarantee schemes should remain an important form of intervention. Key guiding principles on such schemes should contain guidelines on eligibility criteria, coverage ratios, scalable credit approval mechanism, fees, payment rules, use of collateral/down-payment, and equity ratios, among other parameters.

**Building reliable data sources for SME finance** - An effective data collection framework at the national level should include efforts to standardize the definition of SMEs, centralize the collection of supply-side data by the central bank/banking supervisors and other financial supervisors, and survey SMEs in order to identify and quantify underserved SME segments. Demographic data on SMEs by number of employees, turnover, and asset size should be available and help normalize access to data. Computerized business registries would further facilitate the data gathering process and would serve as an important first step for firms joining the formal sector. Annual business and financial reports can provide important measures over time on the size and trends of the SME sector.

## 9. CONCLUSIONS AND RECOMMENDATIONS

As a contributor to a strategy for tackling South Africa's economic and social challenges, a thriving SME community has few equals. SMEs' general tendency towards labour intensity and the openings they offer to the lesser skilled highlight the priority that should be accorded to their growth and development. At present, the dominant narrative is about what is failing to happen: the SME economy is largely stagnant, and is a long way from the purposive, wealth-and-job-creating growth that the country desperately needs.

The findings of this study infer that the training program was dominated by the SMEs from the manufacturing sector as compared to other sectors. As indicated above, this was purely on the basis of the criterion set out by the selection panel. However the results of the SME growth index conducted by SBP business environmental specialist in February

2014 indicated that the manufacturing SME's in South Africa are the most dominant at 58% of the total SMEs in the country.

It is important to note that the success of these SMEs in the market place is crucial to the contribution to employment creation and poverty alleviation which are major challenges in South Africa. It is therefore recommended that SMEs should indeed focus more on their attracting repeat customers, product performance, and to generate enough cash as per the findings of this study. In this instance repeat customers will spend more with the SME while providing word-of-mouth recommendations to their friends and relatives because they will be satisfied with the quality of the products provided. It therefore also makes sense for the SMEs to focus on generating enough cash so they can have a good cash flow to meet their obligations and also to invest in new and improved products yielding a possible sustainable future for them. The implications of the challenges faced by SMEs in South Africa and the results of the study leads to the following recommendations aimed at minimising these challenges.

### 9.1. Government recommendations for policy considerations

- The government should establish a National Small Business Council which will serve as an information hub for all SMEs in the country;
- The country should develop a finance agency with the mandate to improve access to finance by the SMEs; primarily through the provision of 'wholesale finance' or guarantees to retail financial intermediaries, which, in turn, finance the provision of 'wholesale finance' or guarantees to retail financial intermediaries, which, in turn, finance the SME sector;
- Establishment of a skills programme through which SMEs are able to obtain assistance with two of the challenges that they face, i.e. "a lack of management skills" and "developing relationships with customers". Improving skills leads to improved productivity and affectivity - and therefore to a more stable organisation and increased profits;
- Government need to provide support services to SMEs through qualified service providers to allow for growth amongst SMEs.

It is further recommended that the key consideration should also be based on SMEs competitiveness. Most immediate among them is to rethink the regulatory environment, which is normally associated with "red tape" in South Africa. SMEs are contending with an environment ill-suited to their needs. They face numerous demands for compliance, and find that these are often indifferently managed by the officials responsible. Proper assessments of the costs and benefits of regulations are called for. Regulation is necessary, but it must take place with a clear eye on its implications for competitiveness. If the SMEs are to strengthen their areas of competitiveness around attracting repeat customers and product performance, as the two main critical factors as per the findings of the study, then the following is important: escalate the potential for firm productivity. Dealing with this encompasses a wide range of possible activities: investment in capital, innovation and up-skilling. South Africa's skills shortage is a prime problem. It is also one that cannot

be addressed solely within the workforce. The roots of the problem are in a problematic education and social system, and need to be addressed at that level. The other aspect is to appreciate that SMEs do not have the same capacities to focus on their non-core business as larger firms; they often operate with tighter margins, and many SMEs represent a first attempt at entrepreneurship. Assistance in the forms of training, finance or exposure to markets (local or foreign) can be greatly beneficial. According to Global Entrepreneurship, South African report (2006) perhaps most of all, South Africa needs to cherish its entrepreneurs, and its entrepreneurship. A past report from the Global Entrepreneurship Monitor (2006) commented: In an ideal entrepreneurial environment, the pull factors should outweigh the rest. Only then can one say that a true entrepreneurial culture exists in a country". This is equally applicable to the environment that attracts people to entrepreneurship and to the environment that makes it possible for them to thrive.

It is also recommended that government should assist with the formation of business development support (BDS) program. This is where government should play a leading role in mobilising a range of individuals and organisations to respond by providing a range of services broadly referred to as business development support (BDS). These organisations have the potential to address the barriers to SME growth. In South Africa, BDS providers have the potential to provide small businesses with much needed skills to address these challenges. They can help address management and strategic challenges through provision of training and on-going advice to business owners. However, on the demand side, the high cost of BDS services could discourage business owners from using them. It is therefore recommended that government should increase the amount of funding available for high-quality providers of BDS to ensure the continued support for growing South African enterprises.

## **9.2. Recommendations for SMEs' owners/managers**

The following recommendations are made for the SME owners/managers:

- SME owners/managers need to find the resources and take the time to build social and business networks;
- SME owners/managers need to develop an understanding of local markets;
- SME owners/managers need to maintain technological advantage;
- SME owners/managers need to seek bridging arrangements;
- Those owner-managers need to attend management development courses to enhance their knowledge and skills in terms of managing their businesses;
- That owner-manager needs to understand the significance of financial management and that this function is not outsourced to an accountant where the owner-manager is over-reliant on the accountant's role. Financial acumen is vital to the continued existence of the business and owner-managers need to address this. Cash flow can be hampered if credit terms are offered to customers who do not settle their debts within the specified period;
- That owner-manager needs to understand the significance of marketing management. The reliance on key customers requires owner-managers to develop strong customers

relationships, but also that they continually assess the state of their relationship by regularly conducting formal customer satisfaction surveys.

Finally the following is suggested as specific solutions to some of the challenges identified in the literature review so that SMEs can continue to grow:

- It is important for SME owners to understand cash management as a solution to lack of access to funding. This starts with a plan to see what your cash needs are and when your cash needs arise. Then one is in a position to manage it and focus on the cash management techniques most likely to be successful in your business.
- SME owners should strive to have access to skilled mentors and coaches. This will greatly enhance the ability of their businesses to be more successful in the competitive market environment. This requires the SME owners to commit an investment cost on the skilled mentors and coaches. Mentors and coaches in South Africa are mainly business consultants. It is therefore important that SME's needs to commit a certain cost to pay these coaches and business mentors. This is regarded a beneficial investment as the assistance gained from these business mentors and coaches will enhance the success of the SME's.

In conclusion, new development context requires change in both perception and practices in the promotion of SME development. Competitiveness is increasingly man-made; furthermore, it can be leveraged by factors other than location and natural resource endowments. One lever is through the maintenance of on-going access to the available store of global information and knowledge, including market standards, marketing opportunities and innovative technologies. Information in general is very scarce and always hinders market performance especially for the SMEs. Therefore an effort to provide critical information is necessary including technological advancement information.

## REFERENCES

- Altinay, L. & Paraskevas, A. (2008). *Planning Research in hospitality and tourism*. UK: Elsevier.
- Ardic, O., Mylenko, N., Saltane, V. (2011). *Small and Medium Enterprises A Cross- Country Analysis with a New Data Set*, Policy Research Working Paper.
- Ayyagari, M., Demirguc-Kunt, A. & Maksimovic, V. (2011). *Small vs Young Firms across the World: Contribution to Employment, Job Creation and Growth*. World Bank Policy Research, Working Paper 5631, April 2011.
- Barry, H. & Milner, B. (2002). SMEs and E-Commerce; a departure from the traditional prioritisation of training? *Journal of European Industrial Training*, 26 (7), 316-326.
- Bouri, A. et al. (2011). *Report on Support to SMEs in Developing Countries through Financial Intermediaries*.
- Bowler, A., Dawood, M.S. & Page, S. (2007). *Entrepreneurship and Small business Management*. Pretoria: Juta and Co. Ltd.
- Brinders, J., Memela, B. & Mlosy, C.D. (2003). *African Renaissance Entrepreneurship and Small Business Management Development in Africa*. Conference held in October 2003 at Port Elizabeth, South Africa.



- Brink, A. & Cant, M. (2009). *Problems experienced by small businesses in South Africa*.
- Chaston, I. (2000). *Entrepreneurial Marketing; competing by challenging conventions*. London: Macmillan Business Press.
- Cronje, G.J., Du Toit, J. & Motlatla, M. (2004). *Introduction to Business Management*. 6th ed. Cape Town: Oxford Business Press.
- Culkin, N. & Smith, D. (2000). An emotional business: A guide to understanding the motivations of small business decision takers. *Qualitative market research*, 3 (3), 145-157.
- Department of Trade and Industry (DTI). (2012). *White Paper on National Strategy for the Development and Promotion of Small Business in South Africa*. Pretoria, Government Publications.
- Falkena, H. (2000). *SMEs access to Finance in South Africa; a supply side regulatory review*. Report by the task group of the policy board to financial services and regulations. Pretoria: Kluwer publishers.
- Fatoki, O.O. & Garwe, D. (2010). Obstacles to the growth of new SMEs in South Africa: A principal component analysis approach. *African Journal of Business Management*, 4, 729-738.
- Finscope. (2010). *South Africa Small Business Survey*.
- Global Entrepreneurship, (2006). *South African report: 2006*, p.14.
- Herrington, M., Kew, J. & Kew, P. (2010). Tracking Entrepreneurship in South Africa: A GEM Perspective. 2009. *GEM Global Report 2010*.
- Kuratko, D.F. & Hodgetts, R.M. (1995). *Entrepreneurship: A contemporary approach* (3rd ed.). Orlando: The Dryden Press.
- Kuratko, D.F. & Welsch, H.P. (2004). *Strategic Entrepreneurial Growth*, 2<sup>nd</sup> edition. Ohio: Thomson South-Western.
- Jackson, M.L.P. (2004). *Entrepreneurial support in South Africa: a case study of a small enterprise support centre in Johannesburg*. PhD Thesis. Birmingham: University of Birmingham.
- Lloyd, H.R. (2002). *Small and Medium Enterprises (SMEs): instruments of economic growth and development in a South African regional dispensation*. Paper read at the annual conference of the European Regional Science Association held in Port Elizabeth on 2 to 6 August 2002:Port Elizabeth, pp1-25.
- Love, J. & Roper, S. (2013). *SME Innovation, Exporting and Growth*. Enterprise Research Centre, White Paper No. 5, April 2013.
- Mahmood, S. (2008). *Corporate Governance and Business Ethics for SMEs in Developing Countries: Challenges and Way Forward*. New York: Public Affairs.
- Mead, D.C. & Liedholm, C. (1998). The Dynamics of Micro and Small Enterprises in Developing Countries. *World Development*, 26 (1), 61-74.
- Meggison, L.C., Byrd, M.J. & Meggison, W.L. (2003). *Small Business Management: An Entrepreneur's Guidebook* (4th ed.). New York: McGraw-Hill.
- Moodley, S. (2002). Global market access in the Internet era: South Africa's wood furniture industry. *Internet Research: Electronic Networking Applications and Policy*, 12 (1), 31-42.
- Morgan, J.P. (2012). *The Small and Medium Enterprise (SME) Sector – Catalyst for Growth in South Africa*. JPMorgan Chase Foundation.

- National Small Business Association. (2013). *New Survey on Exporting Shows Small Business Export Growth*, Media Release, 12 June 2013.
- National Planning Commission. (2011). *Economy Diagnostic* <http://www.npconline.co.za>.
- Ndwandwe, M. (1998). *Let down for SMMEs*, Enterprise, November.
- Ntsika Enterprise Promotion Agency (Ntsika), (2001). *State of Small Business Development in South Africa*. Annual Review, 2001.
- OECD Conference, (2007), "Enhancing the Role of SMEs in Global Value Chains".
- Pechlaner, H. et al. (2004). Growth Perceptions of small & medium-sized enterprises - The Case of South-Tyrol. *Tourism Review*, 5P (4), 7-13.
- Poutziouris, P.Z., Steier, L. & Smyrnios, K.X. (2004). A commentary on family business entrepreneurial development. *International Journal of Entrepreneurial behaviour and research*, 1 (10), 7-11.
- Reed, R., Lemak, D. J. & Mero, N. P. (2000). Total quality management and sustainable competitive advantage. *Journal of Quality Management*, 5, 5–26.
- Republic of South Africa. (1995). Department of Trade and Industry. *National Strategy for the Development and Promotion of Small Business in South Africa*. Cape Town: Government Printer. (Notice 213 of 1995, 16317).
- Republic of South Africa, (2009). Parliamentary Monitoring Group report; productivity SA, Unemployment Insurance Fund and Compensation Fund: Strategic Plans 2009-10, August 26.
- Rao, S.S., Metts, G. & Monge, C.A.M. (2003). Electronic Commerce development in small and medium enterprises; a stage model and its implications. *A Business Process Management Journal*, 9 (1),11-32.
- Rogerson, C.M. (2001a). Growing the SMME Manufacturing Economy of South Africa: Evidence from Gauteng Province. *Journal of Contemporary African Studies*, 19 (2), 267-291.
- Rogerson, C.M. (2004). The impact of the South African government's SMME programmes: a ten year review (1994-2003). *Development South Africa*, 21 (5), 765-784.
- Rogerson, C.M. (2006). The Market Development Approach to SMME Development: Implications for Local Government in South Africa. *Urban Forum*, 17 (1), 54-78.
- Rwigema, H. & Karungu, P. (1999). SMME development in Johannesburg's Southern. *Metropolitan Local Council: an assessment of development in South Africa*, 16 (1), 101-124.
- Rwigema, H. & Venter, R. (2004). *Advanced Entrepreneurship*. Cape Town: Oxford University Press.
- SBP Alert, (2013). Issue Paper 1. <http://www.sbp.org.za> (accessed April 10, 2014).
- Shafeek, Sha. (2009). Enhancing the Strategy for Developing Small Growth Potential Firms in the Eastern Cape. <http://www.accademicjournals.org/AJBM> (accessed April 10, 2014).
- Soontiens, W. (2002). Managing International Trade: an analysis of South African SMEs and regional trade. *Journal of Management Decisions*, 40 (7), 710-719.
- Stokes D. & Wilson, N. (2006). *Small Business Management and Entrepreneurship*. South Western Cengage Learning: DP Publications Ltd.
- Storey, D.J. (1994). *Understanding the Small Business Sector*. London: Routledge.



Timms, S. (2011). *How South Africa can Boost Support to Small Businesses: Lessons from Brazil and India*. Trade and Industrial Policy Strategies (TIPS).

United Nations Development Programme (UNDP) (2003). The challenge of sustainable development in South Africa: unlocking people's creativity. *South African Development Report, 2003*. Cape Town: Oxford University Press.

Wadhwa, V. R. et al. (2009). *The Anatomy of an Entrepreneur: Making of a Successful Entrepreneur*. Kauffman Foundation, November, 2009.

# NATIONAL INNOVATION POLICIES IN THE EU: A FUZZY-SET ANALYSIS

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**ABSTRACT:** *This paper argues that innovation policy research can benefit from utilizing new research methods as they might lead to different policy recommendations. It demonstrates this by using a set-theoretic fsQCA method to analyse the data on innovation policies in the European Union (EU). It shows that the use of correlation-based statistical methods is not appropriate for the evaluation of innovation policies due to their causally complex nature that correlational statistical methods cannot unravel. This paper demonstrates this by focusing on the special importance of linkages among actors and innovation commercialisation through entrepreneurship and the notion that they represent a necessary condition for innovation success. Results confirm that the single factor of Linkages & entrepreneurship is the necessary condition for innovation success, thus emphasizing the importance of an open innovation framework for innovation policy-making. Results also show three combinations of sufficient conditions (but no single factor) lead to innovation success. They confirm the causal complexity of innovation policy and confirm that using different research methods will lead to different policy recommendations.*

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**Keywords:** *Open innovation, national innovation systems, QCA, causal complexity, IUS, innovation policy*

**JEL Classification:** B4, Z1, O3

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## 1. INTRODUCTION

National innovation policies are considered to be one of the most important economic development policies governments have at their disposal. Research on the remarkable economic progress in some countries, sometimes described as economic miracles, cite government innovation policies as a major factor of success – for example, in Taiwan (Kraemer, Gurbaxani, & King, 1992). National innovation policy is considered especially relevant for small, developing economies as a part of their adjustments to the changing international, economic and technological order as well as for improvements to their own economic and technological situations (Lin, Shen, & Chou, 2010).

The foundations of innovation policy-making research lie in scholarly research on innovation. In the past 10 years, innovation research has seen significant changes with the

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increased focus on new innovation concepts like user-led innovation (von Hippel, 1986, 2005) and open innovation (Chesbrough, 2003). These new concepts have profound effects on innovation policy-making. Their main insight is that the success of innovation policies lies in the recognition of the importance of linkages between actors in innovation systems and of entrepreneurship to commercialise innovation (Herstad, Bloch, Ebersberger, & van de Velde, 2010). Linkages serve as channels for knowledge diffusion and recombination and also facilitate its commercialisation. Entrepreneurship is crucial for commercial success in a world of open innovation (Chesbrough, 2003) as open innovation influences the development of new, open business models (Chesbrough, 2006).

However, new innovation concepts also influence the need to develop new methods for innovation policy research. Innovation policy studies have mainly used traditional statistical research methods for testing their hypotheses. But the use of correlation-based statistical methods is not appropriate for testing due to the causally complex nature of innovation policies. There is strong evidence that methods such as set-theoretic methods could be more suitable (Schneider & Wagemann, 2012, p. 89). We will demonstrate the use of a typical set-theoretic method called fuzzy-set qualitative comparative analysis (fsQCA) for evaluating innovation policy measures, especially the importance of Linkages & entrepreneurship for innovation policy success. More often used in sociology, this method is well suited to the field of policy research (Rihoux & Grimm, 2006).

The intended contribution of the paper is to demonstrate new methods for the analysis of innovation policies that might lead to different policy recommendations. We are doing so by focusing our research on the special importance of linkages among actors and innovation commercialisation through entrepreneurship and the notion that they represent a necessary condition for innovation success. The importance of an open innovation framework for innovation policy-making will thus be emphasised.

## **2. METHODOLOGICAL AND THEORETICAL BACKGROUND**

### **2. 1. The importance of causal complexity in innovation policy evaluation**

In this paper we look at the individual conditions and their interactions for the success of national innovation policies. We focus on several conditions that are needed for their success and test their necessity or sufficiency for successful innovation policy outcomes.

To do so, we first look at the current standard approaches to evaluating the success of innovation policies. There are several approaches for such evaluation, for example systemic (Arnold, 2004), evolutionary (Nill & Kemp, 2009) and participatory (Diez, 2001). There are also some good examples of innovation policies evaluations (e.g. *OECD Reviews of Innovation Policy: Slovenia*, 2012).

During the last few years, an increased number of policy analysts have been opting for multiple case-studies as a research strategy (Rihoux & Grimm, 2006). Their choice is based

on the need to gather in-depth insight into the different cases and capture the complexity of the cases while still attempting to produce some level of generalisation (Ragin, 1987). However, the prevailing way of evaluating innovation policies remains over-simplified. The prevailing way of currently evaluating innovation policies is by constructing a single composite index from a set of indicators. These indexes aggregate a large number of indicators reflecting various aspects of science, technology and related factors into a single composite index (Economist, 2009, p. 2). The underlying method for constructing them is based on simple correlation statistical methods such as regression analysis.

Several examples are often used not only in professional discourse but also in scholarly analysis. In Europe, perhaps most widely used is the annual Innovation Union Scoreboard (IUS) (Hollanders, Es-Sadki, & Commission, 2013) and its IUS Summary Index. While initially intended as a benchmarking tool, it has become the central and authoritative source for the European Commission and other EU institutions as well as national policy-making bodies (Adam, 2014). Globally, other indices such as the Global Innovation Index (published by Cornell University, INSEAD and the World Intellectual Property Organization), Bloomberg's Rankings of the most innovative countries or the Economist Intelligence Unit's Ranking of the world's most innovative countries are comprised and publicised.

Methodologically, such approaches are weak. The underlying assumption of such methods is that a higher score on each individual indicator implies better innovation performance. Every improvement of each individual indicator will lead to better innovation performance. This represents a clear example of causal simplicity where researchers focus on linear additive effects of single variables independent of any other causal factors (Schneider & Wagemann, 2012). However, there are good reasons to believe that the phenomenon of successful innovation policy is more complicated than that. Innovations can be explained in a multi-causal manner. (Edquist, 2001, p. 11).

Acknowledging the weaknesses of the prevailing approach, OECD publishes its bi-annual OECD Science, Technology and Innovation Scoreboard (*OECD Science, Technology and Industry Scoreboard 2013*, 2013) as a comparative analysis. It compares member states along a set of indicators but does not try to aggregate them into a single index. Instead, it qualitatively compares innovation trends. While methodologically more sound, this approach does not tackle the issues of the role of individual innovation factors and their influence on innovation success. It also has limited generalisation use. A better method would take into account the complex nature of innovation policy as the interplay of different policy measures and evaluate individual policy measures at the same time. It would incorporate the characteristics of both qualitative and quantitative methods. The focus should lie on causality of innovation policy measures and their necessity or sufficiency for successful innovation outcomes.

We believe innovation policies have the characteristics of causal complexity (Edquist, 2001). There are three characteristics of causal complexity that are defined as:

- equifinality,
- conjunctural causation and
- causal asymmetry.

Empirical analysis and case studies suggest that different and mutually non-exclusive innovation policies can be successful and lead to similar outcomes. For example, the United States has different innovation policies than the Scandinavian countries, and even more different yet are those of South Korea. However, they are all considered successful innovators. They all have high IUS Summary Index scores even though their policy mixes are substantially different. The EU offers some tools to compare innovation policy measures for each country in its Joint Inventory of Policy Measures,<sup>3</sup> which shows the variety of different policy measures national policy-makers implement, even though they often reach very similar innovation success (measured by the IUS Summary Index or by other measurements). In another example, the IUS Summary Index scores for Ireland and the United Kingdom in 2013 are virtually equal at 0.61, even though their corresponding policy mixes are quite different. This is an example of equifinality.

Additionally, there is clear evidence that single policies can unfold only in combination with other precisely specified conditions. An example is a policy measure to support the establishment of a venture capital (VC) industry to help support the commercialisation of technologies. The case study of a very successful government intervention by the Israeli government in 1990s (the Yozma instrument) has been replicated by a number of countries but with much less success – for example Slovenia and Croatia (Švarc, 2006); neither Slovenia nor Croatia experienced such successful development of their respective VC industries as was observed in Israel. The reason for the lack of success probably lies in a lack of other conjunct policy measures – for example, the technology-transfer mechanisms and structure in Israel that were significantly different than those in EU countries. This is an example of conjunctural causation.

Finally, policies that lead to innovation success are not the same as the (lack of) policies leading to innovation failure. It is an over-simplification to claim that a lack of innovation success is the result of lacking innovation policies that were sufficient to lead to innovation success in other countries. If this were sufficient for innovation success, all the countries would copy successful policies, and soon after they would become successful themselves. In reality, implementing exactly the same innovation policies that were successful in Israel will not turn a country like Slovenia into a leading venture capital provider, just as the lack of a developed venture capital industry is not the only culprit of less successful innovation outcomes. Causal conditions leading to the presence of successful innovation outcomes are of only limited use for the causal role of its absence. This is an example of causal asymmetry.

Statistical regression-based methods cannot achieve causally complex results as they cannot unravel set relations and the form of causal complexity that comes with it. For example, correlation is a symmetric measure in the sense that if we are able to explain the positive or high values of a dependant variable, then we are also able to explain the negative or low values of the dependent variable (Schneider & Wagemann, 2012). In contrast, set-theoretic relations such as sufficiency and necessity are indicated by asymmetric set

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<sup>3</sup> Available at [http://erawatch.jrc.ec.europa.eu/erawatch/opencms/research\\_and\\_innovation/](http://erawatch.jrc.ec.europa.eu/erawatch/opencms/research_and_innovation/)

relations. Asymmetry describes the fact that insights into the causal role of a condition are of limited use for the causal role of its absence. The explanation of the occurrence of the outcome does not necessarily help us explain its non-occurrence.

Data patterns of correlation also look quite different from those of a set relation. It is absolutely possible for a researcher to find a perfect set relation but fail to detect any strong correlation between the variables. Correlational methods rely on both the presence of conditions (variables) at the same time as the presence of the outcome and their absence. They have equal analytic relevance. On the contrary, set-theoretic methods look at cases where both conditions and outcomes are absent as irrelevant for explaining the causation. They should be analysed by developing another set-theoretic model with a new, negated outcome. The conditions influencing the presence of an outcome (in this case innovation success) are not the same as the conditions influencing its absence. Set-theoretic models incorporate this asymmetry, while correlation-based models are inherently symmetrical. Methods like ordinary least squares in which the sum of the square roots of distances between dots and regression line are minimised are a direct expression of this symmetry (Schneider & Wagemann, 2012, p. 84).

Methodologically induced assumptions of simplicity run the risk of generating oversimplified representations that are very much detached from the cases and data patterns that underlie the analysis of innovation policies. They do not correspond to the complexity of the social world and lead to wrong policy recommendations and a waste of resources.

## **2.2. Set-theoretic methods are more suitable for researching causal complexity**

As correlational statistical methods cannot achieve causally complex results, they are not suitable for researching causally complex phenomena. Unlike conventional statistical techniques which are based on examinations of sufficiency (Ragin, 2000), set-theoretic methods can examine the links between various combinations of causal conditions and the outcome as both necessary and sufficient conditions. They can systematically and formally examine the necessary and sufficient conditions for the outcome. This is important here, as it is yet to be established whether certain innovation policy measures are either necessary and/or sufficient for countries to achieve desired innovation outputs. The use of set-theoretic methods means that causal relationships between conditions and the outcome can be explored. These findings may, in turn, lead to clearer policy implications than would be the case from an analysis of the marginal effects obtained from regression analyses (Fiss, 2011).

This paper uses a relatively new approach of a set-theoretic method to show that other methodological approaches will yield different results and a different view on the innovation process and consequent innovation policy-making. This approach allowed for a detailed analysis of how causal conditions contribute to the outcome in question. It was based on a configurational understanding of how causes combine to bring about

outcomes (Fiss, 2011, 2012). We have used the most often used set-theoretic method, called qualitative comparative analysis (QCA).

The original QCA method was developed 27 years ago (Ragin, 1987) and is based on the binary logic of Boolean algebra. Essentially, QCA examines how the membership of cases in the set of causal conditions is linked to the membership in the outcome set (Allen & Aldred, 2011). Cases are best understood as configurations of attributes. Their comparison allows a researcher to examine instances of the cause and outcome to understand patterns of causation. It uses set-subset relations to examine causal patterns of necessity and sufficiency. A condition is necessary, if, whenever the outcome is present, the condition is also present. Additionally, the condition is sufficient if, whenever the condition is present, the outcome is also present (Schneider & Wagemann, 2012, p. 76). The QCA method uses formal procedures to test the necessity and sufficiency of conditions for the outcome. In this paper, we demonstrate the use of these procedures in innovation policy research and evaluation.<sup>4</sup>

An additional benefit of the QCA method is that it also attempts to maximise the number of comparisons that can be made across the limited number cases under investigation. The technique aims to resolve the problem of a small number of case observations by allowing inferences to be drawn from the maximum number of comparisons that can be made across the case under analysis. As such, it is particularly useful when analysing country comparisons as their numbers are inherently small but at the same time too high for the use of other qualitative methods such as case studies.

The original QCA method was based on crisp values of 1 indicating the presence of a particular set and 0 indicating its absence (Ragin, 2007). Due to its binary logic, this method is today known as a crisp-set QCA (csQCA) and has been criticised as the researcher has to determine the values of each variable. But as most variables are essentially continuous, the division will always be arbitrary. A second, related problem is the fact that the technique does not allow an assessment of the effect of the relative strengths of the independent variables (as they can only have two values). In order to avoid these problems, the QCA method was upgraded with fuzzy-set theory to address partial memberships in the set (Ragin & Rihoux, 2009). This fits well with innovation policy research as individual innovation policy indicators are often normalised and based on a continuous scale. On the other hand, fuzzy-sets are a powerful tool that allows researchers to calibrate partial membership in sets without abandoning the core set-theoretic principles (such as subset relations). They are at the same time qualitative and quantitative as they incorporate both kinds of distinctions in the calibration of the degree of set membership (Ragin & Rihoux, 2009).

Based on this reasoning, we have used a set-theoretic method of fuzzy-set qualitative comparative analysis (fsQCA) to test innovation policy measures. Specifically, we have used fsQCA to analyse the causal complexity of innovation policies, aiming to assess the

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<sup>4</sup> For an excellent introduction into QCA methods, its theory and procedures, the reader is referred to Schneider and Wagemann, 2012.



relationship between combinations of ‘causal conditions’ and the related output (Ragin & Rihoux, 2009). We demonstrate this analysis based on an idea originating from the open innovation paradigm.

### 2.3. Open innovation and its influence on innovation policy-making

The theoretical background of this paper is the premise that innovation is not a closed system but rather is dependent of the extent of mutual cooperation. Innovation policies need to take this into account and not focus solely on supporting individual companies but on their collaboration as well. This premise is central to the open innovation paradigm (Chesbrough, 2012). It assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology.

The implications of open innovation systems on innovation policies have been predicted and studied since the definition of the concept. One of the open innovation’s main arguments is that linkages between actors serve as channels for knowledge diffusion and recombination. Lack of linkages and networking across organisational boundaries represents a system failure, as do lock-ins to specific collaboration partners, sources of ideas and information or an excessive overall ‘closure’ of learning processes (Herstad et al., 2010). These failures need to be tackled in a way similar to market failures – through policy intervention (Klein Woolthuis, Lankhuizen, & Gilsing, 2005). Recently, several papers and studies discussed the question of how national innovation policies can be reframed in a context of open innovation (De Backer, Cervantes, Van De Velde, & Martinez, 2008; Ebersberger, Herstad, Iversen, Kirner, & Som, 2011).

The central idea behind open innovation is that, in a world of widely distributed knowledge, companies cannot afford to rely entirely on their own research but should instead buy or license processes or inventions (i.e. patents) from other companies. In addition, internal inventions not being used in a firm’s business should be taken outside the company (e.g. through licensing, joint ventures or spin-offs) (H. W. Chesbrough, 2003). In other words, linkages between companies and other institutions are crucial for the successful implementation of innovation in companies. However, innovation itself is only one part of the process – the value creation part. To ensure commercial success, companies also need to capture the newly created value. Claiming ownership of the intellectual property for newly developed technologies and finding different paths to the market are also crucial parts of the open innovation concept (H. W. Chesbrough, 2006). This means that companies of all sizes can create and capture value from ideas and technologies. Open innovation is becoming increasingly relevant to entrepreneurs and the organisations that support them. This second part of the open innovation concept essentially emphasises entrepreneurship and the importance of business ecosystems for established companies and startups (McPhee & Segers, 2013). Without successful linkages between different innovation actors, there can be no successful innovation and thus no value creation. Without successful entrepreneurs, positioned in a vibrant business ecosystem, there can



be no value captured from successful innovation. Both are necessary for a successful national innovation system.

National innovation policies have already started to adjust to the recent changes. Some successful examples include Ireland (Irish Innovation Taskforce, 2010), Taiwan (Lin et al., 2010) and the US (Technology, 2010). On the contrary, innovation policies that do not adjust to open innovation will not be successful (Svarc, 2006). Far from becoming redundant, innovation policies remain an essential element of industrial policy.

Based on the insights contributed by the new innovation concept of open innovation, we will use an example of Linkages & entrepreneurship, as defined in an open innovation framework, and demonstrate that they are a necessary condition for the success of innovation policies.

*Hypothesis 1: Linkages & entrepreneurship are a necessary condition for the success of national innovation policies.*

The use of a novel research method has allowed us to test not only for the necessity but also for the sufficiency of Linkages & entrepreneurship as well as other conditions for innovation success. We discuss these conditions in more detail below.

### 3. DATA AND METHODS

Using fsQCA, this research has focused on analysing different innovation policies in the EU. The EU has recognised the importance of specific policies that focus on improving innovation outcomes – the ‘narrow’ innovation policies – in order to improve its growth prospects in the newly globalised environment. It recognised it cannot compete in this new environment unless it became more innovative (Commission, 2013a). The main current EU innovation policy is the Innovation Union, one of the Europe 2020 growth strategy’s flagship initiatives (Commission, 2013c). Its aim is to set out a strategic approach to innovation, seeking to boost research and innovation performance in Europe by getting promising ideas and discoveries to the market faster. A crucial part of this approach is building ‘bridges’ connecting science, technology and markets (Commission, 2013b).

An integral part of the Innovation Union is the annual IUS assessment. It provides a comparative assessment of the research and innovation performance of the EU27 Member States and the relative strengths and weaknesses of their research and innovation systems. It has become the benchmark for innovation policy evaluation in the EU and helps member states assess areas in which they need to concentrate their efforts in order to boost their innovation performance (Hollanders et al., 2013). The calculation of the annual composite IUS Summary Innovation Index allows the preparations of country rankings and assures considerable publicity in the media and in the interested public (Schibany & Streicher, 2008). This is also likely one of the most important results of the IUS initiative which has assured its continuation into its 14<sup>th</sup> year.

However, there is also considerable criticism of this approach. New understanding of innovation processes has resulted in changes to the IUS reports and indicator selection. Particularly, the constructs of user innovation and open innovation and the emergence of service innovation have influenced the selection of indicators that comprise the composite index. However, this selection has been limited due to lack of new data as IUS indicators are based on official statistical sources. It also strongly relies on the Community Innovation Survey, a biannual series of harmonised surveys that are executed by the national statistical offices throughout the EU. Lack of sufficient data has certainly influenced the indicator selection, but the overall criticism was more directed at the arbitrary selection of indicators, which is not based on an underlying model of innovation. For example, a methodological review of IUS, implemented by the authors themselves – an IUS methodological review themselves (Hollanders & van Cruysen, 2008) lists a number of critics, including Rammer (2005) who states that “new indicators should be identified and selected on . . . a conceptual analysis rather than on a simple statistical correlation analysis”.

Among other things this has resulted in apparent high-tech bias. Furthermore, the indicators should focus on questions of data quality, including reliability as well as availability for large number of countries. The link between indicators and policies should distinguish between performance indicators and policy indicators. As Schibany (2008) noted, “Any concise inference regarding the selection of indicators and . . . their mutual interaction is mostly ignored”. Additional methodological criticism emphasised the drawbacks of the construction of a single composite indicator, missing the complexity of the innovation process (Cherchye, Moesen, & Van Puyenbroeck, 2004). The low quality of data also raises significant issues of multicollinearity between indicators. Multicollinearity between indicators is a typical problem originating from the statistical method used for the construction of the composite IUS Summary. As discussed above, using correlation statistical methods for causally complex phenomena (like innovation policies) is not recommended (Schneider & Wagemann, 2012).

### 3.1. Operationalisation of the QCA analysis

To perform the fsQCA analysis of the innovation policies, we proceeded along the following steps:

1. We started by compiling a database of existing indicators on innovation policies in the EU.
2. These indicators were then calibrated and converted to (fuzzy) set membership scores.
3. We followed this with the construction of the truth table – a data matrix wherein each row of the table is associated with a special and distinct combination of attributes, and the full table consists of all possible combinations of attributes. We then sorted all empirical cases into the rows of the truth table.
4. We started our analysis with an analysis of necessary conditions and followed that with an analysis of sufficiency.
5. We performed the analysis of sufficiency by using the truth table algorithm: We

minimised the truth table by reducing the number of rows based on the minimum number of cases required for the solution and the minimum consistency level of a solution (consistency meaning the degree to which cases correspond to the set-theoretic relationships expressed in a solution). In fuzzy sets we simply estimated the consistency as the proportion of the cases that are consistent with the outcome.

6. We followed the Standard Analysis procedure to minimise the truth table in order to obtain three solutions – complex, parsimonious and intermediate. Based on the simplifying assumptions, we used an intermediate solution to interpret the results.

To execute the QCA procedure, we used the fs/QCA software (Ragin, Kriss, & Davey, 2006; available at [www.fsqca.com](http://www.fsqca.com)).

### 3.2. Dataset of innovation policy indicators

First, we compiled a database of existing indicators. In order to demonstrate the differences between correlational statistical methods and set-theoretic methods, we used the same data as in the original IUS. By using the same underlying data but obtaining different results, we intended to demonstrate differences between methods. This means that we needed to test the same innovation inputs into innovation activities and the activities themselves (defined as innovation enablers and innovation activities in the IUS) that were tested in the original IUS summary index. The data on human resources, research systems, finance and support, firm investments into research and innovation and Linkages & entrepreneurship were obtained by using the IUS data.

We used the existing dataset of IUS indicators IUS (Commission, 2012). In the IUS, these measures were split into two groups of indicators:

1. Enablers:
  - a. Human resources index (summary index comprised of three indicators: new doctoral graduates, population with completed tertiary education and youth with upper secondary level education)
  - b. Open, excellent and attractive research systems (three indicators on international scientific co-publications, scientific publications among the top 10% most cited and non-EU doctoral students)
  - c. Finance and support (two indicators on public research and development [R&D] expenditure and on VC financing)
2. Firm activities:
  - a. Firm investments (two indicators on business R&D expenditure and non-R&D innovation expenditure)
  - b. Linkages & entrepreneurship (three indicators on [SMEs] innovating in-house, innovative SMEs collaborating with others and public-private co-publications)
  - c. Intellectual Assets (four indicators on Patent Cooperation Treaty [PCT] patent applications, PCT patent applications in societal challenges, community trademarks and community designs)

All indicators used were defined in the same way as in the original IUS. That means they are based on a set of indicators measuring the success of national innovation policies for each particular condition rather than measuring concrete activities on the level of companies.

As our hypothesis was focused specifically on Linkages & entrepreneurship, we could see that the composite indicators are comprised of internal SME innovation, SME innovation linkages and general science and innovation linkages. While more and better indicators on Linkages & entrepreneurship would be desirable, we have used the existing composite index in order to demonstrate the new research method and its benefits in innovation policy research. The IUS is also very useful as it collects a large database of innovation indicators and innovation policy measures that can be used for analysis with methods other than the IUS Summary Index.

While IUS data are available for more than 50 countries, we were primarily interested in identifying differences between the countries of the EU or those closely connected to them (usually in membership talks or in special arrangements with the EU). This assured relatively similar institutional and regulatory backgrounds, and, to a lesser extent, cultural backgrounds. Thus, we could assume that the differences in the innovation output of countries were the result of innovation policies and not differences in framework policies or the different institutional structures of individual countries. In the end, we used the dataset for 23 countries.

We used the average value for the period between 2007 and 2009 for our indicators. We did not use the indicators for measuring economic effects and innovators as the authors of the index classified them as measures of innovation output. Our research design meant that we needed to use a different measure of innovation output – the (aggregate) IUS Summary Index itself.

### 3.3. Data calibration

In order to operationalise our research, we constructed fuzzy-set scores for each indicator and for the output of each country based on four-item scale. The QCA analysis would normally request its own calibration thresholds for the data; however, in this case, the aim of the paper was the analysis of IUS data. They are already normalised, so it would be against the aim of the paper to devise different measures than the ones originally used in the IUS. For the same reasons, it would be unreasonable to use any other set-theoretic method than fsQCA as individual cases (countries) have already obtained index scores spanning the full range between 0 and 1.

The IUS reporting had delineated countries into four groups. The Summary Innovation Index score of Innovation leaders is 20% or more above that of the EU27; of Innovation followers, it is less than 20% above but more than 10% below that of the EU27; of Moderate

innovators, it is less than 10% below but more than 50% below that of the EU27; and for Modest innovators, it is below 50% that of the EU27. These thresholds were used for the direct calibration of the data and their subsequent grouping into one for the four groups that were given the same fuzzy score. For example, the EU's average Summary Innovation Index score for 2010 was 0.53255 – 120% of that was 0,6391, 9% value was 0.4793 and 50% value was 0.2663. These values were used as the three points for the direct method of calibration and the thresholds for the groups that were given the same fuzzy score. All countries with an IUS Summary Index score higher than 0.6391 were given the fuzzy score of one, those between 0.6391 and 0.4793 were given a fuzzy score of 0.66 etc. We decided to use the same calibration for IUS factors (composite indicators, conditions in the QCA analysis) as well.

### **3.4. Analysis of necessity**

We started the data analysis with the analysis of necessary conditions for the presence of the outcome using the formal QCA procedures. The results of this analysis implied that the Linkages & entrepreneurship fulfil the criteria for a necessary condition for the outcome IUS as they had a very high consistency of almost 0.98 (they also had high coverage). This result was confirmed by the XY plot for the variable of Linkages & entrepreneurship as it showed a high probability of necessity of this condition with a single observation (Spain) visible above the bisecting line and all others lying below the line as expected to fulfil the criteria of necessity (whenever the outcome is present, the condition is also present). This confirmed our central hypothesis that this condition is necessary. The formal procedure conducted on the analysis of necessity did not show any other necessary conditions.

### **3.5. Analysis of sufficiency – The truth table algorithm**

We proceeded with the formal analysis of sufficiency. The XY plots also suggested that Finance and support could be a sufficient condition by itself. However, further examination showed that three cases (Estonia, Norway and France) lay below the bisecting line, thus breaking the rule for sufficiency (whenever the condition is present, the outcome is also present). These cases will be noted for further examination when analysing the results.

We proceeded with the truth table algorithm. After hiding the logical remainder rows (in this case, rows with no recorded cases), we coded the outcome with 1 if the raw consistency was above 0,99. This threshold was not only theoretically sound, but it was also marked with a clear break in the consistency values as the next row had a low consistency score of 0,83 and a relatively low PRI consistency score – potentially implying that this sufficiency condition could also be the sufficiency condition of the negated outcome  $\sim Y$ . The truth table thus obtained is presented in Table 1:

Table 1: Fuzzy-set truth table

A	B	C	D	E	F	Number of cases	Y	Raw consistency	PRI consistency
1	1	1	1	1	1	8	1	1	1
1	1	0	1	1	0	1	1	1	1
1	1	1	0	1	1	3	1	1	1
1	1	0	1	1	1	1	1	1	1
1	0	0	1	1	0	1	1	1	1
0	0	1	1	1	0	1	1	0,99	0,97
1	1	1	0	1	0	1	0	0,83	0,75
0	0	0	1	1	0	1	0	0,8	0
0	1	0	0	0	0	1	0	0,75	0
0	0	0	1	0	1	1	0	0,67	0
0	0	0	0	1	0	1	0	0,6	0
0	0	0	0	0	0	1	0	0,43	0
0	0	0	1	0	0	2	0	0,37	0
1	0	0	0	0	0	1	0	0,25	0

Notes: \*The consistency threshold of 0,85 was used due to low PRI scores in truth table rows 7 and 8

\*\* Written in Boolean algebra:  $(A*B*C*D*E*F)+(A*B*\sim C*D*E*\sim F)+(A*B*C*\sim D*E*F)+(A*B*\sim C*D*E*F)+(A*\sim B*\sim C*D*E*\sim F)+(\sim A*\sim B*C*D*E*F)=Y$  where

A= hr\_c= Human resources

B= rs\_c= Open, excellent and attractive research systems

C= fs\_c= Finance and support

D= fi\_c= Firm investments

E= la\_c= Linkages & entrepreneurship

F= ia\_c= Intellectual assets

Y (outcome) = IUS = Innovation Union Scoreboard innovation performance score

### 3.6. Logical minimisation procedure

Three solutions were obtained from the truth table using the Standard Analysis procedure.

Complex solution:

$$(A*\sim C*D*E*\sim F)+(A*B*C*E*F)+(\sim A*\sim B*C*D*E*\sim F)*(A*B*\sim C*D*E)+(A*B*D*E*F)=Y$$

Parsimonious solution:

$$(A*D)+(C*D)+(A*F)+(B*F)+(C*F)+(E*F)=Y$$

Intermediate solution:

$$(E*D*C)+(E*D*A)+(F*E*C*B*A)=Y ; E*((D*C)+(D*A)+(F*C*B*A))=Y$$

We decided to use the intermediate solution as the best one for further analysis as it was based on the most plausible, theory-based assumptions for logical reminders. These assumptions were based on easy counterfactuals and are normal in the Standard Analysis as part of the QCA procedure. Both methods are part of the Standard Analysis procedure and are essentially mathematical tools that enable us to obtain useful solutions from a limited number of cases.

The simplifying assumptions that were used were directional expectations and prime implicants. The directional expectation used presumed that the presence of each individual condition would have a positive effect on the presence of the outcome based on a sound theoretical background. Prime implicants had to be used as a mathematical tool in the logical minimisation procedure due to limited diversity. We have marked four prime implicants (A\*F, B\*F, C\*F and E\*F) to obtain the intermediate solution, indicating that different combinations of conditions combined with the condition of F (Intellectual Assets) were used to obtain the solution.

#### 4. RESULTS

Our chosen solution has recognised three paths to a successful IUS Summary Index:

$$E*((D*C)+(D*A)+(F*C*B*A))=Y \text{ or}$$

*Linkages & entrepreneurship AND*

*((Finance and support AND Firm investments) OR (Firm investments AND Human resources) OR (Human resources AND Open, excellent and attractive research systems AND Finance and support AND Intellectual assets))  
lead to the presence of the outcome (innovation success, measured as a high IUS Summary Index Score).*

Table 2 presents the analysis of sufficient conditions and parameters of fit for the outcome of 'Innovation Union Summary Index success'.

Table 2: *Analysis of sufficient conditions for the outcome of Innovation Union Summary Index success'*

Solution	E*D*C	+	E*D*A	+	F*E*C*B*A
Single country coverage	Estonia		Ireland, Austria, Slovenia		France, Netherlands
Consistency	0,96		1,00		1,00
Raw coverage	0,58		0,62		0,55
Unique coverage	0,07		0,11		0,07
Solution consistency		0,971			
Solution coverage		0,753			

Notes: \* A= hr\_c= Human resources

B= rs\_c= Open, excellent and attractive research systems

C= fs\_c= Finance and support

D= fi\_c= Firm investments

E= la\_c = Linkage & entrepreneurship = necessary condition (present in all sufficient conditions)

F= ia\_c = Intellectual assets

\*\* Finland, Sweden, Switzerland, Belgium, Denmark, Germany, Luxembourg and the UK were covered by more than one combination.



The analysis of sufficient conditions showed that the condition of Linkages & entrepreneurship was confirmed to be the only sufficient condition present in all solution paths to IUS success. This re-confirmed our original hypothesis that the condition of Linkages & entrepreneurship is necessary for innovation success (measured by a high IUS score).

The results also showed three combinations of sufficient conditions that lead to the presence of the outcome. So, while no individual condition is sufficient for high a IUS score, there are three combinations of sufficient conditions that are adequate.

#### 4.1. Analysis of the robustness of results

In order to test the robustness of the three solution paths, we repeated the QCA procedure with small changes to the data calibration process and small changes to the raw consistency value. Both methods showed that our results were relatively robust. In most cases, using slightly different thresholds yielded relatively similar fuzzy scores as there were clear breaks in the original data, emphasised by the direct method of calibration.

Similarly, in order to test the robustness of the truth table, we also tried to use the raw consistency threshold for the presence of the outcome of 0,8, as is often the standard in fsQCA analysis. It became obvious that a truth table obtained in this way has a significant problem. While consistency scores for rows 7 and 8 were higher than 0,8, their PRI scores were low – even 0 in the case of row 8. This showed that both sufficiency conditions are possibly also sufficiency conditions for the negated outcome  $\sim Y$ . For that reason we decided to increase the consistency threshold to 0,99, where another clear break in the data assured no problems with the PRI scores. Thus, we obtained the original truth table presented above. Small changes to the consistency threshold of 0,99 did not change the structure of the truth table and had no effect on the results. Our results proved to be quite robust according to standard tests of robustness.

However, one problem with our QCA procedure was that it required a large number of prime implicants. This implied that we might have issues with limited diversity. In this case, we had only 23 observations (countries), but we had six conditions – meaning that there are 64 different combinations of conditions. Unfortunately, all the observations in our dataset have only filled 14 truth table rows, resulting in 50 logical reminders. It would help greatly if there were more observations and fewer logical reminders, so we plan to improve the dataset in the future with additional cases that will add to the variability. Nevertheless, there are no indications that additional observations would lead to significantly different solution paths. We therefore conclude that the results are quite robust.

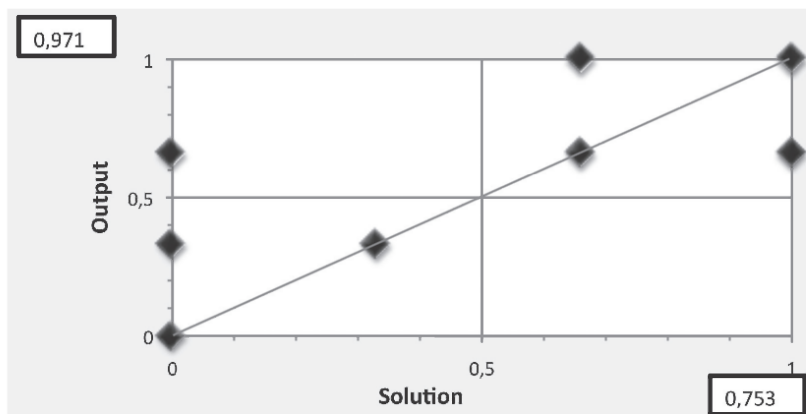
#### 4.2. Assessment of the quality of the results

While we obtained relatively robust results, they could still be of low quality in terms of explaining the actual cases of the countries. Luckily, the QCA analysis allowed us to



formally test the quality of the solution. Both solution consistency scores and solution coverage scores are relatively high. That tells us that most of the countries (cases in our analysis) fit well into the three solution paths – their output (innovation success) is well predicted within our model. The plot of the solution shows that there is an overwhelming majority of typical cases that lie on the bisecting line and several irrelevant cases with very low solution outcomes. The plot also shows a single deviant case with a high solution score but a low outcome score: Estonia. This is a deviant case in terms of consistency in degree. This could imply that some conditions could be missing in the sufficiency path to explain the case of Estonia. Estonia is thus a good target for specific analysis in the form of a case study. On the other hand, we have another outlier in the form of Norway that has a high outcome score but a low solution score. It is thus a deviant case for coverage and could imply that the entire solution path could be missing. Again, this would be a good choice for a case study (although one can imagine that sufficient oil revenue and other broad innovation factors make Norway highly attractive for innovation).

Figure 1: XY plot for the overall solution



**Notes:** \* Solution consistency and solution coverage are reported in the corners.

We can conclude that our solution has relatively high coverage and consistency values and that a large majority of cases lie on the bisecting line, representing typical cases for the solution. The solution is actually quite good at explaining the different sufficiency conditions leading to innovation success.

A general observation one can also ascertain from the XY solution plot is a clear clustering of countries. With the exception of Norway, all Scandinavian countries and Switzerland are successful and have good solution scores. On the other hand, Southern European countries as well as some Eastern European countries cluster together with low outcome scores and low solution scores – in the bottom left corner – and are thus irrelevant cases. A potential explanation for this might be that their low scores could be explained by special conditions. However, the QCA analysis requires a special analysis to explain the negation of the outcome (in this case, the absence of innovation success). We continued

to perform the analysis for the negation of the outcome -  $\sim Y$  = low Innovation Union Scoreboard Summary Index. While not presented here due to space limitations, it does show conditions leading to a lack of innovation success different from the ones leading to its presence. Such asymmetric results are normal for the QCA method but are not possible to obtain using correlational statistical methods.

## 5. DISCUSSION

These results were already quite interesting for the evaluation of the methodology background of the IUS Summary Index. Our QCA analysis showed that the IUS Summary Index methodology is flawed as it lies on a foundation of the probabilistic method of regression analysis. The results of this method are not to be interpreted as if they reveal set relations, necessity or sufficiency. For example, the IUS Summary Index implies that if a country aims to increase individual innovation factors (conditions in QCA analysis), this would lead to a (marginal) increase in its IUS Summary Index score. However, our analysis showed that countries with high IUS Summary Index scores have used different and often specific paths and combinations of conditions to obtain their scores. It is not necessary to have high scores in all factors to reach the outcome. Similarly, in order to improve innovation success, missing conditions can impede achievement of overall success even if countries continue to increase other factors. Single innovation policy measures can unfold only in combination with other precisely specified conditions. In our case, an increase in the *Intellectual assets* score would not improve the overall innovation success of a country like Ireland or Slovenia as sufficient conditions for their innovation success are *Human resources* and *Firm investments* (as well as the necessary condition for all innovation success of *Linkages & entrepreneurship*). This confirmed conjunctural causation – a defining characteristic of causal complexity.

Another advantage of using a set-theoretic method in our research was that it enabled potential clusters of institutional configurations and countries to be identified. If such clusters could be found, this would imply convergence tendencies among countries. Additionally, this approach could lead to an observation that several different configurations of causal conditions will be linked to the same outcome (Allen & Aldred, 2011). This is very useful for our research as it allowed us to assess whether different countries are able to reach the same objective – innovation outputs – by different means. The results of our research showed three distinct paths to the outcome, each with specific countries that use it (there are also a number of countries that use more than one path at the same time). This confirmed equifinality – another characteristic of causal complexity.

Finally, the results showed that the paths to the outcome were not the same as the paths to the negation of the outcome. Three distinct paths exist to explain the combinations of sufficient conditions that lead to the presence of the outcome, and one condition is proven to be necessary. However, while not presented in the paper, four paths lead to the negation of the outcome and no condition is necessary. This is a clear example of causal asymmetry.

Our research showed that the phenomenon of successful innovation policy is causally complex. It also showed that the IUS Summary Index does not account for this complexity. The IUS Summary Index is inherently a correlation model. This method would be appropriate if the innovation theory implied (and empirical evidence confirmed) that the linear additive effects of single variables independent of any other causal factor would be sufficient to explain different levels of innovation outcomes between countries. As this does not seem to be the case and innovation policies are causally complex, set-theoretic methods are a better methodological model for research on innovation policies (Schneider & Wagemann, 2012, p. 77).

This does not mean that set-theoretic methods have no limitations. They are based on data calibration that influences set memberships. In general, slight changes in the calibration could lead to significantly different results. Its use of logical reminders to obtain maximum diversity and best results is difficult and often flawed (although one can always choose to ignore the use of logical reminders and just use the complex solution that does not include logical reminders in its analysis). And initially, the method is somewhat difficult to use as its logic rests on Boolean algebra and not on the probabilistic statistical approach that most social science researchers are more familiar with. However, the use of this novel method can improve the understanding of some phenomena that 'standard' statistical methods cannot explain well. We believe that innovation policy research is such a phenomenon.

## 6. CONCLUSION AND IMPLICATIONS

We have identified a couple of specific countries that call for more thorough in-depth analysis in the form of case studies. Our analysis identified Estonia and Norway as specific targets. Estonia has a high solution score but a low outcome score. This is a deviant case for consistency in degree. On the other hand, we have another outlier in the form of Norway, which has a high outcome score but a low solution score. It is thus a deviant case for coverage. Both cases are not well explained by the three solution paths obtained as results of the QCA procedure. They call for more in-depth analysis in the form of case studies.

The demonstration of the fsQCA procedure on our dataset also confirmed the special importance of *Linkages & entrepreneurship* as a necessary condition for innovation success. This supports the idea originating from the open innovation framework: Innovation is not a closed system but is rather dependent of the extent of mutual cooperation. A lack of linkages and networking across organisational boundaries does represent a systemic failure, as do lock-ins to specific collaboration partners, sources of ideas and information or excessive overall 'closure' of learning processes (Herstad et al., 2010). This failure needs to be tackled in a way similar to market failures – through policy intervention (Klein Woolthuis et al., 2005). Innovation policies need to take this into account and devise policy measures that do not focus solely on supporting individual companies but on their collaboration as well.

Examples of such policies are already in place. In the EU, they include the Knowledge and Innovation Communities (KIC) of the European Institute of Innovation and Technology

(EIT). They focus on the international collaboration of companies, public research organisations, universities and other actors from several EU countries in pursuit of the development of a specific technology (and creating pan-European value chains for the future). The results of these policies are measured in the IUS by public-private co-publications, innovative SMEs collaborating with others and SMEs innovating in-house. R&D collaboration (especially international) and joint entrepreneurial development of new innovations form the necessary condition for innovation success and should be targeted by national policy-makers. Another interesting example of such a policy instrument is the so-called ‘innovation voucher’ – successfully implemented in the US and in Israel. Companies can obtain a subsidy from the government that has to be used for obtaining innovation results (often technology or intellectual property) from public research organisations. Thus, it facilitates mutual cooperation and knowledge transfer between public research (often in the realm of basic science) and commercialisation in private companies. Both private and public stakeholders benefit from such collaboration, as does the general public due to increased societal yields of public funds invested into basic public research in the form of newly created value. While this value is captured by the companies, it also contributes towards financing public goods through taxes and social contributions (and often licence fees).

However, there is no single public policy supporting Linkages & entrepreneurship that will be successful in every business (eco)system. While good practice examples as the ones mentioned above should be tried in several countries, the results of our analysis show that there are different solution paths leading to innovation success. This means that individual countries with their distinct business systems will be more inclined to try certain policies than others and will also be able to benefit more from certain policy measures than from others. This leads to the individual solution paths towards innovation success. Countries with similar business systems will develop similar solution paths, which we can observe in our results. This also means that individual countries should not blindly copy measures that work in other countries. Rather, they should test different measures and keep those that yield the best results, establishing their own solution paths. Successful innovation policy-making should be focused on establishing a platform for testing and evaluating different innovation policy measures, continuing those that are proven successful and discontinuing those that are not – replacing them with new measures to test. Such a lean policy-making approach mimics the lean approach to business development seen in startup companies.

Our research shows that the IUS framework remains useful as it provides data for a comparative assessment of research and innovation performance, collecting a large database of innovation indicators and innovation policy measures. This makes it a useful tool for innovation research. The IUS also highlights the importance of innovation policy to policy-makers and the general public, assuring innovation policies considerable publicity in the media and in the interested public. It has been instrumental in the preparation of the new pan-European flagship initiative called the ‘Innovation Union’ as part of the EU’s 10-year strategy. However, the IUS Summary Index should not be recommended as a tool for innovation policy evaluation.

Finally, the results of our research revealed the specific limitations of our research. This research has the potential to expand its use by continuing with specific in-depth case studies, focusing on individual innovation policy measures and exploring the institutional structure and framework conditions for innovation.

Another clear limitation of this research is that it does not focus on evaluating particular and individual innovation policy measures. This was not its purpose, but such evaluation would be highly useful for a better understanding of the distinct causally complex processes that lead to innovation success. The EU, with its commonalities (shared cultural and to some extent regulatory environment) and differences in implementing national innovation policies represents a perfect laboratory for innovation policy research. There is also a sufficient amount of data gathered on EU countries, both on policy measures and their results. Further research in this direction would help explain large differences in innovation success between countries sharing so much otherwise.

Further studies on the broader innovation policies and institutional framework supporting innovation will also need to focus on the influence that these policies have on innovation success. For example, the 'varieties-of-capitalism' (Hall & Soskice, 2001) approach shows that the institutional structures of different types of economies influence their innovation capabilities and innovation success. We did not include such conditions in our analysis, but they could yield interesting results.

There is also clear evidence that socio-economic factors are increasingly important for the positioning of innovation activities in global value chains. Looking at 'narrow' innovation policies (those that specifically target innovation activities) might not be sufficient as other framework conditions might be even more important. A thorough analysis of the factors influencing innovation success will have to include them as well into the research design and dataset.

## REFERENCES

- Adam, F. (2014). *Measuring National Innovation Performance*. Berlin, Heidelberg: Springer Berlin Heidelberg. doi:10.1007/978-3-642-39464-5
- Allen, M. M. C., & Aldred, M. L. (2011). Varieties of capitalism, governance, and high-tech export performance: A fuzzy-set analysis of the new EU member states. *Employee Relations*, 33 (4), 334–355. doi:10.1108/01425451111140622
- Arnold, E. (2004). Evaluating research and innovation policy: a systems world needs systems evaluations. *Research Evaluation*, 13 (1), 3–17. doi:10.3152/147154404781776509
- Cherchye, L., Moesen, W., & Van Puyenbroeck, T. (2004). Legitimately Diverse, yet Comparable: On Synthesizing Social Inclusion Performance in the EU. *JCMS: Journal of Common Market Studies*, 42 (5), 919–955. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/j.0021-9886.2004.00535.x/abstract>
- Chesbrough, H. (2012). Open Innovation: Where We've Been and Where We're Going. *Research-Technology Management*, 55 (4), 20–27. doi:10.5437/08956308X5504085
- Chesbrough, H. W. (2003). *Open innovation: the new imperative for creating and profiting from technology* (p.

227). Harvard Business Press. Retrieved from <http://books.google.com/books?hl=en&lr=&id=4hTRWStFhVgC&pgis=1>

Chesbrough, H. W. (2006). *Open Business Model* (p. 256). Boston: Harvard Business Press. Retrieved from [http://books.google.si/books?id=-f4XSIN37coC&dq=open+business+models&source=gbs\\_navlinks\\_s](http://books.google.si/books?id=-f4XSIN37coC&dq=open+business+models&source=gbs_navlinks_s)

Commission, E. (2013a). DG Enterprise and industry - Industrial Innovation. *European Commission web portal*. Retrieved from <http://ec.europa.eu/enterprise/policies/innovation/>

Commission, E. (2013b). DG Enterprise and industry - Innovation Policy. *European Commission web portal*.

Commission, E. (2013c). Innovation Union - a Europe 2020 Initiative. *European Commission web portal*. Retrieved from [http://ec.europa.eu/research/innovation-union/index\\_en.cfm](http://ec.europa.eu/research/innovation-union/index_en.cfm)

De Backer, K. et al. (2008). *Open innovation in Global Networks* (Vol. 14, p. 132). Paris. doi:10.1016/j.drudis.2009.09.001

Diez, M. A. (2001). The Evaluation of Regional Innovation and Cluster Policies: Towards a Participatory Approach. *European Planning Studies*, 9(7), 907–923. doi:10.1080/09654310120079832

Ebersberger, B., Herstad, S., Iversen, E., Kirner, E., & Som, O. (2011). *A ANALYSIS OF INNOVATION DRIVERS AND BARRIERS Economic and Market Intelligence on Innovation Open Innovation in Europe : effects , determinants and policy*. *Innovation* (p. 235).

Economist, I. U. (2009). *A new ranking of the world ' s most innovative countries: notes on methodology* (p. 11). London.

Edquist, C. (2001). The Systems of Innovation Approach and Innovation Policy: An account of the state of the art. *DRUID Conference, Aalborg*, 1–24. Retrieved from [http://www.druid.dk/uploads/tx\\_picturedb/ds2001-178.pdf](http://www.druid.dk/uploads/tx_picturedb/ds2001-178.pdf)

Fiss, P. (2011). Building better causal theories: a fuzzy set approach to typologies in organization research. *Academy of Management Journal*, 54 (2), 393–420.

Fiss, P. (2012). Using Qualitative Comparative Analysis (QCA) and Fuzzy Sets.

Hall, P. A., & Soskice, D. (2001). *Varieties of capitalism: The institutional foundations of comparative advantage* (p. 540). New York: Oxford University Press.

Herstad, S. J., Bloch, C., Ebersberger, B., & van de Velde, E. (2010). National innovation policy and global open innovation: exploring balances, tradeoffs and complementarities. *Science and Public Policy*, 37 (2), 113–124. doi:10.3152/030234210X489590

Hollanders, H., Es-Sadki, N., & Commission, E. (2013). *Innovation Union Scoreboard 2013. The Innovation Union's performance scoreboard for ...* (p. 80). Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Innovation+Union+Scoreboard#1>

Hollanders, H., & van Cruysen, A. (2008). *Rethinking the European Innovation Scoreboard: A New Methodology for 2008-2010* (p. 44).

Irish Innovation Taskforce. (2010). *Innovation Ireland - Report of the Innovation Taskforce* (p. 132). Dublin.

Klein Woolthuis, R., Lankhuizen, M., & Gilsing, V. (2005). A system failure framework for innovation policy design. *Technovation*, 25 (6), 609–619. doi:10.1016/j.technovation.2003.11.002

Kraemer, K. L., Gurbaxani, V., & King, J. L. (1992). Economic development, government policy, and the diffusion of computing in Asia-Pacific countries. *Public Administration Review*, 52 (2), 146–156.

- Lin, G. T. R., Shen, Y.-C., & Chou, J. (2010). National innovation policy and performance: Comparing the small island countries of Taiwan and Ireland. *Technology in Society*, 32 (2), 161–172. doi:10.1016/j.techsoc.2010.03.005
- Mcphee, C., & Segers, J. (2013). Editorial: Open Innovation and Entrepreneurship. *Technology Innovation Management Review*, (April), 3–5.
- Nil, J., & Kemp, R. (2009). Evolutionary approaches for sustainable innovation policies: From niche to paradigm? *Research Policy*, 38 (4), 668–680. doi:10.1016/j.respol.2009.01.011
- OECD *Reviews of Innovation Policy: Slovenia*. (2012) (p. 182).
- OECD *Science, Technology and Industry Scoreboard 2013*. (2013) (p. 279). doi:http://dy.doi.org/10.1787/sti\_scoreboard-2013-en
- Ragin, C. C. (1987). *The comparative method* (p. 181). University of California Press.
- Ragin, C. C. (2000). *Fuzzy-set social science* (p. 350).
- Ragin, C. C. (2007). *Družboslovno raziskovanje - enotnost in raznolikost metode* (p. 201).
- Ragin, C. C., Kriss, A. D., & Davey, S. (2006). *Fuzzy-Set/Qualitative Comparative Analysis 2.0*. Tuscon, Arizona: University of Arizona, Department of Sociology.
- Ragin, C. C., & Rihoux, B. (2009). *Configurational Comparative Methods* (p. 185).
- Rammer, C., & (ZEW), C. for E. E. R. (2005). *Comments on EIS Improvements for 2005*.
- Rihoux, B., & Grimm, H. (2006). *Innovative Comparative Methods for Policy Analysis* (p. 358). Springer.
- Schibany, A., & Streicher, G. (2008). The European Innovation Scoreboard: drowning by numbers? *Science and Public Policy*, 35 (10), 717–732. doi:10.3152/030234208X398512
- Schneider, C. Q., & Wagemann, C. (2012). *Set-theoretic Methods for the Social Sciences* (p. 350).
- Svarc, J. (2006). Socio-political factors and the failure of innovation policy in Croatia as a country in transition. *Research Policy*, 35 (1), 144–159. doi:10.1016/j.respol.2005.09.002
- Švarc, J. (2006). Socio-political factors and the failure of innovation policy in Croatia as a country in transition. *Research Policy*, 35 (1), 144–159. doi:10.1016/j.respol.2005.09.002
- Technology, P. C. O. A. O. S. A. (2010). *Report to the President and the Congress on the Third Assessment of the National Nanotechnology Initiative* (Vol. 4, p. 96). Washington.
- Von Hippel, E. (1986). Lead Users: A Source of Novel Product Concepts. *Management Science*, 32 (7), 791–805. doi:10.1287/mnsc.32.7.791
- Von Hippel, E. (2005). *Democratizing innovation*.



## APPENDIX

## Raw data

2010 VALUES (ORIGINAL NORMALISED VALUES)	Summary Innovation Index	Human resources	Research systems	Finance and support	Firm investments	Linkages & entrepreneu rship	Intellectual assets
Belgium	<b>0,625</b>	0,657	0,761	0,597	0,471	0,733	0,511
Czech Republic	<b>0,400</b>	0,509	0,283	0,294	0,419	0,429	0,257
Denmark	<b>0,704</b>	0,633	0,777	0,674	0,564	0,813	0,875
Germany	<b>0,711</b>	0,605	0,544	0,597	0,695	0,629	0,799
Estonia	<b>0,492</b>	0,532	0,326	0,646	0,631	0,607	0,349
Ireland	<b>0,571</b>	0,746	0,631	0,359	0,501	0,533	0,446
Greece	<b>0,339</b>	0,450	0,298	0,206	0,220	0,466	0,138
Spain	<b>0,410</b>	0,405	0,539	0,497	0,264	0,261	0,401
France	<b>0,540</b>	0,670	0,656	0,656	0,349	0,470	0,477
Italy	<b>0,429</b>	0,426	0,398	0,386	0,438	0,305	0,517
Luxembourg	<b>0,651</b>	0,747	0,534	0,635	0,505	0,547	0,647
Hungary	<b>0,333</b>	0,430	0,246	0,262	0,324	0,203	0,267
Netherlands	<b>0,595</b>	0,631	0,820	0,710	0,235	0,585	0,679
Austria	<b>0,626</b>	0,581	0,613	0,498	0,502	0,743	0,753
Poland	<b>0,304</b>	0,584	0,153	0,338	0,313	0,187	0,243
Portugal	<b>0,426</b>	0,438	0,447	0,549	0,417	0,356	0,346
Slovenia	<b>0,499</b>	0,602	0,410	0,542	0,557	0,602	0,425
Slovakia	<b>0,322</b>	0,563	0,160	0,146	0,460	0,205	0,168
Finland	<b>0,708</b>	0,877	0,593	0,832	0,639	0,900	0,643
Sweden	<b>0,766</b>	0,880	0,795	0,911	0,666	0,849	0,788
United Kingdom	<b>0,599</b>	0,698	0,784	0,749	0,470	0,551	0,469
Norway	<b>0,485</b>	0,663	0,817	0,656	0,213	0,567	0,305
Switzerland	<b>0,818</b>	0,820	1,000	0,666	0,713	0,709	0,952

## Calibrated data

	Summary Innovation Index	Human resources	Research systems	Finance and support	Firm investments	Linkages & entrepreneu rship	Intellectual assets
country	ius_c	hr_c	rs_c	fs_c	fi_c	la_c	ia_c
BE	0,94	0,96	1	0,72	0,85	1	0,57
CZ	0,25	0,6	0,06	0,04	0,64	0,61	0,04
DK	0,99	0,94	1	0,9	0,98	1	1
DE	0,99	0,9	0,81	0,72	1	0,99	1
EE	0,56	0,69	0,11	0,85	1	0,99	0,12
IE	0,85	0,99	0,96	0,09	0,92	0,94	0,34
GR	0,12	0,37	0,08	0,02	0,05	0,78	0,01
ES	0,27	0,24	0,79	0,37	0,1	0,08	0,22
FR	0,76	0,97	0,97	0,87	0,31	0,79	0,44



	Summary Innovation Index	Human resources	Research systems	Finance and support	Firm investments	Linkages & entrepreneurship	Intellectual assets
IT	0,33	0,3	0,26	0,13	0,73	0,15	0,6
LU	0,96	0,99	0,77	0,83	0,93	0,95	0,94
HU	0,11	0,31	0,04	0,03	0,23	0,03	0,04
NL	0,9	0,93	1	0,94	0,06	0,98	0,97
AT	0,94	0,85	0,94	0,37	0,92	1	0,99
PL	0,08	0,86	0,01	0,07	0,2	0,03	0,03
PT	0,32	0,33	0,42	0,53	0,62	0,29	0,12
SI	0,59	0,89	0,3	0,5	0,98	0,99	0,28
SK	0,1	0,8	0,01	0,01	0,82	0,03	0,01
FI	0,99	1	0,91	0,99	1	1	0,94
SE	1	1	1	1	1	1	1
UK	0,9	0,98	1	0,97	0,85	0,96	0,41
NO	0,53	0,96	1	0,87	0,04	0,97	0,07
CH	1	1	1	0,89	1	1	1

### Fuzzy scores

	Summary Innovation Index	Human resources	Research systems	Finance and support	Firm investments	Linkages & entrepreneurship	Intellectual assets
BE	1	1	1	0,66	0,66	1	0,66
CZ	0,33	0,33	0	0	0,66	0,66	0
DK	1	0,66	1	1	1	1	1
DE	1	0,66	0,66	0,66	1	1	1
EE	0,66	0,33	0	1	1	1	0,33
IE	1	1	1	0	0,66	1	0,33
GR	0	0	0	0	0	0,66	0
ES	0,33	0	0,66	0,33	0	0	0,33
FR	0,66	1	1	1	0,33	0,66	0,66
IT	0,33	0	0,33	0	0,66	0,33	0,66
LU	1	1	0,66	1	0,66	1	1
HU	0	0	0	0	0,33	0	0
NL	1	0,66	1	1	0	1	1
AT	1	0,66	1	0,33	0,66	1	1
PL	0	0,66	0	0	0,33	0	0
PT	0,33	0	0,33	0,33	0,66	0,33	0,33
SI	0,66	0,66	0,33	0,33	1	1	0,33
SK	0	0,33	0	0	0,66	0	0
FI	1	1	1	1	1	1	1
SE	1	1	1	1	1	1	1
UK	1	1	1	1	0,66	1	0,66
NO	0,66	1	1	1	0	1	0
CH	1	1	1	1	1	1	1

# THE TRADE-OFF BETWEEN ROAD AND RAILROAD FREIGHT TRANSPORT – COST BENEFIT ANALYSIS FOR SLOVENIA

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**ABSTRACT:** *The choice of transportation mode for freight transport has a profound effect on logistics companies, infrastructure providers and society as a whole. The efficiency of freight transport is important because it has a profound effect on several economic and environmental factors. The paper analyses the costs difference between railroad and road freight transport. The stakeholder analysis is used to enable the identification of the interests of various groups. The government is identified as the focal stakeholder. The governmental decision support model that focuses on the Slovenian case of road and railway freight transport is proposed. The proposed model can serve the government with its decision-making process when adopting policies that concern road and railroad transport such as subsidies or increased road tolls in order to promote railroad transport.*

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**Keywords:** *freight transport, road transport, railroad transport, government, stakeholder analysis*

**JEL Classification:** R42, O18

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## 1. INTRODUCTION

The choice of transportation mode has a profound effect on logistics companies, infrastructure providers and society as a whole. Often the transportation modes that are optimal for society are overlooked due to the interests of particular stakeholders. Further, strategic decisions in practice are often made based on quick calculations without clearly outlining the underlying assumptions. On the other hand, academic research often suffers from a lack of relevance and is lost in complex mathematical models that do not lead to direct practical use.

A typical example of such a decision is the trade-off between road and railroad freight transportation. For environmental reasons the use of railroads is preferred, whereas due to the costs, time and convenience the road transport usually prevails (Ricci & Black,

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2005). Both the financial and non-financial costs of various choices have to be considered, although this often proves difficult. Such decisions are namely typically made without a careful consideration of all stakeholders. Often, the focus is solely on a few indicators or a single one. A typical example is an exclusive focus on reducing CO<sub>2</sub> emissions, disregarding other, perhaps even more important factors, such as particulate matter, noise and water pollution. Therefore, a more scientific approach is to monetise all the decision variables and to provide a cost-benefit analysis (Annema, Koopmans & Van Wee, 2007).

The interests of various actors (government, infrastructure operators, carriers, shippers) need to be analysed. An important contribution of our paper is thus the identification of variables that influence governmental decisions when promoting either road or railroad transport. We identify and compare different costs associated with rail and road freight transport and assess the costs of changing modes for such transport. In order to make such comparison possible we monetise all the identified costs. The analysis is deliberately simple enough to allow it to be repeated in various environments and with different input variables. In addition, the variables and factors not included in the calculation are clearly stated to assure the greater validity and better interpretation of the results.

The structure of the paper is as follows: in the next section we describe different stakeholders and their interests within the scope of the stakeholder theory. We identify the government as the focal stakeholder. We then introduce influencing factors the government as the central stakeholder needs to take into consideration. This is followed by the presentation of the results of the cost benefit analysis. In the last section we summarise the results as well as outline the limitations and proposals for further research.

## 2. ACTORS AND THEIR INTERESTS

### 2.1. Stakeholder theory in transport

The paper examines the trade-off between railroad and road freight transport using the existing infrastructure. Stakeholder analysis is used to enable the identification of the interests of various groups and identifying the focal stakeholder via stakeholder mapping. Stakeholders are defined as groups which can affect and/or are affected by the achievement of an organisation's purpose (Freeman, 1984). Stakeholder theory then describes the constellation and cooperation of their cooperative and competitive interests. It also recommends practices, attitudes and structures that constitute stakeholder management. All stakeholders with legitimate interests cooperate to obtain benefits and there is no *prima facie* priority of one set of interest and benefits over the other (Donaldson & Preston, 1995). Multiple interdependent stakeholders' demands need to be accommodated and organisations need to respond to the simultaneous influences of various stakeholders (Rowley, 1997).

While the stakeholder analysis is most often used to examine stakeholders at the organisational level it can be used to examine the industry-level situation as well. See e.g. Byrd

(2007) who analysed stakeholders in tourism development to investigate how planners and developers should involve stakeholders in the development of tourism. The development of transport infrastructure can be approached in a similar way.

The stakeholder analysis is particularly appropriate for the analysis of logistics because of the multiple and sometimes ill-defined and conflicting objectives expressing the values, needs and aspirations of the various stakeholders involved in and affected by the planning and operation of inter-modal transport facilities (Zografos & Regan, 2004). Further, the decisions affect a wide array of individuals and companies, not only primary but also secondary stakeholders (e.g. individuals who suffer in traffic jams or due to transport-caused pollution). A typical example is the State of Georgia's Department of Transportation that conducts stakeholder audits to identify stakeholders' interests and obtain their cooperation. All these are needed to succeed in its mission of providing a safe, seamless and sustainable transportation system in Georgia that supports the state's economy and is responsive to citizens' concerns and its numerous other primary and secondary stakeholders (Thomas & Poister, 2009).

There are many evaluation criteria for evaluating decisions, e.g. financial costs, hazardous gas emissions, congestion levels or energy consumption. Evaluation criteria for each stakeholder need to be determined (Brewer, Button & Hensher, 2005). Analysing the positions and interests of stakeholders is vital for effective environmental conflict management (Elias, Jackson & Cavana, 2004). In order to encourage meaningful commitment from industry, government has a major role to play in facilitating the environment for such participation in the provision of transport infrastructure (Hensher & Brewer, 2001). Different aspects have to be taken into account and the consequences of the projects are usually far reaching and the different policy alternatives are numerous and difficult to predict (Macharis & Bontekoning, 2004). The analysis of stakeholders assists in identifying the types of strategies, responses and postures that may be adopted by firms in addressing transport reform, e.g. the effects on climate change (Martin & Rice, 2010).

Several different stakeholders are involved when considering road transport vis-à-vis railroad transport. Each actor has its own interests which can lead to conflicts between the actors. In the following subsection we identify and analyse the stakeholders that are likely to be affected by activities that promote either road or railroad transport. The government is identified as a focal stakeholder that tries to pursue goals that are best for society as a whole. Other stakeholders such as infrastructure operators, transport providers and shippers are also discussed as vital stakeholders since the policies directly affect them.

## 2.2. Government and other stakeholders

The government is often seen as just another stakeholder, analogous to the way in which some popular political models portray business as just another interest group competing for political favours. However, government is far more than that because it is the major player in the public policy process. The government is the only entity with the legitimacy

to speak for society as a whole and can thus change the way corporations and industries are governed and managed (Buchholz & Rosenthal, 2004).

One of the foremost concerns for the government is economic growth which is importantly influenced by the country's capability to provide its business environment with state-of-the-art transport infrastructure (Sanchez-Robles, 1998). However, building such infrastructure is costly. Compromises are therefore made when deciding on which infrastructure to invest in. With the limited governmental budgets it is not possible to build the entire necessary infrastructure for all transportation modes. Therefore, it is in the government's best interest to invest in the transport infrastructure that will yield the best results as measured by monetary or some other gains (Sanchez-Robles, 1998). External cost variations can also have different impact on distribution network design (Ortolani, Persona & Sgarbossa, 2011). There are several reasons why infrastructure investment and planning execution is difficult: a lack of relevant data and in-depth analysis, a lack of transparency in national investment planning, biased ex-ante appraisal and a lack of ex-post analysis of investment projects (Short & Kopp, 2005). A cost-benefit analysis should provide a single method across different infrastructure projects overseen by different ministries. However, in Dutch case only half of the analyses of infrastructure projects helped in the decision-making process, while the other half had weaknesses with respect to their methods and assumptions (Annema, et al., 2007).

Another important interest of the government is tax and duty collection. Fuel taxes and duties vary significantly between different countries but they nevertheless represent an important state income. The share of taxes in fuel prices can be high such as in Europe (64% in the United Kingdom, 63% in Germany, 62% in France, 51% in Slovenia (OGRS, 2006) or low such as in the United States (18%) (Davis, Diegel & Boundy, 2011). Therefore, when optimising its tax and duty gains the government needs to evaluate whether to promote road or railroad transport. Yet, other types of costs connected to either transport mode also need to be considered (Macharis & Bontekoning, 2004). The evaluation also needs to include the available energy resources and the impact on the environment which will be discussed next.

Environmental protection is another important interest of the government. It is in the government's interest to lessen the environmental impact of transport. There are differences between the environmental impact of each of the discussed transportation modes on a micro or a macro scale, where the micro scale includes areas in the proximity of the transport routes and the macro scale is the effect on the wider areas.. One example of decrease of environmental effects is the Russian-Finnish case where a modal shift from roads to railroads has been proposed in order to promote green transport practices. This shift has largely been prevented by insufficient infrastructure and equipment (Padilha & Hilmola, 2010).

The interests described above are interwoven which means that the government needs to weigh the different effects. This can be done by monetising the effects and seeking the financial optimum.

Highway and railroad operators share the same interest: to maximise profit. Both can either be publicly-owned or private companies. In either cases a public-private partnership is established in the form of concessions or franchises where a private company either operates the service, provides the infrastructure or both (McQuaid & Scherrer, 2005). Generally, the companies operate within a certain governmentally imposed framework; the government is therefore always involved as a stakeholder, either directly via governmental ownership or indirectly via governmental regulations.

Transport via highways or railroads means more revenue for operators on one side, but also higher maintenance costs on the other, irrespective of who owns the infrastructure. However, an increase in traffic does not linearly increase operating costs due to the automation of some of the operating processes such as toll collection (Massiani & Ragazzi, 2008). Another limitation is the capacity of the infrastructure (Abril et al., 2008).

Similar to operators, transport providers also follow the same goal, namely, to maximise profit. Transport providers can use different transport modes to meet the needs of their customers. For example, a road transport provider can load their vehicles on trains for a certain part of the route. However, they are limited by the costs of infrastructure use. Other limitations include fuel prices, labour costs, emissions (Macharis & Bontekoning, 2004), information quality (Popovic & Habjan) etc. Their interests are therefore to reduce costs in order to lower the cost price and eventually their selling price.

If the desired cost price is not achieved then transport companies need to be stimulated by subsidies from outside stakeholders such as government. There are several programmes at EU and national level which promote the use of railroads as a transport mode (EEA, 2007). According to the European Environment Agency (Best et al., 2007), non-infrastructure subsidies (subsidies not related to infrastructure investments) for rail are significantly higher than for other modes, with rail receiving EUR 33 billion of non-infrastructure subsidies in comparison to only EUR 7 billion of non-infrastructure subsidies received for roads. One such example is the Belgium government which subsidises rail transport in order for it to be able to compete with other transport modes (Pekin et al., 2008).

In most cases, customers do not prefer one of the two discussed transportation options per se. The major deciding factors for shippers are not solely related to transport costs but also include other criteria such as service reliability and connectivity (Cook, Das, Aeppli & Martland, 1999). The choice of mode itself depends mainly on the shipment size (Holguín-Veras, Xu, de Jong & Maurer, 2011).

Based on the stakeholder mapping approach which evaluates power and interest of each stakeholder we can identify the government as the focal stakeholder. (Eden & Ackermann, 2013). The interest in this case is the interest of a particular stakeholder to impose their expectations on the particular decisions regarding road and railroad transport, while the power is the ability of each stakeholder to do so (Olander & Landin, 2005).

The government is identified as a high power high interest stakeholder. Other identified stakeholders are identified as low power, high interest stakeholders.

### 3. INFLUENCING FACTORS

Based on the descriptions of the interests of different stakeholders in the previous section we conclude that the only stakeholder which does not have a predetermined stance is the government. It has to coordinate the different interests of various other stakeholders by looking for the societal global optimum. Based on a literature review, the major influencing factors involved in such optimisation are economic and environmental.

The first group of factors are economic factors which include economic development and a balanced budget. Economic development can be catalysed by developing transport infrastructure (Sanchez-Robles, 1998). Further, the maintenance of existing infrastructure in itself provides a boost to economic growth (Ighodaro, 2009). A study of governmental capital transport investments in over 50 countries has shown that investments in infrastructure are an important element of economic development (Boopen, 2006). For example, the gap in economic growth between different Chinese provinces was caused by different levels of investments in transport networks (Demurger, 2001). Due to limited budget resources governments need to selectively invest in various projects, including infrastructural ones. A balanced budget is therefore also an important influential economic factor.

The second group of influencing factors encompasses environmental factors associated with different types of transport. Freight transport has undesirable effects on the environment, out of which greenhouse emissions are often considered to be the most prominent (Bauer, Bektas & Crainic, 2010). Emissions from land transport and from road transport in particular, have significant impacts on the atmosphere and on climate change (Uherek et al., 2010). Yet the environmental impact is not limited to CO<sub>2</sub> emissions. For example, fine particulate and sulphur oxide-related pollution are associated with all-cause, lung cancer, and cardiopulmonary mortality (Pope et al., 2002).

Of the two transport modes compared here, road transport is much more polluting than rail transport per tonne-km of goods transported (Santos, Behrendt & Teytelboym, 2010). Rail external costs are about four to five times lower than trucking external costs (Forkenbrock, 2001). These external costs include costs of noise which is the same for both modes, greenhouse gasses and air pollution costs which are about eight times higher for road transport, and costs of accidents which are about three and a half times higher for road transport (Forkenbrock, 2001). Traffic congestion is another important type of external cost (Janic, 2007). It accounts for roughly a third of all road delays (McKinnon, Edwards, Piecyk & Palmer, 2009).

Both groups of influencing factors are interwoven which means that decisions that are made to appease one group affect another. A shift towards the greater use of rail in freight



transport is desirable in order to lower the environmental impact. The available railroad infrastructure needs to be able to absorb the cargo shift from roads. If it does not, the investments into the infrastructure need to be considered. In terms of cargo transportation it is better to invest in railroad infrastructure than in highway infrastructure because of the mentioned positive externalities in the form of the environmental impact while also improving the speed of shipments (Pazour, Meller & Pohl, 2010).

#### 4. DECISION MODEL

The model focuses on the Slovenian case of road and railway freight transport. Its goal is to show an example that can serve the government as a decision-support mechanism and what-if analysis tool when deciding whether to subsidise rail transport and how that decision impacts the national budget. The potential drivers for shift from road to railroad transport are explained in the previous section.

In the Slovenian case both the highway and the railroad operator are owned by the government. In addition, the railroad operator is also the main provider of rail transport services. The public ownership of both gives the government the ability to directly manage both of them in order to pursue optimisation on the national level.

##### 4.1. Data collection

The data were collected from several different sources. The first two sources were internal data from the Motorway Company in the Republic of Slovenia (DARS) and from the Slovenian Railways. These data were supplemented from various public sources such as the Slovenian Roads Agency, and the Statistical Office of the Republic of Slovenia. The last group of data sources were previous research papers.

The proposed model includes the following input data obtained for the year 2010:

1. prices of highway tolls for different types of heavy goods vehicles based on engine types, provided by DARS (Motorway Company in the Republic of Slovenia);
2. number of heavy goods vehicles passing through specific toll stations, provided by DARS, and number of heavy goods vehicles passing through different highway check points across the country, provided by the Slovenian Roads Agency;
3. costs of infrastructure maintenance provided by DARS;
4. available cargo transport capacity of railway infrastructure (Brezigar, February 19, 2013);
5. the model assumes heavy goods vehicles weighing 40 tonnes, which is the highest permitted mass in Slovenia;
6. the fuel consumption rate used is 32.5 litres per 100 kilometres (Schittler, 2003);
7. the assumed average speed of road freight vehicles is 62km/h (Cornillier, Laporte, Boctor & Renaud, 2009; Fabiano, Curro, Palazzi & Pastorino, 2002);
8. depreciation period for road freight vehicles is 22,000 working hours and the price



- for a new road freight vehicle EUR 100,000 (Heavy-duty truck and bus engines);
9. costs of CO<sub>2</sub> and the price of petrol were assessed on 14.12.2010; and
  10. the gross salary of truck drivers is based on the average gross salary for the road freight industry, as provided by the Statistical Office of the Republic of Slovenia.

#### 4.2. Assumptions

Based on the data available some assumptions had to be made and certain limitations imposed on the calculations. The assumptions made are as follows:

1. each truck is assumed to travel entirely through at least one of the four highway sections in Slovenia (see Figure 1);
2. all marginal costs and revenues are constant;
3. the customers (shippers) are looking for the lowest price;
4. there are no data available that would provide us with the elasticity of demand for transport services, therefore it is assumed that the first unit of road transport that moves to railroad transport has the same financial effects than the last unit;
6. infrastructural investments are not taken into consideration; and
7. financial consequences for road and railroad freight transport companies are neglected since the model assumes the Government's point of view.

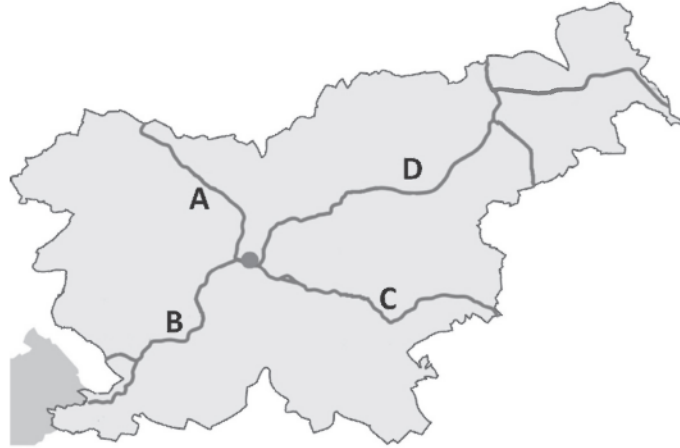
#### 4.3. Results

We analysed the impact of possible governmental decisions on the costs and incomes of the stakeholders. These include tolls, infrastructure wear, fuel consumption, fuel taxes, equipment depreciation and CO<sub>2</sub> pollution.

Firstly, we calculated the difference between the costs of road and rail freight transport on the national level at a yearly aggregate level. The cost of rail freight transport is 155% higher in this case.

However, since the calculation is based on the aggregate level the results could be misleading. This is due to the fact that the costs of railroad freight transport are provided in EUR/km and are decreasing with transport distance. Therefore, the distances need to be separated into different sections in order to ascertain the cost differences by sections. We decided to base the sections on the Slovenian highway cross. We therefore used the four different sections with the junction in the centre of Slovenia. For each of the sections average values for one heavy duty vehicle route are calculated. These amounts are also multiplied by the number of vehicles in a certain time period in order to arrive at aggregate data. The sections are labelled A, B, C, D and can be seen in Figure 1.

Figure 1: Slovenian highway scheme



The sections have different lengths. The shortest is section A which is 69km long, followed by section B which is 101km long, section C is 118km long, while the longest section is section D which is 198km long.

Table 1 shows different financial effects with regard to the four different highway sections. The financial effects can be costs for one stakeholder and income for another as outlined in section 2.2.

Table 1: Results on a yearly level

Highway section	A	B	C	D
no. of kilometres	18,683,672	175,347,543	46,712,103	298,770,312
time spent (in hours)	301,350	2,828,186	753,421	4,818,876
tolls (in €)	6,742,028	38,156,411	9,567,458	67,817,061
road wear (in €)	1,522,418	14,288,001	3,806,284	24,344,969
fuel consumption (in litres)	6,072,193	56,987,952	15,181,433	97,100,351
fuel costs (in €)	6,153,136	57,747,601	15,383,802	98,394,699
fuel tax (in €)	2,551,596	23,946,907	6,379,390	40,802,539
CO <sub>2</sub> pollution (in tonnes)	16,626	156,034	41,567	265,863
CO <sub>2</sub> costs (in €)	230,766	2,165,753	576,951	3,690,173
driver costs (in €)	1,822,368	17,103,050	4,556,205	29,141,460
depreciation costs (in €)	1,369,771	12,855,392	3,424,641	21,903,982

For shippers the costs of rail are significantly higher than road freight transport. The difference is lowest on the longest section (D) where the costs of rail transport are 123% higher than costs of road transport. The biggest difference is in section B where it is 202%, with sections A and C being in the middle (199% and 163%, respectively).

This clearly shows that the total costs of railroad transport are considerably (at least two times) higher than those of road transport. An interesting question is what the govern-

ment can do to promote more railroad freight transport in order to lower the environmental impacts of the transport as outlined in section 3.

The extent of potential shift of transport depends on the excess capacities of the current railroad infrastructure. These cumulative data for all four sections were obtained from the railroad network operator (Brezigar, February 19, 2013). The number of road transports on the entire road network is 2.6 million per year, and the extra free capacity of the railroad network is 0.35 million equivalent units per year. The railroad network could therefore transport around 13.5% of current road transport. For larger shifts, the model would have to be expanded to include infrastructure investments.

The first option to promote more railroad freight transport would be to subsidise the railroad freight transport providers so they can lower their prices to achieve competitive prices compared to road transport providers. In addition to the costs of subsidies, the government would also collect less fuel taxes while, on the other hand, the road wear would be less and CO<sub>2</sub> pollution would decrease. The amount of road tolls collected would also be lower which would indirectly impact the government budget in the Slovenian case since the highway operator is owned by the government.

If we take highway section A for example, subsidising one freight transport on railroad would cost the government EUR 137.69 in subsidies to match the price of road freight transport providers. On the other hand, the government's direct income would be EUR 9.42 lower due to lost fuel taxes, while the direct cost would be EUR 0.83 lower due to the reduced CO<sub>2</sub> pollution. The changes in the income of the highway infrastructure provider are lost tolls which are EUR 24.38 in this case, while the cost of road wear would also go down by EUR 5.62. All in all, it would cost the government EUR 165.04 to redirect one freight transport on section A from road to rail. The costs of other sections can be seen in Table 2.

Table 2: *Governmental costs for redirecting one unit of freight transport from road to railroad*

Section	Costs per unit of freight (in €)
A	165.04
B	201.80
C	191.83
D	265.22

The costs of subsidizing the amount of transport that the current railroad infrastructure can absorb (13.5%) are therefore EUR 78 million per year. If the entire road freight transport were switched to railroads, the costs would be EUR 578 million per year. However, such a shift would have to include the costs of railroad infrastructure investments.

Another option for the government to promote the use of railroad freight transport would be to increase highway tolls, thereby increasing the costs of road freight transport. Taking the data that we provided in Table 1 into consideration, the tolls would have to

be raised by 492% in order to make the road freight transport costs equal to the railroad freight transport costs. Obviously the shift of all road transport to railroad can only be theoretical, since the railroads can only absorb 13.5% of road transport. Based on these calculations we conclude that the shift from road to railroad transport within an existing network can be costly and therefore has a questionable financial feasibility.

## 5. CONCLUSION

We provided an insight into the difference between railroad and road freight transport by using stakeholder analysis. We identified the government as the focal stakeholder. The developed decision model can serve the government with its decision-making process when adopting policies that concern road and railroad transport within an existing network infrastructure. Although it includes only a small segment of possible relevant data it does enable the inclusion of additional variables. In such a way new policies can be thoroughly analysed. Furthermore, the paper highlighted a complex system of different stakeholders. Several assumptions needed to be made and the way they are made strongly affects the results.

The paper has several limitations. The calculation included only the data for one country. In reality, most transport routes are trans-national, therefore longer routes can be taken into consideration when comparing railroad and road transport since railroad transport is more competitive over long distances (Posner, 2008) and a breakeven point could be calculated for railroad freight transport when comparing it to road freight transport. Differences in railroad distances, traffic patterns, competition, capacity constraints and passenger traffic prioritization between different railroad systems such as EU and in North America (Clausen & Voll, 2013) also affect the calculations. Further, the calculation is valid for current prices (e.g. fuel or highway tolls); inter-modal logistics networks are very sensitive to changes in costs (Ishfaq & Sox, 2010). In our case very detailed data was available for roads while only limited data was available for railroads. Further analysis would also be facilitated if the price elasticity of the demand for highway freight transport were known so that the effects of incremental toll changes could be assessed. In this respect, the analysis of elasticity of demand and its evolution over time is particularly important (Fouquet, 2012). The calculation is also limited by the capacities of the railroad and road network because it does not include infrastructure investments. Such investments are also one of the main topics for further research.

Further research should delve into a more in-depth understanding of the objective functions of various stakeholders and how the end result can be modified with further constraints without reducing the profit too much. Such an approach can help define different mechanisms that would induce companies to focus on other aspects besides profit; for example, reducing carbon emissions without a considerable impact on their profits (Hua, Cheng & Wang, 2011). Logistics decisions need to examine multiple decision criteria pertaining to multiple stakeholders (Brewer, et al., 2005). The inter-relationships amongst all stakeholders are complex as one group may initiate actions that become im-

pediments for others. Developing systems-based sustainable alternatives to traditional, environmentally-harmful transport modes (e.g. automobiles, trucks) requires the network of relationships between stakeholders and impediments to be considered (Byrne & Polonsky, 2001).

## REFERENCES

- Abril, M. et al. (2008). An assessment of railway capacity. *Transportation Research Part E: Logistics and Transportation Review*, 44 (5), 774-806.
- Annema, J. A., Koopmans, C. & Van Wee, B. (2007). Evaluating transport infrastructure investments: The Dutch experience with a standardized approach. *Transport Reviews*, 27 (2), 125-150. doi: 10.1080/01441640600843237
- Bauer, J., Bektas, T. & Crainic, T. G. (2010). Minimizing greenhouse gas emissions in intermodal freight transport: an application to rail service design. *Journal of the Operational Research Society*, 61 (3), 530-542. doi: doi:10.1057/jors.2009.102
- Best, A. et al. (2007). *Size, structure and distribution of transport subsidies in Europe*. In B. Huckestein (Ed.), (Vol. 2007, pp. 36). Copenhagen: European Environment Agency.
- Boopen, S. (2006). Transport infrastructure and economic growth: Evidence from Africa using dynamic panel estimates. *The Empirical Economics Letters*, 5 (1), 38-52.
- Brewer, A. M., Button, K. J. & Hensher, D. A. (Eds.). (2005). *Handbook of logistics and supply chain management* (Vol. 2): Elsevier.
- Brezigar, M. (February 19, 2013). [Slovenian railroad cargo capacities].
- Buchholz, R. & Rosenthal, S. (2004). Stakeholder theory and public policy: How governments matter. *Journal of Business Ethics*, 51 (2), 143-153. doi: 10.1023/B:BUSI.0000033608.61005.1f
- Byrd, F., T. (2007). Stakeholders in sustainable tourism development and their roles: applying stakeholder theory to sustainable tourism development. *Tourism Review*, 62 (2), 6-13.
- Byrne, M. R. & Polonsky, M. J. (2001). Impediments to consumer adoption of sustainable transportation: Alternative fuel vehicles. *International Journal of Operations & Production Management*, 21 (12), 1521-1538.
- Clausen, U. & Voll, R. (2013). A comparison of North American and European railway systems. *European Transport Research Review*, 5 (3), 129-133.
- Cook, P. D. et al. (1999, 1999). *Key factors in road-rail mode choice in India: applying the logistics cost approach*. Paper presented at the Simulation Conference Proceedings, 1999 Winter.
- Cornillier, F. et al. (2009). The petrol station replenishment problem with time windows. *Computers & Operations Research*, 36 (3), 919-935.
- Davis, S. C., Diegel, S. W. & Boundy, R. G. (2011). *Transportation energy data book* (30th ed.). Knoxville: Oak Ridge National Laboratory.
- Demurger, S. (2001). Infrastructure development and economic growth: An explanation for regional disparities in China? *Journal of Comparative Economics*, 29 (1), 95-117.
- Donaldson, T. & Preston, L. F. (1995). The stakeholder theory of the corporation: Concepts, evidence, and implications. *The Academy of Management Review*, 20 (1), 65-91.

- Eden, C. & Ackermann, F. (2013). *Making strategy: The journey of strategic management*. London: Sage.
- EEA. (2007). *Size, structure and distribution of transport subsidies in Europe*. Copenhagen.
- Elias, A. A., Jackson, L. S. & Cavana, R. Y. (2004). Changing positions and interests of stakeholders in environmental conflict: A New Zealand transport infrastructure case. *Asia Pacific Viewpoint*, 45 (1), 87-104. doi: 10.1111/j.1467-8376.2004.00229.x
- Fabiano, B. et al. (2002). A framework for risk assessment and decision-making strategies in dangerous good transportation. *Journal of Hazardous Materials*, 93 (1), 1-15.
- Forkenbrock, D. J. (2001). Comparison of external costs of rail and truck freight transportation. *Transportation Research Part A: Policy and Practice*, 35 (4), 321-337.
- Fouquet, R. (2012). Trends in income and price elasticities of transport demand (1850-2010). *Energy Policy*, 50, 62-71.
- Freeman, R. E. (1984). *Strategic Management: A Stakeholder Approach*. Englewood Cliffs, New Jersey: Prentice-Hall.
- Heavy-duty truck and bus engines, O. a. h. w. d. c. s. u. h. p. (2012). <http://www.dieselnet.com/standards/us/hd.php> (accessed November 23, 2012).
- Hensher, D. A. & Brewer, A. M. (2001). Developing a freight strategy: the use of a collaborative learning process to secure stakeholder input. *Transport Policy*, 8 (1), 1-10. doi: 10.1016/s0967-070x(00)00031-7
- Holguin-Veras, J. et al. (2011). An experimental economics investigation of shipper-carrier interactions in the choice of mode and shipment size in freight transport. *Networks and Spatial Economics*, 11 (3), 509-532. doi: 10.1007/s11067-009-9107-x
- Hua, G., Cheng, T. C. E. & Wang, S. (2011). Managing carbon footprints in inventory management. *International Journal of Production Economics*, 132 (2), 178-185.
- Ighodaro, C. A. U. (2009). Transport infrastructure and economic growth in Nigeria. *Journal of research in national development*, 7 (2).
- Ishfaq, R. & Sox, C. R. (2010). Intermodal logistics: The interplay of financial, operational and service issues. *Transportation Research Part E: Logistics and Transportation Review*, 46 (6), 926-949.
- Janic, M. (2007). Modelling the full costs of an intermodal and road freight transport network. *Transportation Research Part D: Transport and Environment*, 12 (1), 33-44.
- Macharis, C. & Bontekoning, Y. M. (2004). Opportunities for OR in intermodal freight transport research: A review. *European Journal of Operational Research*, 153 (2), 400-416.
- Martin, N. & Rice, J. (2010). Analysing emission intensive firms as regulatory stakeholders: a role for adaptable business strategy. *Business Strategy and the Environment*, 19 (1), 64-75. doi: 10.1002/bse.661
- Massiani, J. & Ragazzi, G. (2008). Cost and efficiency of highway concessionaires: a survey of Italian operators. *European Transport*, (38), 85-106.
- McKinnon, A. et al. (2009). Traffic congestion, reliability and logistical performance: a multi-sectoral assessment. *International Journal of Logistics Research and Applications*, 12 (5), 331-345. doi: 10.1080/13675560903181519
- McQuaid, R. & Scherrer, W. (2005). *Public-private partnership - Comparative issues in the UK, Germany and Austria*. Paper presented at the 11th International Public Private Partnerships Conference, Iasi.

- OGRS. (2006) (Vol. 101): Official Gazzete of the Republic of Slovenia.
- Olander, S. & Landin, A. (2005). Evaluation of stakeholder influence in the implementation of construction projects. *International journal of project management*, 23 (4), 321-328.
- Ortolani, C., Persona, A. & Sgarbossa, F. (2011). External cost effects and freight modal choice: research and application. *International Journal of Logistics Research and Applications*, 14 (3), 199-220. doi: 10.1080/13675567.2011.609536
- Padilha, F. & Hilmola, O.-P. (2010). Green transport practices and shifting cargo from road to rail in Finnish-Russian context. In O.-P. Hilmola & E. Korovyakovsky (Eds.), *Transport Logistics and Energy Efficient Supply Chains Across the Borders* (pp. 49-62). Kouvola: Lappeenranta University of Technology.
- Pazour, J. A., Meller, R. D. & Pohl, L. M. (2010). A model to design a national high-speed rail network for freight distribution. *Transportation Research Part A: Policy and Practice*, 44 (3), 119-135.
- Pekin, E. et al. (2008). *Integrated decision support tool for intermodal freight transport*. Paper presented at the Nectar Cluster Meeting: Freight Transport and Intermodality.
- Pope, C. A. et al. (2002). Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA: The Journal of the American Medical Association*, 287 (9), 1132-1141. doi: 10.1001/jama.287.9.1132
- Popovic, A. & Habjan, A. (2012). Exploring the effects of information quality change in road transport operations. *Industrial Management & Data Systems*, 112 (9), 1307-1325.
- Posner, H. (2008). Rail freight in the USA: lessons for Continental Europe. *CER Essay Series*.
- Ricci, A. & Black, I. (2005). The social costs of intermodal freight transport. *Research in Transportation Economics*, 14, 245-285.
- Rowley, T. J. (1997). Moving beyond dyadic ties: A network theory of stakeholder influences. *The Academy of Management Review*, 22 (4), 887-910.
- Sanchez-Robles, B. (1998). Infrastructure investment and growth: Some empirical evidence. *Contemporary Economic Policy*, 16 (1), 98-108. doi: 10.1111/j.1465-7287.1998.tb00504.x
- Santos, G., Behrendt, H. & Teytelboym, A. (2010). Part II: Policy instruments for sustainable road transport. *Research in Transportation Economics*, 28 (1), 46-91.
- Schittler, M. (2003). *State-of-the-art and emerging truck engine technologies*. Paper presented at the 9th Diesel Engine Emission Reduction Conference, Newport.
- Short, J. & Kopp, A. (2005). Transport infrastructure: Investment and planning. Policy and research aspects. *Transport Policy*, 12 (4), 360-367.
- Thomas, J. & Poister, T. (2009). Thinking about stakeholders of public agencies: The Georgia department of transportation stakeholder audit. *Public Organization Review*, 9 (1), 67-82. doi: 10.1007/s11115-008-0070-7
- Uhrek, E. et al. (2010). Transport impacts on atmosphere and climate: Land transport. *Atmospheric Environment*, 44 (37), 4772-4816.
- Zografos, K. G. & Regan, A. C. (2004). Current challenges for intermodal freight transport and logistics in Europe and the United States. *Transportation Research Record: Journal of the Transportation Research Board*, (1873), 70-78.



# THE EFFECTS OF ACCOUNTING TREATMENT AND FINANCIAL CRISIS ON THE STOCK OPTION PLANS OF ITALIAN COMPANIES

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**ABSTRACT:** *Many studies state that favourable accounting treatment has been one of the main reasons firms issue employee stock options. However, stock options have recently received growing criticism with a possible effect on incentive effectiveness and outrage costs. The main purpose of this study is to explore the impacts of IFRS 2 and the recent financial crisis on stock option compensation. Empirical evidence suggests that (i) IFRS 2 did not have a significant effect on the granting of stock options, and (ii) the issue of stock options is less likely to occur during a financial crisis.*

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**Keywords:** *stock option, IFRS 2, financial crisis, executive compensation, IFRS adoption*

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**JEL Classification:** M41, M48, J33

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## 1. INTRODUCTION

In the last decade, stock option plans (hereafter SOPs) have generated considerable interest among academic researchers, government regulators, business, and the popular press. The topic has fascinated accounting scholars, who have devoted their efforts to exploring possible determinants of SOP adoption and the actual effects of this form of incentive. Among the factors often associated with the issue of SOPs, favorable accounting treatment has been cited in many studies, thus highlighting the low perceived cost of stock options (Hall & Murphy, 2003; Murphy, 2002; Murphy, 2003; Muurling & Lehnert, 2004).

The recognition of SOPs required by IFRS 2 is the outcome of increasing pressure and a long debate on the need for this form of incentive to be more transparent (Ferri & Sandino, 2009; Guay, Kothari, & Sloan, 2003; Hall & Murphy, 2003). Such recognition

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has radically changed the accounting treatment of SOPs within European listed firms. Further, before mandatory recognition, many companies (especially high-tech ones) expressed serious concerns about the significant negative impact of SOPs on their financial accounts (Chalmers & Godfrey, 2005); consequently, their lobbies firmly opposed the new accounting treatment (see Cheng & Smith, 2013; Dechow, Sloan, & Sweeney, 1996; Koh, 2011; Zeff, 2002 for the U.S. perspective and Subramaniam and Tsay, 2012 for the Canadian perspective). Therefore, studying the impact of IFRS 2 on the issuing of SOPs, and investigating whether the reaction to mandatory cost recognition has resulted in a reduction of this practice, are understandably interesting. In this context, it is useful to recall that prior research suggests recognized financial items can attract more investor attention than items simply disclosed in footnotes (Espahbodi et al., 2002; Frederickson, Hodge, & Pratt, 2006).

In order to explore the key determinants of SOPs in recent years, it is worth noting that this kind of incentive is connected to political costs and that SOPs have also been the target of growing criticism, especially when the global financial crisis started to affect the real economy. They may therefore have a significant impact on incentive effectiveness and outrage costs, both of which can limit stock options (Murphy, 2002).

The present study aims to investigate the impact of IFRS 2 and of the financial crisis on the issuing of SOPs. Additionally, we consider determinants derived from stock option literature, with particular reference to incentive alignment, financial constraints, and tax benefits, all of which have proved to have relevant explanatory power for the issuing of SOPs.

The analysis is carried out on the entire population of Italian listed companies over the years 2000-2009. Thus, the time horizon extends over 10 years: the five years before IFRS adoption, and the five years with IFRS-compliant financial statements. We have taken this approach because many SOPs adopted by listed companies include more than one issue of stock options (hence they last for more than one year). We can therefore show the impact on SOPs more accurately by using such an extended time horizon.

In the aforementioned context, Italy is particularly interesting for several reasons. First, the diffusion of Italian stock options seems largely dependent on external factors, as the growth of stock option plans in 1994-1996 (mainly owing to favorable fiscal treatment) demonstrates (Di Pietra & Riccaboni, 2001). Therefore, it is reasonable to suppose that less favorable accounting treatment could also affect corporate behavior. Second, before IFRS 2 the accounting treatment of SOPs in Italy was limited to the disclosure of quantitative information about the number of stock options and their variations during the year, without any data about their fair value. This approach differs significantly from the 1993 version of the Statement of Financial Accounting Standards (SFAS) 123 that requires disclosure of stock-based compensation costs, thereby encouraging their recognition. In such a scenario, IFRS 2 represents a radical change: from total absence of value information (not even in footnotes) to recognition of SOPs in the P&L account and detailed additional disclosure. Further, Italy is one of the few EU countries where the adoption of IFRS is mandatory for

the consolidated and individual accounts of listed companies (none of which have opted for preliminary voluntary transition), while other countries limit the application of the rules of the International Accounting Standards Board (IASB) to consolidated financial statements only. This may imply IFRS 2's stronger influence on corporate practices.

We find that the new accounting treatment that the adoption of IFRS 2 provided did not result in fewer firms issuing SOPs, despite the robust opposition of listed companies to mandatory recognition. In addition, in line with our predictions, empirical evidence suggests that a financial crisis reduces the probability of firms issuing stock options.

Our results contribute to the literature with both theoretical and policy implications. First, they increase our understanding of determinants of SOPs granting by considering several accounting and economic determinants, thereby increasing our understanding of SOP determinants. Our study also explores the effect of IFRS 2 in terms of real earnings management by analyzing the impact of the standard on firms' practices, thus providing useful evidence to standard setters.

The remainder of the paper is structured as follows. The prior literature is discussed in section 2. Section 3 develops the hypotheses to be tested. Section 4 describes the research method employed, and section 5 presents the results of the empirical tests. The last section provides conclusions.

## 2. REVIEW OF THE LITERATURE

The issuing of SOPs and the motivations behind such decisions have been widely researched from various perspectives. Prior literature has developed several hypotheses that have led to mixed evidence: (a) alignment of interests, (b) rent extraction, (c) personnel retention, (d) tax benefits, and (e) perceived cost.

The agency theory approach analyses the use of SOPs as a form of compensation and incentive, aligning the interests of managers and shareholders (Fama, 1980; Jensen & Murphy, 1990a; Jensen & Murphy, 1990b). In this regard, optimal contracting theory suggests that SOPs can reduce agency problems by combining managers' and shareholders' objectives. From such a perspective, SOPs mitigate risk-related incentive problems, encouraging managers to focus less on reporting short-term accounting profits and more on long-term profitability, thereby increasing their compensation packages. Empirical studies test this hypothesis by considering either the effect of SOPs (Agrawal & Mandelker, 1987; Morgan & Poulsen, 2001) or the corporate characteristics that are consistent with the proposed view such as a firm's Tobin's  $q$  (Frye, 2004; Kedia & Mozumdar, 2002; Khan, Dharwadkar, & Brandes, 2005; Yermack, 1995).

A second interesting stream of research deals with managers' exploitation of stock options as a legal tool in order to subtract wealth from a company. This "rent extraction" perspective (Bebchuk, Fried, & Walker, 2002; Hanlon, Rajgopal, & Shevlin, 2003; Melis, Carta, & Gaia,

2011) stems from the combined effect of the impressive amounts of options granted in some large U.S. corporations and the growing demand for fair corporate governance rules. Such a managerial power approach is based on the idea that boards do not operate at arm's length when devising executive compensation arrangements; rather, they have power to influence their own pay and use this power to extract rents. Further, the desire to camouflage such behavior could lead to the use of inefficient compensation packages that provide suboptimal incentives and thereby hurt shareholder value.

Another reason for issuing SOPs that has received considerable attention from prior literature (even though only a few empirical studies have explored it) regards the benefits of personnel policies. SOPs can be a particularly useful tool to attract and retain key personnel (Arya & Mittendorf, 2005; Balsam & Miharjo, 2007; Ittner, Lambert, & Larcker, 2003; Kedia & Mozumdar, 2002; Oyer, 2000; Oyer & Schaefer, 2005), an advantage that is twofold. First, young and start-up companies are able to hire managers by offering them compensation that relies more on growth prospects than high cash salaries. Second, this kind of incentive can play a screening or sorting role because talented and less risk-adverse employees will find option-based contracts more attractive.

A significant amount of prior literature also focuses on tax benefits provided by stock options. Depending on national rules and the design of SOPs, this form of compensation can lead to considerable corporate tax and/or executive income tax savings. Empirical studies suggest that the tax component is essential in understanding the SOPs phenomenon (Aboody & Kasznik, 2008; Ciccotello, Grant, & Grant, 2004; Hite & Long, 1982, Klassen & Mawani, 2000; Zattoni & Minichilli, 2009)

The perceived cost view (Murphy, 2002) takes into account two relevant benefits of SOPs. The first enables a firm to obtain the advantages associated with SOPs without requiring cash outflows, thus providing a useful tool for companies that face cash constraints (Core & Guay, 2001; Kedia & Mozumdar, 2002; Matsunaga, Shevlin, & Shores, 1992; Yermack, 1995;). The second refers to the accounting explanation for stock option widespread diffusion (Carter, Lynch, & Tuna, 2007; Hall & Murphy, 2002; Muurling & Lehnert, 2004), a stream of research based on the idea that disclosure is not a substitute for recognition (Espahbodi, 2002; Frederickson, Hodge, & Pratt, 2006). This is consistent with findings from U.S. studies showing that firms voluntarily recognizing stock option expenses (under SFAS 123) have significantly lower expenses than other firms (Aboody, Barth, & Kasznik, 2004).

Using a similar perspective, other studies focus on the link between stock options and earnings management. Matsunaga (1995) tests two hypotheses about the financial costs related to SOPs. The first concerns the relationship between the issuing of incentive share-based plans and the adoption of accounting policies that aim to boost profits (e.g., FIFO instead of LIFO, and faster amortization criteria). The second hypothesis deals with achieving established target profits. Results suggest a relationship between the issuing of stock option plans and earnings management, a connection that has also been hypothesized by Cheng and Warfield (2005). They find a positive relationship between

the amount of compensation in the form of stock options and the amount of discretionary accruals. Other studies (Balsam, Mozes, & Newman, 2003; Bartov & Mohanram, 2004; Bergstresser & Philippon, 2004; Burns & Kedia, 2003; Gao & Shrieves, 2002; Kadan & Yang, 2005; Peng & Röell, 2004) find a positive correlation between the amount of stock options and earnings management practices, especially those practices aimed at manipulating discretionary accruals opportunistically. These policies tend to increase profits when managers exercise their options in order to increase any personal advantage connected to the option exercise when share prices are high. In contrast, when stock option plans are issued, these studies assume opposite earnings management practices. Lower profits favor lower exercise prices, increasing those benefits of managers that are related to the revaluation of share prices in future periods characterized by higher profits. Additionally, empirical evidence shows that managers are more likely to engage in earnings management when they hold a larger proportion of their compensation in performance-vested stock options (Kuang, 2008).

With regard to the perceived cost hypothesis, few empirical studies consider the actual or estimated impact that the application of IFRS 2 may have on the granting of SOPs in terms of real earnings management, a practice that manipulates real business activities to manage reported earnings (Graham, Harvey, & Rajgopal, 2005; Xu, Taylor, & Dugan, 2007). Street and Cereola (2004) evaluate the quantitative impact of the standard and conclude that the new accounting rule will change diluted EPS. Crasselt (2006) studies the impact of IFRS 2 by monitoring the evolution of share-based payments on a sample of German listed firms, focusing on conflict among the different SOP motivations (accounting, fiscal, and incentive). Empirical results indicate that after 2004 accounting reasons drive the design of incentive plans to a lesser extent than in the past.

Even if they do not specifically address IFRS 2 adoption, the main results from recent US literature seem relevant to understanding how fair value recognition of SOPs in P&Ls affects the issuing of stock options. For example, SFAS 123R (the revised version of SFAS 123) and IFRS 2 converge toward P&L recognition of the fair value of equity instruments granted during the vesting period. Further, even if differences about external environment, institutional structures, and culture exist between the U.S. and Europe (Nobes, 1998), the former has provided a good background for studying SOPs because these instruments were a key feature of irrational exuberance during the bubble in the late 1990s.

More specifically, Carter, Lynch, and Tuna (2007) demonstrate that financial reporting costs play a role in determining CEO compensation, reducing the use of options but increasing the use of restricted stocks, without any reduction in overall CEO recompense. In other words, these findings support the idea that it is difficult for firms to downsize executive pay packages that result from prior favorable accounting treatment of SOPs. Choudhary, Venkatachalam, and Rajgopal (2009) confirm that the recognition of stock options in P&Ls plays a role in firms' real actions. Specifically, they find that in anticipation of SFAS 123R several firms accelerated the vesting of employee stock options to avoid recognizing unvested stock options at fair value in the following financial statements. Empirical evidence also confirms a real effect of SFAS 123R on the vesting terms of SOPs,

supporting the idea that firms try to defer recognition of stock option expense (Cadman, Rusticus, & Sunder, 2013)

However, opportunistic reporting on stock options (e.g., the use of volatility to underestimate fair value cost) could be significantly limited by specific and exhaustive authoritative guidance regarding fair value estimation (Choudhary, 2011). This result is interesting because it seems to corroborate the idea that firms treat recognized and disclosure values differently. Particularly, recognized values are more likely to be underestimated because they are usually considered more reliable than disclosed items (Schipper, 2007).

A question remaining unanswered in the literature concerns the effect of the mandatory adoption of IFRS 2 on the issuing of SOPs over an appropriate multi-year period. It should be noted that the design of SOPs usually requires fixed option issues for more than one year (e.g., in Italy, the average is three years) (Ramassa, 2006), and hence, a significant effect might be observed only some years after first time adoption (FTA). This longer time horizon also makes it possible to study the impact of the global financial crisis, which led to mounting pressure on corporate executives, thus increasing the outrage costs of SOPs.

### 3. DEVELOPMENT OF HYPOTHESES

Prior stock option literature generally acknowledges that the favorable accounting treatment of SOPs played a large role in determining their widespread adoption (Hall & Murphy, 2003; Murphy, 2002; Muurling & Lehnert, 2004). Some years after the mandatory adoption of IFRS for European listed companies, the impact of IFRS 2 on the issuing of SOPs can now be tested in terms of real earnings management. In line with the perceived cost stream of research, it is logical to expect that the mandatory recognition of the cost of SOPs reduced the adoption of this form of incentive. This leads to the following hypothesis:

*H1: After the mandatory adoption of IFRS 2, the probability of firms issuing SOPs decreases.*

Our expectations with regard to H1 are not straightforward. According to the literature, the low visibility of SOPs because of previous accounting treatment is without doubt a relevant benefit for granting stock options. This is particularly true for countries such as Italy where no disclosure on option value was required before the adoption of IFRS 2. Additionally, prior literature shows that the Italian context is characterized by a high degree of earnings management practices (Leuz, Nanda, & Wysocki, 2003). These considerations would imply a significant association with, and expectation of, a negative sign. However, mixed evidence from the aforementioned streams of research may justify alternative expectations. This is consistent with many scholars who argue that the motivations behind, and determinants of, SOPs are not mutually exclusive and that there is not a perspective that is able to single-handedly explain the widespread adoption of SOPs (Hall & Murphy, 2003).

This line of reasoning suggests that change in accounting treatment may not be significant because of a larger role played by other factors after the transition to IFRS 2.

The second hypothesis refers to the impact of the financial crisis on options. According to Murphy (1999, 2002), stock-based compensation may increase during sustained bull markets for two reasons. First, with many SOPs the number of shares to be granted is determined on just one date and fixed for several years. Therefore, in periods of escalating stock prices, the value of shares and options granted will increase relative to cash compensation. Second, participants are more likely to accept stock-based pay instead of cash during prolonged market upturns. As well as the aforementioned considerations, it is worth noting that the financial crisis highlighted some cases of executives receiving extremely high compensation despite poor corporate performance. This caused growing criticism toward SOPs, increasing outrage costs connected to this kind of incentive. Therefore, we expect a negative association between a financial crisis and the granting of SOPs and suggest that:

*H2: During a financial crisis, the probability of firms issuing SOPs decreases.*

Because of the role played by many different determinants in explaining SOPs, we also postulate and test three hypotheses relating to the major determinants explored by stock option literature.

Thus, the third hypothesis concerns the incentive alignment perspective, with particular regard to the association between growth opportunities and granting SOPs. It is assumed that a firm's need to align employee incentives with those of shareholders is associated with stock option compensation. Consistent with previous studies (Ding & Sun, 2001; Kedia & Mozumdar, 2002; Yermack, 1995), we hypothesize that firms with valuable growth opportunities will grant incentives. This leads to our third hypothesis:

*H3: The probability of firms issuing SOPs increases for firms with higher growth opportunities.*

Firms facing financial constraints are expected to be more likely to grant options (Core & Guay, 2001; Kedia & Mozumdar, 2002; Matsunaga, Shevlin, & Shores, 1992; Yermack, 1995). Therefore, for our fourth hypothesis we propose that:

*H4: The probability of firms issuing SOPs increases for firms facing liquidity constraints.*

Finally, taking into consideration Italian regulations, we test tax benefits, which until 2006 favored the personal income tax returns of plan participants, making this form of incentive preferable to cash compensation. Therefore, our fifth hypothesis can be expressed as follows:

*H5: After restrictions on tax benefits for SOPs, the probability of firms issuing SOPs decreases.*



## 4. RESEARCH DESIGN

### 4.1. Empirical Model and Variable Definitions

In order to verify the aforementioned hypotheses, we use a logistic regression model (LOGIT). The model assumes the following relation between the proposed explanatory variables and firms' decisions to issue SOPs:

$$SO\_ISSUE_{it} = 1 / (1 + e^{-Z_{it}})$$

$$Z_{it} = \beta_0 + \beta_1 IFRS\_2_{it} + \beta_2 CRISIS_t + \beta_3 GROWTH_{it} + \beta_4 OCF_i + \beta_5 TAX_t + \beta_6 LOG\_ASSET_{it} + \beta_7 LEVERAGE_{it} + \beta_8 ROA_{it} + \beta_9 REGULATED_i + \beta_{10} MKT\_INDEX_t \quad (1)$$

where

$SO\_ISSUE_{it}$	=	dependent variable equal to 1 if the firm $i$ issues stock options in year $t$ , and 0 otherwise;
$IFRS\_2_{it}$	=	dummy variable codified 1 if firm $i$ has financial statements prepared in accordance with IFRS 2 (options' value recognized as an expense) in year $t$ , and 0 otherwise;
$CRISIS_t$	=	dummy variable codified 1 if the year $t$ is a year of financial crisis (2009), and 0 otherwise;
$GROWTH_{it}$	=	proxy for the presence of growth opportunities. For firm $i$ in year $t$ the calculation is made by adding together the book value of assets and the difference between the market and book values of common stock, and dividing the total by the book value of assets (approximation of Tobin's $q$ );
$OCF_i$	=	cash flow from operations for firm $i$ in year $t$ ;
$TAX_t$	=	dummy variable equal to 0 if in the year $t$ there are tax incentives for issuing stock options in favor of the employee (2000-2006), and 1 otherwise;
$LOG\_ASSET_{it}$	=	log of the total assets for firm $i$ in year $t$ ;
$LEVERAGE_{it}$	=	total debt divided by total equity for firm $i$ in year $t$ ;
$ROA_{it}$	=	return on assets for firm $i$ in year $t$ ;
$REGULATED_i$	=	dummy variable codified 1 if firm $i$ operates in a regulated industry, and 0 otherwise. We identify the utilities, banking, and insurance industries as heavily regulated;
$MKT\_INDEX_t$	=	market index (FTSE Italia All-Share) of the Milan Stock Exchange at the end of the year $t$ ;
$\epsilon_i$	=	error term.

With regard to our proxy for crisis, it is useful to underline that the negative effects of the global financial crisis on the real economy did not peak at the same time around the world. Because our study focuses on Italy, we use 2009 as the year in which the impact of the crisis on the real economy became evident. This is supported by the main indexes, which exhibited negative signs starting from the last quarter of 2008 and progressively

worsened in 2009 (e.g., 2009 nominal GDP was equal to -5%, the industrial production index was -18%, and private consumption growth was -1.8%).

Consistent with Smith and Watts (1992) and Yermack (1995), our proxy that captures firm growth opportunities is an approximation of the ratio of market-to-book values of firm assets. For this purpose, we define a variable approximately equal to Tobin's q by adding together the book value of assets and the difference between the market and book values of common stock, and dividing the total by the book value of assets.

In line with prior literature, we control for the five variables that we believe affect the decision to issue stock options by including them as independent variables in the model. Three variables enable us to include some firm characteristics in the analysis (size, profitability, and financial sources). Another variable summarizes exogenous factors, such as stock market performance, which could be important determinants for decision-making because of the market-based nature of stock options.

Lastly, as in prior literature (Demsetz & Lehn, 1985; Smith & Watts, 1992) we conjecture that managers in highly regulated industries will receive lower stock option incentives because of the reduced range of managerial discretion. Thus, we identify three highly regulated industries: banking, insurance, and public utilities (Bizjak, Brickley, & Coles, 1993).

Table 1 presents the proxies used for independent variables and the predicted sign of each relationship between covariates and the decision to issue stock options.

Table 1: *Proxies and predicted signs for explanatory variables (the variables are grouped according to the main hypotheses).*

Hypotheses		Predicted sign	Proxies	Explanatory variables
1) Mandatory adoption of IFRS2	(H1)	-	Dummy variable (0 = Italian GAAP, 1 = IFRS 2)	IFRS_2
2) Financial crisis	(H2)	-	Dummy variable (1 = year of financial crisis in Italy: 2009)	CRISIS
3) Incentive alignment	(H3)	+	Approximately equal to Tobin's q	GROWTH
4) Liquidity constraints	(H4)	-	Operating cash flow	OCF
5) Tax benefits	(H5)	-	Dummy variable (1 = years 2007-2009; 0 = years 2000-2006)	TAX
6) Control variables:				
Firm size			Log of total assets	LOG_ASSET
Leverage			Debt-equity ratio	LEVERAGE
Firm's profitability			Return on assets	ROA
Regulated industries			Dummy variable (1 = regulated industries: banking, insurance, and utilities)	REGULATED
Stock market performance			FTSE Italia All-Share	MKT_INDEX



## 4.2. Sample and data

The hypotheses are tested on the entire population of Italian listed companies during the period 2000-2009. From this population, we only exclude foreign firms to ensure homogeneity in accounting standards. Consequently, in our sample there are no firms adopting IFRS 2 on a voluntary basis before 2005. Consistent with prior research, we exclude firm-year observations that do not have sufficient data to compute the variables needed to estimate the model. Collectively, these filters yield a sample of 1,616 firm-year observations.

In order to obtain data for our analysis we relied on Capital IQ, a database provided by Standard and Poor's market and accounting data drawn from corporate financial statements. This source provides data for which we need to define both explanatory and control variables. Non-accounting data consist of the approximation of Tobin's q and stock market performance. Accounting data include operating cash flow, total assets, leverage, and return on assets. Both market and accounting data refer to the end of each fiscal year investigated (2000-2009).

## 5. ANALYSIS OF RESULTS

### 5.1. Summary statistics

Because our sample ( $N = 1,616$ ) has outlying observations in most of the explanatory variables, we remove them from the analysis. We isolate outliers by means of the simple three-sigma rule (Barnett and Lewis, 1994), thus isolating companies that have:

$$|x - \mu(x)| > 3 \sigma(x) \quad (2)$$

where

$\sigma(x)$  is the standard deviation of the variable ( $x$ ).

Table 2 shows descriptive statistics for the full sample investigated ( $N = 1,555$ ) after the outlying observation exclusion. As expected, when comparing mean and standard deviation with the minimum and maximum values, Table 2 seems to reveal the absence of outlying observations. It should be noted that only three variables, Tobin's q (GROWTH), the operating cash flow (OCF), and the debt-equity ratio (LEVERAGE) could give rise to outlying observations implied by the values in the 'Maximum' column of the table. These values, however, do not justify further exclusion.

With respect to the growth opportunities variable (GROWTH), it is interesting to note that 75% of the firms in our sample have limited growth opportunities (see the value of  $q_1$ ). It would be worth analyzing whether the remaining 25% of firms with high-growth opportunities are those that usually issue stock option plans. Additionally, regarding the

leverage variable (LEVERAGE), Table 2 reveals that 75% of our sample's firms have a considerable proportion between debt and equity (debt-equity ratio with values around 1) even if the remaining 25% might also have a high level of total indebtedness (maximum value equal to 13.11).

Table 2: *Summary statistics of explanatory variables (N = 1,555)*

Variable	Mean	Std. dev.	Minimum	q <sub>1</sub>	Median	q <sub>3</sub>	Maximum
<b>Explanatory variables:</b>							
IFRS_2	.634	.4817	0	0	1	1	1
CRISIS	.139	.346	0	0	0	1	0
GROWTH	1.278	.562	.045	.964	1.129	1.416	7.654
OCF	357.508	1,721.839	-17,987	1.863	18.367	117.702	22,720
TAX	.406	.491	0	0	1	1	0
<b>Control variables:</b>							
LOG_ASSET	6.405	1.872	2.368	5.046	6.044	7.561	12.350
LEVERAGE	1.035	1.215	1.00e-06	.340	.759	1.288	13.116
ROA	2.838	4.375	-13.232	.635	2.890	5.212	18.697
REGULATED	.135	.342	0	0	0	1	1
MKT_INDEX	-.049	.230	-.423	-.217	-.105	.158	.243

IFRS\_2 = IFRS 2 adoption (dummy variable); CRISIS = year of financial crisis in Italy (dummy variable); GROWTH = approximately equal to Tobin's q; TAX = year of fiscal incentive for stock option in Italy (dummy variable); LOG\_ASSET = log of total assets; LEVERAGE = debt-equity ratio; ROA = return on assets; REGULATED = regulated industries (dummy variable); MKT\_INDEX = stock market performance (FTSE Italia All-Share).

## 5.2. Multivariate analysis

Before proceeding to the regression results, we analyze the Spearman (rank) correlation coefficients for variables (Table 3). With reference to the dependent variable (SO\_ISSUE), Table 3 shows a significant association between the decision to issue stock options and three explanatory variables: crisis, growth, and operating cash flow. As suggested by the literature, since SOPs offer companies a method for saving cash (stock options represent "cashless" compensation), the lower the operating cash flow generated in the year, the higher the probability of issuing stock options. In this case, however, the positive association does not support traditional expectations. Nonetheless, the signs for the other two variables seem to support stock option literature. With reference to our measure of growth, the positive association reveals that in companies with large growth opportunities, the use of market-based pay mechanisms could be useful in order to introduce an incentive alignment between managers and shareholders. Further, the negative association between periods of financial crisis and stock option issues seems to reveal that the potential excessive benefits related to these market-based pay mechanisms could be reduced during a crisis. Finally, the control variable reveals that the stock option issue seems to be positively associated with firm size and performance.

With reference to independent variables, Table 3 shows that some statistically significant correlation exists. The relative weakness in the correlation coefficients for these variables suggests that multicollinearity is not likely to be a significant issue in the multivariate analysis. The Pearson correlation (untabulated) shows similar results, validating the robustness of the aforementioned results.

Table 3: Spearman (rank) correlation matrix

Variables	SO_ISSUE	IFRS_2	CRISIS	GROWTH	OCF	TAX	LOG_ASSET	LEVERAGE	ROA	REGULATED	MKT_INDEX
SO_ISSUE	1										
IFRS_2	0.007	1									
CRISIS	-0.052**	0.305***	1								
GROWTH	0.151***	0.005	-0.140***	1							
OCF	0.211***	-0.066***	-0.027	0.110***	1						
TAX	-0.015	0.627***	0.487***	-0.176***	-0.060***	1					
LOG_ASSET	0.229***	-0.001	-0.010	-0.074***	0.703***	0.000	1				
LEVERAGE	0.023	0.067***	0.067***	-0.054**	0.003	0.086***	0.202***	1			
ROA	0.177***	-0.120***	-0.120***	0.408***	0.437***	-0.045*	0.224***	-0.145***	1		
REGULATED	0.010	0.009	0.009	-0.129***	0.160***	0.026	0.252***	0.011	-0.063***	1	
MKT_INDEX	0.042*	-0.604***	-0.604***	0.276***	0.018	-0.389***	0.025	-0.054**	0.141***	-0.003	1

This table provides the Spearman (rank) correlation matrix for explanatory and dependent variables. Values indicated in bold show statistically significant relationships between variables. \*, \*\*, and \*\*\* indicate statistical significance at less than 10%, 5%, and 1% levels respectively (two-tailed). Pearson correlation shows similar results.

SO\_ISSUE = stock option issues (dummy variable); IFRS\_2 = IFRS 2 adoption (dummy variable); CRISIS = year of financial crisis in Italy (dummy variable); GROWTH = approximately equal to Tobin's q; TAX = year of fiscal incentive for stock options in Italy (dummy variable); LOG\_ASSET = log of total assets; LEVERAGE = debt-equity ratio; ROA = return on assets; REGULATED = regulated industries (dummy variable); MKT\_INDEX = stock market performance (FTSE Italia All-Share).

Table 4 presents the results of the logistic regression. As already shown in the univariate analyses, the regression coefficients for two explanatory variables (CRISIS and GROWTH) are statistically significant at less than 5% and 1% levels respectively, with signs that support our hypotheses. Specifically, the estimate for the former dummy variable (CRISIS, significant at a .02 level) reveals that the probability of issuing stock options decreases during periods of financial crisis (H2). In order to interpret the possible effect of the dependent variables on the probability of issuing stock options, we take into account the transformation of the regression coefficients (odds ratios).

Since our variable (CRISIS) denotes the presence (1) or the absence (0) of financial crisis in year  $t$ , the odds ratio equal to 0.25 indicates that the relative probability of a firm choosing to issue stock options decreases by 75% in years of financial crisis. This result supports the predicted negative association (H2), confirming that during a financial crisis firms are less likely to grant stock options. Such a finding is consistent with the reduced incentive (Murphy, 1999; 2002) and heightened outrage costs associated with this kind of compensation, as confirmed by anecdotal evidence.

With reference to the other variable (GROWTH, significant at a .000 level), the value and sign of the coefficient reveal that the higher a firm's growth opportunities, the higher the probability of issuing stock options. Because of the variable's unit of measure, the interpretation of odds ratios for Tobin's q is not very enlightening. It is more relevant to look at the marginal effect of a firm's growth opportunities on its decision to issue SOPs. In particular, a mean 1% change in Tobin's q is associated with a 1.7% increase in the probability of granting an SOP.

With reference to control variables, Table 4 shows that a firm's size (LOG\_ASSET) is positively associated with the decision to issue stock options, significant at a .000 level. This result agrees with the findings of prior stock option literature. Further, in the U.S. context, empirical evidence from prior studies shows that firm size is positively associated with the voluntary recognition of the costs of SOPs. This is in line with our results and suggests that IFRS 2 did not have a relevant impact on the issuing of SOPs because larger firms (which are more likely to adopt SOPs) are less affected by the mandatory recognition of stock option costs.

The other control variables included in the model are not significant at conventional levels. This suggests that they are not relevant determinants in the decision to issue SOPs.

These results, taken together, support the following considerations of our main hypotheses: (i) IFRS 2's introduction has not induced a reduction in the use of SOPs (H1); and (ii) the issue of stock options is much more likely in years without a financial crisis than in years with a financial crisis (H2). With regard to the three hypotheses relating to the major determinants explored by stock option literature, only H3 seems to be confirmed by empirical results, suggesting that the probability of issuing SOPs is higher for firms with better growth opportunities. Estimates do not show that liquidity constraints (H4) and tax benefits (H5) have a significant impact on the granting of SOPs.

Table 4 Panel A indicates the model's goodness of fit for explaining the issuing of SOPs, with a likelihood-ratio chi-squared significance at less than .000, a hit rate of 94.92%, a McFadden pseudo- $R^2$  of .2585, and a Nagelkerke pseudo- $R^2$  of .298 (untabulated). The model's goodness of fit should be considered, bearing in mind not only the fact that pseudo- $R^2$  should not be confused with  $R^2$  for OLS regression, but also that it is often a small value.

In order to deal with concerns about a failure to meet assumptions, we regress logit, estimating the standard errors clustered by firm (Petersen, 2009). Consistent with our univariate results, collinearity diagnostics do not highlight issues for the independent variables, with variance inflation factors (VIFs) lower than 2.5. To check the stability of our results, we re-test our model using alternative proxies for covariates. Estimates (untabulated) do not substantially differ after these robustness checks.

Table 4: *Logistic regression results*

Panel A – Model summary - goodness of fit									
		Number of obs.		=	1,555				
		Wald chi <sup>2</sup> (10)		=	86.01				
Log-likelihood = -233.790		Prob > chi <sup>2</sup>		=	0.000				
		Pseudo R <sup>2</sup>		=	0.258				
Panel B – Estimated coefficients									
LOGIT	Variable	Hypothesis	Predicted sign	Coeff.	Std. err.	z	P >  z	[95% conf. interval]	
Explanatory variables									
	IFRS_2	(H1)	-	.560	.361	1.55	0.121	-1.48	1.268
	CRISIS	(H2)	-	-1.374**	.592	-2.32	0.020	-2.534	-.2148
	GROWTH	(H3)	+	.908***	.342	2.66	0.008	.238	1.578
	OCF	(H4)	-	.000	.000	0.18	0.854	-.000	.000
	TAX	(H5)	-	-.014	.333	-0.04	0.967	-.667	.6396
Control variables									
	LOG_ASSET			.681***	.109	6.27	0.000	.468	.893
	LEVERAGE			.010	.192	0.05	0.960	-.366	.385
	ROA			.099	.086	1.15	0.249	-.069	.267
	REGULATED			-.462	.613	-0.75	0.452	-1.662	.741
	MKT_INDEX			-1.137	.696	-1.63	0.103	-2.501	.229
	constant			-9.908	.957	-10.35	0.000	-11.784	-8.032

This table shows coefficients from logistic regression (LOGIT), with standard errors clustered by firm. We illustrate Wald Statistics, Log Likelihood and McFadden pseudo-R<sup>2</sup>. \*\*, and \*\*\* indicate significance at less than 10%, 5%, and 1% levels respectively. IFRS\_2 = IFRS 2 adoption (dummy variable); CRISIS = year of financial crisis in Italy (dummy variable); GROWTH = approximately equal to Tobin's q; TAX = year of fiscal incentive for stock options in Italy (dummy variable); LOG\_ASSET = log of total assets; LEVERAGE = debt-equity ratio; ROA = return on assets; REGULATED = regulated industries (dummy variable); MKT\_INDEX = stock market performance (FTSE Italia AllShare).

## 6. CONCLUSIONS

In the last few decades, many studies have explored corporate and external determinants of the granting of SOPs to employees, providing mixed evidence that has supported different explanations for this phenomenon.

Our study aimed to explore the impact of two recent events: the mandatory recognition of SOPs imposed by IFRS 2 and the recent financial crisis. These two external factors were expected to have a significant impact on corporate compensation policies. With regard to IFRS 2, studies proposing a perceived cost view, and the intense lobbying activity against the standard, suggest that a less favorable accounting treatment (the cost recognition of SOPs) could affect the use of SOPs, with a significant reduction in the number of firms issuing options. The financial crisis was also expected to have a negative impact on SOPs

because of political and outrage costs. These increased when the crisis started to affect the real economy.

A number of benefits and advantages are associated with stock options in prior literature (Muurling & Lehnert, 2004). We tested the impact of these further by taking into consideration the traditional SOP determinants. In particular, we tested minor hypotheses regarding the incentive alignment view and the roles of liquidity constraints and tax benefits.

Thus, we ran a logit regression, adopting the granting of stock options to employees in a specific year (0/1) as a dependent variable. As covariates, we used five variables from our hypotheses (IFRS 2 mandatory adoption, financial crisis, growth opportunities, liquidity constraints, and tax benefits) and controlled for size, leverage, profitability, industry, and stock market performance.

Contrary to the considerable emphasis placed by previous studies on the accounting treatment of SOPs, our work indicates that the increased transparency provided by the mandatory adoption of IFRS 2 (H1) did not result in firms issuing fewer SOPs. It is relevant to point out that our results are obtained over a five-year period after first time adoption (FTA), and hence, they are not limited to the immediate effect of IFRS 2, an effect that could be misleading because of the multi-year design of SOPs. This interpretation is consistent with prior literature because it claims that a specific benefit cannot single-handedly explain corporate behavior and that the influence of different advantages can change over time.

With reference to H2, our findings match Murphy's (2002) and lend empirical support to the observation that a financial crisis reduces the probability of firms issuing stock options. We interpret the results as evidence in support of the idea that a financial crisis not only affects the incentive power of SOPs, but could also increase outrage costs. These two factors seem to be major barriers against the issuing of SOPs. This is not surprising and can be seen as a reaction to growing criticism toward SOPs prompted by cases of executives receiving extremely high compensation despite poor corporate performance.

Consistent with our predictions, growth opportunities (H3) seem to influence the decision to issue SOPs, increasing the probability of using stock-based compensation. This matches the incentive alignment view and is also consistent with the idea that SOPs are adopted when their incentive power is higher, a proposal confirmed by the fall in firms issuing options because of the financial crisis. In contrast, empirical evidence does not support H4 and H5, suggesting that financial constraints and tax benefits are less significant in explaining corporate practices.

Our work has both theoretical and policy implications. First, it contributes to the stock option literature by suggesting that the recent financial crisis has played a role in reducing the number of SOPs issued. This could be explained by increased outrage costs related to this kind of compensation. Our findings also support the idea that the mandatory

introduction of IFRS 2 has not induced a reduction in the use of SOPs, contrary to expectations deriving from the perceived cost view. In this context, the present study also contributes to existing research on the impact of IFRS 2 and has important policy implications about the real effect produced by the increased transparency of SOPs. Finally, unlike most IFRS literature, our interest is not in market reactions or earnings quality, but in the real effect on firms' behavior. This is extremely relevant from a standard setting point of view.

## REFERENCES

- Aboudy, D., Barth, M.E. & Kasznik, R. (2004). Firms' voluntary recognition of stock-based compensation expense. *Journal of Accounting Research*, 42 (2), 123-150.
- Aboudy, D. & Kasznik, R. (2008). Executive stock-based compensation and firms' cash payout: the role of shareholders' tax-related payout preferences. *Review of Accounting Studies*, 13 (2/3), 216-251.
- Agrawal, A. & Mandelker, G.N. (1987). Managerial incentives and corporate investment and financing decisions. *Journal of Finance*, 42 (4), 823-837.
- Arya, A. & Mittendorf, B. (2005). Offering stock options to gauge managerial talent. *Journal of Accounting and Economics*, 40, 189-210.
- Balsam, S. & Miharjo, S. (2007). The effect of equity compensation on voluntary executive turnover. *Journal of Accounting and Economics*, 43, 95-119.
- Balsam, S., Mozes, H.A. & Newman, H.A. (2003). Managing pro forma stock option expense under SFAS No.123. *Accounting Horizons*, 17 (1), 31-45.
- Barnett, V. & Lewis, T. (1994). *Outliers in Statistical Data* (3rd ed.). New York: Wiley.
- Bartov, E. & Mohanram, P. (2004). Private information, earnings manipulations, and executive stock-option exercises. *The Accounting Review*, 79 (4), 889-920.
- Bebchuk, L., Fried, J. & Walker, D. (2002). Managerial power and rent extraction in the design of executive compensation. *University of Chicago Law Review*, 69, 751-846.
- Bergstresser, D. & Philippon, T. (2004). *CEO incentives and earnings management*. Working paper, Harvard University.
- Bizjak, J.M., Brickley, J.A. & Coles, J.L. (1993). Stock-based compensation and investment behavior. *Journal of Accounting and Economics*, 16 (1-3), 349-372.
- Burns, N. & Kedia, S. (2003). *Do executive stock options generate incentives for earnings management? Evidence from accounting restatements*. Working paper, University of Georgia and Harvard Business School.
- Cadman, B.D., Rusticus, T.O. & Sunder, J. (2013). Stock option grant vesting terms: economic and financial reporting determinants. *Review of Accounting Studies*, 18 (4), 1159-1190.
- Carter, M.E., Lynch, L.J. & Tuna, I. (2007). The role of accounting in the design of CEO equity compensation. *The Accounting Review*, 82 (2), 327-357.
- Chalmers, K. & Godfrey, J.M. (2005). Expensing stock-based payments: A material concern? *Journal of International Accounting, Auditing & Taxation*, 14 (2), 157-173.



- Cheng, Q. & Warfield, T.D. (2005). Equity incentives and earnings management. *The Accounting Review*, 80 (2), 441-476.
- Cheng, X. & Smith, D. (2013). Disclosure versus recognition: the case of expensing stock options. *Review of Quantitative Finance and Accounting*, 40 (4), 591-621.
- Choudhary, P. (2011). Evidence on differences between recognition and disclosure: a comparison of inputs to estimate fair values of employee stock options. *Journal of Accounting and Economics*, 51, 77-94.
- Choudhary, P., Venkatachalam, M. & Rajgopal, S. (2009). Accelerated vesting of employee stock options in anticipation of FAS 123R. *Journal of Accounting Research*, 47 (1), 105-146.
- Ciccotello, C.S., Grant, C.T. & Grant, G.H. (2004). Impact of employee stock options on cash flow. *Financial Analysts' Journal*, 60 (2), 39-46.
- Core, J. & Guay, W. (2001). Stock option plans for non-executive employees. *Journal of Financial Economics*, 61 (2), 253-287.
- Crasselt, N. (2006). *The design of share-based payments in Germany after the introduction of IFRS 2 and SFAS 123R*. Paper presented at the European Accounting Association's Annual Congress, Dublin, Ireland.
- Dechow, P.M., Sloan, R.G. & Sweeney, A.P. (1996). Causes and consequences of earnings manipulation: an analysis of firms subject to enforcement actions by the SEC. *Contemporary Accounting Research*, 13 (1), 1-36.
- Demsetz, H. & Lehn, K. (1985). The structure of corporate ownership: causes and consequences. *Journal of Political Economy*, 93, 1155-1177.
- Ding, D.K. & Sun, Q. (2001). Causes and effects of employee stock option plans: evidence from Singapore. *Pacific-Basin Finance Journal*, 9, 563-599.
- Di Pietra, R. & Riccaboni, A. (2001) *Reporting of stock options: creative compliance in a regulated environment*. Università di Siena, Quaderni senesi di Economia Aziendale e di Ragioneria, Serie interventi, 72.
- Espahbodi, H., Espahbodi, P., Rezaee, Z. & Tehranian, T. (2002). Stock price reaction and value relevance of recognition versus disclosure: the case of stock-based compensation. *Journal of Accounting and Economics*, 33, 343-373.
- Fama, E.F. (1980). Agency problem and the theory of the firm. *Journal of Political Economy*, 88 (2), 288-307.
- Ferri, F. & Sandino, T. (2009). The impact of shareholder activism on financial reporting and compensation: the case of employee stock options. *The Accounting Review*, 84 (2), 433-466.
- Frederickson, J.R., Hodge, F.D. & Pratt, J.H. (2006). The evolution of stock option accounting: disclosure, voluntary recognition, mandated recognition, and management. *The Accounting Review*, 81 (5), 1073-1093.
- Frye, M.B. (2004). Equity-based compensation for employees: firm performance and determinants. *Journal of Financial Research*, 27 (1), 31-54.
- Gao, P. & Shrieves, R.E. (2002). *Earnings management and executive compensation: a case of overdose of option and underdose of salary?* Working paper, University of Tennessee, Knoxville.
- Graham, J., Harvey, C. & Rajgopal, S. (2005). The economic implications of corporate financial reporting. *Journal of Accounting and Economics*, 40 (1/3), 3-73.
- Guay, W., Kothari, S.P. & Sloan, R. (2003). Accounting for employee stock options. *The American Economic Review*, 93 (2), 405-409.



- Hall, B.J. & Murphy, K.J. (2002). Stock options for undiversified executives. *Journal of Accounting and Economics*, 33 (1), 3-42.
- Hall, B.J. & Murphy, K.J. (2003). The trouble with stock options. *Journal of Accounting Perspectives*, 17 (3), 49-70.
- Hanlon, M., Rajgopal, S. & Shevlin, T. (2003). Are executive stock options associated with future earnings? *Journal of Accounting and Economics*, 36 (1/3), 3-43.
- Hite, G. & Long, M. (1982). Taxes and executive stock options. *Journal of Accounting and Economics*, 4, 3-14.
- Jensen, M.C. & Murphy, K.J. (1990a). CEO incentives - It's not how much you pay, but how. *Harvard Business Review*, 68 (3), 25-31.
- Jensen, M.C. & Murphy, K.J. (1990b). Performance pay and top-management incentives. *Journal of Political Economy*, 90 (2), 949-974.
- Kadan, O. & Yang, J. (2005). *Executive stock options and earnings management*. Working paper, Washington University, Saint Louis.
- Kedia, S. & Mozumdar, A. (2002). *Performance impact of employee stock options*. Working paper, Harvard Business School.
- Khan, R., Dharwadkar, R. & Brandes, P. (2005). Institutional ownership and CEO compensation: a longitudinal examination. *Journal of Business Research*, 58 (8), 1078-1088.
- Klassen, K.J. & Mawani, A. (2000). The impact of financial and tax reporting incentives on option grants to Canadian CEOs. *Contemporary Accounting Research*, 17 (2), 227-262.
- Koh, W.C. (2011). What drives firms' decisions to lobby and determinants of their lobbying positions: Evidence from firms' comment letter. *The International Journal of Accounting*, 46 (1), 1-24.
- Kuang, Y.F. (2008). Performance-vested stock options and earnings management. *Journal of Business Finance & Accounting*, 35 (9-10), 1049-1078.
- Ittner, C.D., Lambert, R.A. & Larcker, D.F. (2003). The structure and performance consequences of equity grants to employees of new economy firms. *Journal of Accounting and Economics*, 34, 89-127.
- Leuz, C., Nanda, D. & Wysocki, P.D. (2003). Earnings management and investor protection: an international comparison. *Journal of Financial Economics*, 69 (3), 505-527.
- Matsunaga, S.R. (1995). The effects of financial reporting costs on the use of employee stock options. *The Accounting Review*, 70 (1), 1-26.
- Matsunaga, S., Shevlin, T. & Shores, D. (1992). Disqualifying dispositions of incentive stock options: Tax benefits versus financial reporting costs. *Journal of Accounting Research*, 30, 37-76.
- Melis, A., Carta, S. & Gaia, S. (2012). Executive director remuneration in blockholder-dominated firms: how do Italian firms use stock options? *Journal of Management and Governance*, 16 (3), 511-541.
- Morgan, A. & Poulsen, A. (2001). Linking pay to performance – compensation proposals in the S&P 500. *Journal of Financial Economics*, 62 (3), 489-523.
- Murphy, K.J. (1999). Executive compensation. In Ashenfelter, O. & Card, D. (Eds.), *Handbook of Labor Economics* (Vol. 3). Amsterdam: North-Holland.
- Murphy, K.J. (2002). Explaining Executive Compensation: Managerial Power vs. the Perceived Cost of Stock Options. *University of Chicago Law Review*, 69, 847-869.

- Murphy, K.J. (2003). Stock based pay in new economy firms. *Journal of Accounting and Economics*, 34, 129-147.
- Muurling, R. & Lehnert, T. (2004). Option-based compensation: a survey. *The International Journal of Accounting*, 39 (4), 365-401.
- Nobes, C. (1998). Towards a general model of the reasons for international differences in financial reporting. *Abacus*, 34 (2), 162-187.
- Oyer, P. (2000). *Why do firms use incentives that have no incentive effects?*. Working paper, Stanford University.
- Oyer, P. & Schaefer, S. (2005). Why do some firms give stock options to all employees?: An empirical examination of alternative theories. *Journal of Financial Economics*, 76 (1), 99-133.
- Peng, L. & Röell, A. (2004). *Executive pay, earnings manipulation and shareholder litigation*. Working paper.
- Petersen, M.A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of Financial Studies*, 22 (1), 435-480.
- Schipper, K. (2007). Required disclosures in financial reports. *The Accounting Review*, 82 (2), 301-326.
- Smith, C.W. & Watts, R.L. (1992). The investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Financial Economics*, 32, 263-292.
- Street, D.L. & Cereola, S. (2004). Stock option compensation: impact of expense recognition on performance indicators of non-domestic companies listed in the U.S. *Journal of International Accounting, Auditing & Taxation*, 13 (1), 21-37.
- Xu, R.Z. Taylor, G.K., & Dugan, M.T. (2007). Review of real earnings management literature. *Journal of Accounting Literature*, 26, 195-228.
- Yermack, D. (1995). Do corporations award CEO stock options effectively? *Journal of Financial Economics*, 39 (2/3), 237-269.
- Zattoni, A. & Minichilli, A. (2009). The diffusion of equity incentive plans in Italian listed companies: what is the trigger? *Corporate Governance: An International Review*, 17 (2), 224-237.
- Zeff, S. (2002). "Political" lobbying on proposed standards: A challenge to the IASB. *Accounting Horizons*, 16 (1), 43-54.



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