Chapter 4
Results

This chapter will present the discovery of the best strategy to buy eight stocks before XD dates. It indicates the numbers of day before the selling day that an investor should buy the stocks. The selling day is the last day before XD dates.

To detect the regime switching, the change point must satisfy the criteria mentioned in section 3.2. The existence of regime switching depends on the presence of the change point. Without the change point, there is no regime switching.

Major results presented in this study are as follows:

Result 1: Buying strategy
Result 2: Sensitivity analysis of random selection
Result 3: Sensitivity analysis of mutation rate
Result 4: Buying strategy with zero mutation rate
Result 5: Comparison of profit between different periods of XD dates
Result 6: Best buying strategies for each stock

4.1 Result 1: Buying strategies before XD dates in the whole year

Even though genetic algorithm suggests buying strategies for stocks, the buying signals may not satisfy the criteria for the detection of regime switching (see section 3.2). Six investment plans found no signal of regime switching, i.e. ADVANC 30 days, CPALL 40 days, IVL 40 days, PTT 30 days, PTT 50 days and SCC 30 days. Fortunately, in other 18 investment plans, the regime switching is found. Therefore, regime switching takes place in 75% of all investment plans.

More than half of regime switching takes place around 21 - 40 days before XD dates. In the case of XD dates in the whole year with mutation rate equals to 0.30, around 38% of regime switching appears during 31 – 40 days before XD dates and 33% appears during 21 – 30 days before XD dates.

Table 2 Best strategy for buying stocks before XD dates in the whole year

Stocks and investment plans	*The best strategy (Lagged days to buy stocks)*	*Regime switching (lagged days before XD)*	*Profit in the year that the best strategy is found (%)*
ADVANC30	{25, 24, 21}	no signal	12.5
ADVANC40	{40, 39, 38, 37, 36, 35, 30, 26, 25,13,5}	35	3.1
ADVANC50	{50, 49, 47, 46, 45, 43, 42, 25, 9, 7, 3}	42	5.18
CPALL30	{29, 28, 27, 26, 25, 23, 6, 4 ,3, 2}	25	3.28
CPALL40	{37, 31, 30, 25, 22, 11, 9, 6, 2, 1}	no signal	-3.26
CPALL50	{49, 48, 47, 46, 45, 38, 35, 31, 25, 23, 22, 13}	45	-0.24
CPF30	{30, 29, 28, 27, 26, 25, 20, 7}	25	9.68
CPF40	{40, 38, 36, 35, 34, 33, 32, 31, 27, 26, 25, 20, 15}	31	5.43
CPF50	{49, 48, 47, 46, 44, 43, 42, 41, 40, 39, 38, 35, 31, 28, 26, 19, 15, 7}	38	8.65
IVL30	{18, 9, 8, 6, 5, 4, 2, 1}	4	-1.84
IVL40	{40, 24, 19, 17, 16, 10, 9, 8, 4, 2, 1}	no signal	-5.27
IVL50	{49, 47, 45, 43, 22, 11, 10, 9, 7, 6, 4, 2, 1}	6	-6.22
KBANK30	{30, 29, 28, 18, 17, 2, 1}	28	-6.19
KBANK40	{40, 38, 37, 36, 35, 34, 24, 17}	34	6.67
KBANK50	{50, 49, 48, 44, 43, 40, 36, 32, 30, 29, 27, 26, 21, 15, 7, 1}	26	-6.46
PTT30	{22, 21, 19, 14}	no signal	7.80
PTT40	{34, 33, 31, 30, 28, 21, 20, 19, 8, 7, 6, 3, 2}	30	-3.70
PTT50	{36, 34, 33, 31, 23, 22, 21, 17, 16, 14, 9, 8, 7, 4, 2}	no signal	-4.82
SCC30	{26, 17, 16, 15, 11}	no signal	3.36
SCC40	{37, 36, 35, 31, 27, 16, 15, 14, 13, 12}	12	3.10
SCC50	{50, 42, 40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 21, 18, 16, 11, 10}	27	4.06
TCAP30	{30, 29, 28, 27, 25, 23, 7, 5}	27	5.07
TCAP40	{40, 39, 38, 37, 36, 34, 33, 32, 29, 27, 20, 19, 15, 9}	32	9.10
TCAP50	{50, 49, 45, 44, 43, 42, 41, 40, 38, 35, 32, 31, 29, 27, 14, 6}	40	11.36

Source: Calculation using Genetic Algorithm written in Matlab

Table 3 Concentration of regime switching before XD dates in the whole year

Days of regime switching (days)	Frequency (times)	%
1 – 10	2	11.11
11 – 20	1	5.56
21 – 30	6	33.33
31 – 40	7	38.89
41 – 50	2	11.11
Total	18	100.00

Note: Mutation rate = 0.30

In the out-of-sample test, the average profit is 5.35%. Genetic algorithm does not guarantee the positive profit when applying the suggested strategies to other XD rounds. The average of minimum profit is minus 6.89%. The investment plan that yields the highest profit is TCAP 50 days (11.38% per investment). The second top gainer is IVL 50 days (9.46% per investment) and TCAP 40 days (9.17 % per investment).

Table 4 Profit of the best strategy (whole year) when applied to out-of-sample observations

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
ADVANC30	15.38	-5.58	2.68	5.80
ADVANC40	9.82	-7.24	2.55	5.02
ADVANC50	13.59	-6.51	3.73	5.34
CPALL30	10.77	-6.79	2.77	6.14
CPALL40	10.09	-3.23	3.72	4.51
CPALL50	17.74	-3.32	6.38	7.68
CPF30	21.18	-8.87	6.15	9.90
CPF40	24.61	-12.26	8.08	11.31
CPF50	27.58	-10.64	8.76	12.07
IVL30	8.04	-1.45	3.29	6.71
IVL40	8.60	-1.48	3.56	7.12
IVL50	14.84	4.08	9.46	7.61
KBANK30	10.50	-6.37	2.15	4.84
KBANK40	17.43	-8.15	3.84	8.24
KBANK50	14.81	-5.77	4.54	6.92
PTT30	17.51	-3.85	3.89	7.10
PTT40	18.25	-2.09	3.56	5.30
PTT50	18.43	-1.56	3.71	5.40
SCC30	19.99	-5.73	5.41	7.82

Table 4 (continued)

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
SCC40	24.16	-8.80	6.28	9.24
SCC50	28.58	-12.61	6.37	11.05
TCAP30	34.92	-14.32	6.85	14.15
TCAP40	42.15	-16.83	9.17	17.49
TCAP50	49.12	-15.99	11.38	19.52
Average of all stocks	19.92	-6.89	5.35	8.60

Source: Calculation using Genetic Algorithm written in Matlab

Next, the results show the highest profit that an investor can gain when the lowest price is known before the selling day. These numbers will be the benchmark of the performance of the strategies suggested by genetic algorithm.

Table 5 Profit when buying at the known lowest price (whole year)

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
ADVANC30	17.26	1.44	6.78	4.27
ADVANC40	17.26	1.44	8.79	5.34
ADVANC50	26.15	1.44	10.69	6.93
CPALL30	20.00	-0.95	8.61	7.32
CPALL40	23.96	2.70	11.38	7.70
CPALL50	28.57	2.70	13.81	9.99
CPF30	26.79	2.48	11.86	8.98
CPF40	35.40	3.70	15.85	11.42
CPF50	48.04	3.83	18.14	14.69
IVL30	23.61	3.92	13.77	13.92
IVL40	30.88	8.16	19.52	16.06
IVL50	48.33	30.06	39.20	12.92
KBANK30	23.46	2.34	8.72	5.78
KBANK40	23.46	-2.80	11.94	8.45
KBANK50	26.57	2.34	16.10	7.15
PTT30	22.27	0.00	8.81	6.81
PTT40	24.79	4.39	11.45	6.33
PTT50	24.79	4.85	12.64	5.85
SCC30	32.76	1.79	11.04	9.05
SCC40	43.01	1.79	13.27	11.78
SCC50	48.47	1.79	14.93	12.93

Table 5 (continued)

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
TCAP30	48.25	-4.37	13.92	14.89
TCAP40	60.24	-4.37	19.31	19.00
TCAP50	69.43	-4.37	21.35	21.49
Average of all stocks	33.07	2.68	14.25	10.38

Note: The average value of all stocks is the mathematical mean. The study cannot calculate the geometric mean because of some negative values in the data

Source: Calculation during the period of 2005 – 2011, excluding the period that the best strategy is discovered in order to match the time periods of the out-of-sample test

In comparison with the highest profit, strategies that are suggested by genetic algorithm gain around 37.52% of the highest profit (table 6). TCAP50 is the most efficient investment plan when it yields around 53% from the potential profit. CPF30 and CPF40 are the second and third top investment plans that extract the most from the potential profit, around 50 - 51%.

Table 6 Comparison of the profit from genetic algorithm and the real data (whole year)

Stocks and investment plans	*Average profit from genetic algorithm in the out-of-sample tests (%)*	*Average potential profit from real data when buying at the lowest price (%)*	*Difference (percentage points)*	*Performance of genetic algorithm* (%)*
ADVANC30	2.68	6.78	-4.10	39.53
ADVANC40	2.55	8.79	-6.24	29.01
ADVANC50	3.73	10.69	-6.96	34.89
CPALL30	2.77	8.61	-5.84	32.17
CPALL40	3.72	11.38	-7.66	32.69
CPALL50	6.38	13.81	-7.43	46.20
CPF30	6.15	11.86	-5.71	51.85
CPF40	8.08	15.85	-7.77	50.98
CPF50	8.76	18.14	-9.38	48.29
IVL30	3.29	13.77	-10.48	23.89
IVL40	3.56	19.52	-15.96	18.24
IVL50	9.46	39.20	-29.74	24.13
KBANK30	2.15	8.72	-6.57	24.66

Table 6 (continued)

Stocks and investment plans	*Average profit from genetic algorithm in the out-of-sample tests (%)*	*Average potential profit from real data when buying at the lowest price (%)*	*Difference (percentage points)*	*Performance of genetic algorithm* (%)*
KBANK40	3.84	11.94	-8.10	32.16
KBANK50	4.54	16.10	-11.56	28.20
PTT30	3.89	8.81	-4.92	44.15
PTT40	3.56	11.45	-7.89	31.09
PTT50	3.71	12.64	-8.93	29.35
SCC30	5.41	11.04	-5.63	49.00
SCC40	6.28	13.27	-6.99	47.32
SCC50	6.37	14.93	-8.56	42.67
TCAP30	6.85	13.92	-7.07	49.21
TCAP40	9.17	19.31	-10.14	47.49
TCAP50	11.38	21.35	-9.97	53.30
Average of all stocks	5.35	14.25	-8.90	37.52

* The performance is the ratio of average out-of-sample profit to average potential profit.

Source: Calculation during the period of 2005-2011

4.2 Result 2: Sensitivity analysis of random selection

To ensure the robustness of randomization, i.e. initialization of parents, crossing over rate and mutated positions, made by genetic algorithm program, this study performs the sensitivity analysis of the random selection. In the 30 day-investment plan, the possibility of investment strategy is 2^{30} which are around one billion variations. In the 40 day-investment plan, the strategy expands to 2^{40} which are around one trillion variations. In the 50-day investment plan, the numbers of strategy reach around one thousand trillion variations. Compared to those huge numbers, the iteration of 4,000 rounds by the program may not find the global maximum profit.

However, the results of the robustness check in case of 30-day investment plan for IVL reveal that the standard error is small. The number is 0.22 when the mean value is 1.02. The standard error is just around 20% of the mean value. Moreover, the minimum profit is 0.69 whose the deviation from mean is around 2 times of the standard deviation.

Therefore, it is apparent that the search algorithm by genetic algorithm yields a robust solution even though the numbers of generated series are very small relatively to all possible outputs.

Table 7 Sensitivity analysis of random selection (running the program 10 times) for IVL 30 days before XD dates in May 2011

Days before selling day*	***Round***									
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
30	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
28	1	1	1	1	1	1	1	1	1	1
27	0	1	1	1	1	1	1	1	1	1
26	0	1	0	1	1	1	1	0	1	0
25	1	1	1	0	1	1	1	0	1	0
24	0	0	0	1	0	0	0	0	0	0
23	0	0	1	0	0	0	0	0	0	0
22	1	0	0	1	0	0	0	1	0	1
21	0	0	0	1	1	0	1	1	1	0
20	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	1
18	1	1	0	0	1	0	0	1	1	0
17	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
15	0	0	0	1	0	0	0	1	1	0
14	0	0	0	0	0	1	1	0	0	0
13	0	0	0	0	0	0	0	0	0	0
12	0	1	0	0	1	0	0	0	0	0
11	0	0	0	0	0	0	0	0	1	0
10	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	1	0	0	0	0	0
4	0	1	0	0	0	0	1	0	0	0
3	1	0	0	0	1	1	0	1	0	0
2	0	1	1	0	1	0	1	1	0	0
1	1	0	0	0	0	1	0	1	1	0

Table 7 (continued)

Profit (%)	0.95	1.07	1.34	1.16	0.76	1.09	1.07	0.79	0.69	1.31
Statistics	Max	1.34	Min	0.69	Average		1.02	Standard deviation		0.22

Note: The selling day is the last day before XD dates.

4.3 Result 3: Sensitivity analysis of mutation rate

So far, the study uses the mutation rate of 0.30. This is the maximum rate that should be used by genetic algorithm according to Pitakaso (2011). Sudtasan and Suriya (2012) used the mutation rate of 0.50 which is controversial that it may be too much. However, the study reluctant to use a low mutation rate because it believes that the strategy needs high mutation to ensure that all the off-springs from the same parents will be different; they will help to search for the global maximum in a broader area than the off-springs that are quite similar.

Surprisingly, the zero mutation rate performs better than positive rates. For all trials of the investment plans, IVL50 in May 2011, CPF50 in August 2006, and CPF50 in April 2011 using variations of mutation rates from zero to 0.50, the results found that the zero rate yields the highest profit.

This result shocks a little bit to the author and make the author revise the outputs of the study by using the zero mutation rate in the genetic algorithm. Therefore, from this point on, the study concerns that the zero mutation rate is superior to positive rates. It will show the results that use zero mutation rate.

Table 8 Sensitivity analysis of mutation rates for IVL 50 days before XD dates in May 2011

Days before selling day*	***Mutation rate***										
	0.00	***0.05***	***0.10***	***0.15***	***0.20***	***0.25***	***0.30***	***0.35***	***0.40***	***0.45***	***0.50***
50	1	1	1	1	1	1	1	1	1	1	1
49	1	1	1	0	0	1	1	1	0	0	1
48	1	1	1	1	0	0	1	0	1	1	1
47	0	1	1	0	1	1	1	0	1	1	0
46	0	1	1	0	1	1	1	1	1	1	1
45	0	1	1	1	0	1	0	1	1	1	1

Table 8 (continued)

Days before selling day*	***Mutation rate***										
	0.00	***0.05***	***0.10***	***0.15***	***0.20***	***0.25***	***0.30***	***0.35***	***0.40***	***0.45***	***0.50***
44	0	0	1	1	1	1	1	1	1	1	1
43	0	1	1	0	0	1	0	1	1	1	0
42	0	0	1	1	0	0	1	0	1	1	0
41	0	0	0	0	0	1	0	0	0	1	0
40	0	0	1	0	0	1	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	1	1	1	0	0	1
37	0	0	0	0	0	0	1	0	0	1	0
36	0	0	0	0	1	1	0	1	0	1	0
35	0	0	0	0	0	0	1	1	1	0	1
34	0	0	0	0	1	0	0	0	0	1	0
33	0	0	0	0	0	0	1	0	0	0	0
32	0	0	0	0	0	1	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	1
30	0	0	0	0	0	0	0	0	0	0	1
29	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	1	0	0	1	0	0	1
27	0	0	1	0	1	1	0	1	0	0	0
26	0	0	0	0	0	0	0	0	0	1	0
25	0	0	0	0	0	1	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	1	0	0	0	0	0	0	1
22	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	1
20	0	0	0	0	0	1	1	0	1	1	0
19	0	0	1	1	0	0	1	0	1	1	0
18	0	0	0	0	0	0	1	0	0	1	1
17	0	0	0	0	1	1	0	0	0	0	1
16	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	1	0	0	0	1	0	1	0
14	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	1	0	0
11	0	0	0	0	0	0	1	0	0	0	0
10	0	0	1	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	1	0	0
5	0	0	0	0	0	0	0	0	0	0	0

Table 8 (continued)

*Days before selling day**	*Mutation rate*										
	0.00	***0.05***	***0.10***	***0.15***	***0.20***	***0.25***	***0.30***	***0.35***	***0.40***	***0.45***	***0.50***
4	0	0	0	0	0	0	0	1	0	0	0
3	0	1	0	0	0	0	0	0	1	0	0
2	0	1	0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0
Profit (%)	27.20	17.49	13.74	10.10	11.78	10.38	10.15	11.62	10.75	10.25	9.54
Statistics	Max	27.2	Min	9.5	Average		13.0	Standard deviation		5.2	

Note: The selling day is the last day before XD dates.

Table 9 Sensitivity analysis of mutation rates for CPF 50 days before XD dates in August 2006

*Days before selling day**	*Mutation rate*										
	0.00	***0.05***	***0.10***	***0.15***	***0.20***	***0.25***	***0.30***	***0.35***	***0.40***	***0.45***	***0.50***
50	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	1	1	0
46	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	1	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0
43	1	0	1	1	1	1	0	1	0	1	0
42	0	1	1	1	0	1	0	1	0	1	1
41	0	1	1	0	1	1	1	0	1	1	0
40	0	1	1	1	1	0	0	0	1	1	1
39	0	1	1	1	1	1	1	0	1	1	1
38	0	0	1	1	1	1	1	1	1	1	0
37	0	0	1	1	1	0	1	1	0	1	0
36	0	0	0	1	1	0	0	0	1	1	0
35	0	0	0	0	0	0	0	1	0	0	1
34	0	0	0	1	0	0	0	0	0	1	0
33	0	0	0	0	0	1	0	1	0	0	0
32	0	0	0	0	0	0	1	1	1	1	0
31	0	0	0	0	0	0	0	1	0	0	0
30	0	0	0	0	0	0	0	0	1	1	0
29	0	0	0	1	0	1	0	0	0	0	0
28	0	0	0	0	1	1	0	0	0	1	0

Table 9 (continued)

*Days before selling day**	*Mutation rate*										
	0.00	***0.05***	***0.10***	***0.15***	***0.20***	***0.25***	***0.30***	***0.35***	***0.40***	***0.45***	***0.50***
27	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	1	0	1	0	1	0	0
24	0	1	0	0	1	0	0	0	0	0	0
23	0	0	1	0	0	0	0	0	0	0	0
22	0	1	0	0	1	0	0	0	1	0	0
21	0	0	1	1	0	0	0	1	0	0	0
20	0	0	0	1	0	1	0	1	1	1	1
19	0	1	1	0	0	0	0	0	1	1	0
18	0	0	1	0	0	1	0	0	0	0	1
17	0	0	0	0	0	0	1	0	0	1	0
16	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	1
13	0	0	0	1	0	1	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
11	0	0	1	1	0	0	0	0	0	0	0
10	0	0	0	0	0	0	1	0	0	0	0
9	0	0	0	1	0	1	0	1	1	1	1
8	0	0	0	0	0	0	1	1	0	1	0
7	0	0	0	0	0	0	0	0	1	1	0
6	0	1	1	1	1	1	1	1	1	1	0
5	0	1	1	1	0	0	1	1	1	1	1
4	0	1	0	1	1	1	1	1	0	1	1
3	0	0	0	1	0	1	0	1	1	1	0
2	0	0	1	0	0	1	1	0	1	1	0
1	0	1	1	1	1	1	1	1	1	0	1
Profit (%)	0.00	-0.46	-1.15	-1.27	-1.25	-1.47	-1.31	-1.29	-1.57	-1.68	-1.31
Statistics	Max	0.00	Min	-1.68	Average		-1.16	Standard deviation		0.50	

Note: The selling day is the last day before XD dates.

Table 10 Sensitivity analysis of mutation rates for CPF 50 days before XD dates in April 2011

Days before selling day*	***Mutation rate***										
	0.00	***0.05***	***0.10***	***0.15***	***0.20***	***0.25***	***0.30***	***0.35***	***0.40***	***0.45***	***0.50***
50	1	1	1	1	1	1	1	1	1	1	1
49	1	1	1	1	1	1	1	1	1	1	1
48	1	1	1	1	0	1	1	1	1	1	0
47	1	1	1	0	1	1	1	1	1	0	1
46	0	1	1	1	1	0	1	0	1	1	1
45	0	0	1	0	1	0	1	0	1	1	0
44	0	1	1	1	0	1	1	0	1	1	1
43	0	1	1	1	0	1	0	1	0	0	0
42	0	1	1	1	0	0	1	1	1	1	1
41	0	1	1	0	0	1	1	1	1	1	1
40	0	0	1	1	1	1	0	1	1	1	1
39	0	1	1	1	0	0	1	0	1	1	1
38	0	0	1	0	0	1	0	0	1	0	0
37	0	1	1	0	1	0	0	1	0	1	0
36	0	0	0	0	0	1	0	1	1	0	0
35	0	0	0	0	0	1	1	0	0	0	1
34	0	0	0	0	0	0	1	1	0	1	0
33	0	0	0	0	1	1	0	1	0	0	1
32	0	0	0	0	0	0	1	1	0	1	1
31	0	0	0	1	1	0	0	0	1	0	0
30	0	0	0	0	1	0	1	0	1	0	0
29	0	0	0	1	1	1	0	0	1	0	0
28	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	1	0	0	1	1	1	0
26	0	0	0	0	0	0	0	0	1	1	0
25	0	0	0	0	0	0	0	0	1	0	1
24	0	0	0	0	1	0	1	0	1	0	0
23	0	0	0	1	1	1	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	1	0
21	0	0	0	0	1	1	0	0	0	0	0
20	0	0	0	0	0	1	0	1	0	1	1
19	0	0	1	0	0	0	0	1	0	1	0
18	0	0	0	0	0	0	0	0	0	1	0
17	0	0	0	0	0	0	0	0	1	0	1
16	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	1	0	1	0	0	0
14	0	0	1	0	0	0	0	0	0	0	0
13	0	0	0	0	0	1	0	1	0	1	0

Table 10 (continued)

*Days before selling day**	*0.00*	*0.05*	*0.10*	*0.15*	*0.20*	*0.25*	*0.30*	*0.35*	*0.40*	*0.45*	*0.50*
	Mutation rate										
12	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	1	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	0	0	1	0
7	0	0	0	0	0	0	1	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	1	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0
Profit (%)	38.7	33.3	30.8	30.9	28.2	27.4	27.6	27.9	28.4	27.2	27.8
Statistics	Max	38.7	Min	27.2	Average		29.8	Standard deviation		3.5	

Note: The selling day is the last day before XD dates.

4.4 Result 4: Buying strategy with zero mutation rate

This section revises the study in section 4.1 by using zero mutation rate. The first impression of the result is that the regime switching disappears. Twelve out of 24 investment plans show no signal of regime switching.

Among 12 chances of the switching, around one-third of them appear during 41 – 50 days before XD dates (around 33%). However, the period of the switching scatters from 1 to 50 days. It is better said that regime switching is specific to each stocks. It may not be able to generalize the period of regime switching for all stocks.

Table 11 Best strategy for buying stocks before XD dates with zero mutation rate using zero mutation rate (whole year)

Stocks and investment plans	*The best strategy (Lagged days to buy stocks)*	*Regime switching (lagged days before XD)*	*Profit in the year that the best strategy is found (%)*
ADVANC30	{26}	no signal	7.02
ADVANC40	{38, 36}	no signal	5.14

Table 11 (continued)

Stocks and investment plans	*The best strategy (Lagged days to buy stocks)*	*Regime switching (lagged days before XD)*	*Profit in the year that the best strategy is found (%)*
ADVANC50	{49, 48}	no signal	6.54
CPALL30	{30, 29, 28, 27, 26, 25, 24, 23, 22}	22	-4.00
CPALL40	{40}	no signal	4.38
CPALL50	{50, 49, 48}	48	4.70
CPF30	{30, 29, 28, 27}	27	2.27
CPF40	{40, 39}	39	0.98
CPF50	{49, 48}	no signal	2.44
IVL30	{29, 28, 25, 19, 16, 15, 11, 10, 9, 7, 3, 2, 1}	no signal	-6.77
IVL40	{39, 36}	no signal	7.34
IVL50	{50, 49, 48, 47, 46}	46	25.59
KBANK30	{30}	no signal	-5.46
KBANK40	{40, 39}	39	-0.99
KBANK50	{50, 49, 48}	48	-4.30
PTT30	{29, 25, 23, 21, 20, 19 ,18, 16, 14}	18	5.79
PTT40	{38, 35,33, 32, 29, 28, 25, 24, 23, 22, 21, 20, 19, 16, 14, 11, 9, 8, 7, 6, 3, 1}	6	-5.52
PTT50	{50, 49, 48, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12}	12	-0.13
SCC30	{30, 28}	no signal	4.94
SCC40	{36}	no signal	8.73
SCC50	{50, 49, 48}	48	6.59
TCAP30	{29}	no signal	-13.68
TCAP40	{40, 39}	39	14.39
TCAP50	{49}	no signal	4.00

Source: Calculation using Genetic Algorithm written in Matlab

Table 12 Concentration of regime switching before XD dates in the whole year in case of zero mutation rate

Days of regime switching (days)	**Frequency (times)**	**%**
1 – 10	1	8.33
11 – 20	2	16.67
21 – 30	2	16.67
31 – 40	3	25.00
41 – 50	4	33.33
Total	12	100.00

Note: Mutation rate = zero

For the out-of-sample test, the strategies yield 7.53% of the profit on average (table 13). This profit is higher than the usage of mutation rate of 0.30 whose profit is around 5.35% on average. The average of maximum profit of no mutation is also higher around 10 percentage points. However, the average of minimum profit is worse, around 4 percentage points lower.

Table 13 Profit of the best strategy (whole year) with zero mutation rate when applied to out-of-sample observations

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
ADVANC30	11.35	-8.44	3.45	6.03
ADVANC40	12.5	-7.84	2.78	6.51
ADVANC50	24.63	-10.48	6.46	8.52
CPALL30	17.56	-9.60	4.82	8.20
CPALL40	23.96	-7.96	6.46	10.76
CPALL50	25.00	-0.58	9.78	10.70
CPF30	25.30	-11.30	7.79	11.48
CPF40	31.51	-16.47	10.97	13.70
CPF50	40.41	-7.14	12.39	16.15
IVL30	5.76	-1.40	2.18	5.06
IVL40	25.35	-13.75	5.80	27.65
IVL50	43.78	-13.70	15.04	40.64
KBANK30	14.21	-12.28	3.61	7.63
KBANK40	20.16	-9.96	5.94	10.49
KBANK50	22.95	-9.45	8.39	9.30
PTT30	18.48	-6.32	3.78	7.34
PTT40	17.43	-2.06	3.76	5.24
PTT50	18.60	-7.73	3.73	7.22
SCC30	26.71	-13.64	5.91	10.94
SCC40	41.97	-15.35	8.67	15.06
SCC50	45.33	-16.45	7.98	15.51
TCAP30	44.22	-14.35	12.28	15.50
TCAP40	57.40	-20.24	13.90	22.63
TCAP50	68.35	-18.55	14.74	24.55
Average of all stocks	28.46	-10.63	7.53	13.20

Source: Calculation using Genetic Algorithm written in Matlab

The study revises the comparison between the profit from strategies suggested by genetic algorithm and the highest potential profit when the lowest buying price is known. Next table shows the highest profit. It is different from the same table in section 4.1 such that the average value of each investment plan is calculated according to the out-of-sample test. It means that when the best solution is found in some rounds of XD dates during 2005 – 2011, that round will not be counted in the out-of-sample test. For example, if the best solution is found in April 2010, then the out-of-sample test and the calculation of the highest potential profit do not include XD dates in April 2010. It is possible that, with a zero mutation rate (in this section) and a positive mutation rate (in section 4.1), the best solutions are not the same. Therefore, the rounds of XD dates included in the out-of-sample test and the calculation of the highest potential profit are different in that case. Therefore, the results of the calculation are different.

Table 14 Profit when buying at the known lowest price (whole year)

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
ADVANC30	17.26	1.44	7.29	4.70
ADVANC40	17.26	1.44	8.79	5.34
ADVANC50	26.15	1.44	10.90	6.88
CPALL30	20.00	0.88	9.75	6.10
CPALL40	23.96	-0.95	10.23	8.95
CPALL50	28.57	2.70	13.81	9.99
CPF30	26.79	3.70	13.08	8.76
CPF40	35.40	3.70	16.26	11.05
CPF50	48.04	3.83	19.18	14.15
IVL30	23.61	3.92	13.77	13.92
IVL40	30.88	3.90	17.39	19.08
IVL50	48.33	3.90	26.11	31.42
KBANK30	23.46	2.34	8.72	5.78
KBANK40	23.46	-2.80	13.01	7.94
KBANK50	26.57	2.34	16.10	7.15
PTT30	22.27	0.00	8.81	6.81
PTT40	24.79	4.39	11.45	6.33
PTT50	24.79	0.00	12.24	6.57
SCC30	32.76	1.79	10.96	9.10
SCC40	43.01	1.79	12.99	11.94

Table 14 (continued)

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
SCC50	48.47	1.79	14.93	12.93
TCAP30	48.25	-4.37	15.00	14.30
TCAP40	60.24	-4.37	19.31	19.00
TCAP50	69.43	-4.37	22.26	21.02
Average of all stocks	33.07	1.18	13.85	11.22

Note: The average value of all stocks is the mathematical mean. The study cannot calculate the geometric mean because of some negative values in the data.

Source: Calculation during the period of 2005 – 2011, excluding the period that the best strategy is discovered in order to match the time periods of the out-of-sample test.

The superiority of the zero mutation rate over positive rates shines again in the comparison between the out-of-sample profit and the highest potential profit. When the performance of the mutation rate of 0.30 is around 33% of the highest profit, the performance of the zero mutation rate is around 54%. It means that the investor can almost gain double profit from the strategies when the algorithm changes the mutation rate from 0.30 to zero.

Table 15 Comparison of the profit from genetic algorithm and the real data (whole year) in case of zero mutation rate

Stocks and investment plans	*Average profit from genetic algorithm in the out-of-sample tests (%)*	*Average potential profit from real data when buying at the lowest price (%)*	*Difference (percentage points)*	*Performance of genetic algorithm* (%)*
ADVANC30	3.45	7.29	-3.84	47.33
ADVANC40	2.78	8.79	-6.01	31.63
ADVANC50	6.46	10.90	-4.44	59.27
CPALL30	4.82	9.75	-4.93	49.44
CPALL40	6.46	10.23	-3.77	63.15
CPALL50	9.78	13.81	-4.03	70.82
CPF30	7.79	13.08	-5.29	59.56
CPF40	10.97	16.26	-5.29	67.47
CPF50	12.39	19.18	-6.79	64.60
IVL30	2.18	13.77	-11.59	15.83
IVL40	5.80	17.39	-11.59	33.35

Table 15 (continued)

Stocks and investment plans	*Average profit from genetic algorithm in the out-of-sample tests (%)*	*Average potential profit from real data when buying at the lowest price (%)*	*Difference (percentage points)*	*Performance of genetic algorithm* (%)*
IVL50	15.04	26.11	-11.07	57.60
KBANK30	3.61	8.72	-27.8119	11.49
KBANK40	5.94	13.01	-7.07	45.66
KBANK50	8.39	16.10	-7.71	52.11
PTT30	3.78	8.81	-5.03	42.91
PTT40	3.76	11.45	-7.69	32.84
PTT50	3.73	12.24	-8.51	30.47
SCC30	5.91	10.96	-5.05	53.92
SCC40	8.67	12.99	-4.32	66.74
SCC50	7.98	14.93	-6.95	53.45
TCAP30	12.28	15.00	-2.72	81.87
TCAP40	13.90	19.31	-5.41	71.98
TCAP50	14.74	22.26	-7.52	66.22
Average of all stocks	7.53	13.85	-6.32	54.37

* The performance is the ratio of average out-of-sample profit to average potential profit.
Source: Calculation during the period of 2005-2011

4.5 Result 5: Comparison of profit between different periods of XD dates (the first and second half of the year)

It is interesting to see whether the strategies and performance of genetic algorithm differ between the first and second half of the year. In the first half of the year, XD dates gather around March, April and May while they concentrates around August, September and November in the second half of the year. If the profit in these two rounds were not so different, it would mean that investors have two chances in a year to make profit.

4.5.1 XD dates in the first half of the year

This section repeats the calculation in section 4.4 using the zero mutation rate but calculates only for XD dates in the first half of the year. The results show that the regime switching takes place in 18 out of 24 investment plans (75%)

which is much higher than the appearance in the whole year (50%). Therefore, it can be said that regime switching does exist especially in the first half of the year.

However, it is once again that the period of the switching is scattered from 1 – 50 days. The switching can take place very close to XD dates (1 – 10 days), relatively further (21 -30 days) or very far (41 -50 days) with almost similar probability (around 22 – 28%).

Table 16 Best strategy for buying stocks before XD dates in the first half of the year using zero mutation rate

Stocks and investment plans	*The best strategy (Lagged days to buy stocks)*	*Regime switching (lagged days before XD)*	*Profit in the year that the best strategy is found (%)*
ADVANC30	{24, 22, 21, 19, 17, 15, 13, 12, 8, 7, 6, 5, 3}	5	-3.73
ADVANC40	{39, 38, 37, 36, 35, 33, 32, 31, 29, 27, 25, 23, 22, 21, 20, 15, 14, 12, 11, 8, 7, 6, 4, 3}	11	-2.61
ADVANC50	{50, 49, 48, 47, 46, 45}	45	1.55
CPALL30	{30, 29, 28, 27, 26, 25, 24, 23, 22}	22	-4.00
CPALL40	{38, 36}	no signal	1.79
CPALL50	{50, 49, 48}	48	4.70
CPF30	{29, 28, 26, 25}	25	5.57
CPF40	{40, 39, 38, 37 ,36}	36	0.96
CPF50	{49, 48}	no signal	2.44
IVL30	{27}	no signal	2.91
IVL40	{39, 36}	no signal	7.34
IVL50	{50, 49, 48, 47, 46}	46	25.59
KBANK30	{30}	no signal	-5.46
KBANK40	{40, 39, 38, 37, 35, 33, 32, 31, 29 28}	28	-7.64
KBANK50	{50, 49, 48}	48	-4.23
PTT30	{30, 29, 25, 24,23, 22, 20, 19, 17, 16, 10, 8,6 5, 4, 3, 2}	2	-5.06
PTT40	{38, 35,33, 32, 29, 28, 25, 24, 23, 22, 21, 20, 19, 16, 14, 11, 9, 8, 7, 6, 3, 1}	6	-5.52
PTT50	{50, 42, 34, 33, 32, 31, 30, 28, 27,26,25,24,22,21,20,19, 17, 16, 14, 9, 8, 6, 5, 4, 1}	4	-6.11
SCC30	{30, 28, 27, 26, 25, 24, 21, 16}	24	2.93
SCC40	{40, 39, 38, 37, 35, 34, 32, 29, 27, 26, 25, 23, 22, 21, 16, 15, 14, 13, 12}	12	2.45
SCC50	{50, 49, 48, 47, 46, 45, 44}	44	5.68

Table 16 (continued)

Stocks and investment plans	*The best strategy (Lagged days to buy stocks)*	*Regime switching (lagged days before XD)*	*Profit in the year that the best strategy is found (%)*
TCAP30	{30}	no signal	4.43
TCAP40	{40, 39, 38, 37}	37	8.55
TCAP50	{50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37}	37	14.12

Source: Calculation using Genetic Algorithm written in Matlab

Table 17 Concentration of regime switching before XD dates in the first half of the year in case of zero mutation rate

Days of regime switching (days)	Frequency (times)	%
1 – 10	4	22.22
11 – 20	2	11.11
21 – 30	4	22.22
31 – 40	3	16.67
41 – 50	5	27.78
Total	18	100.00

Note: Mutation rate = zero

The out-of-sample test shows that the average profit rises to around 10% compared to around 7.5% in the whole year. The minimum profit reduces to minus 0.16 which is almost non-negative profit. The maximize profit is, however, less than the case of the whole year; the number is around 23% compared to around 28%.

Table 18 Profit of the best strategy (first half of the year) with zero mutation rate when applied to out-of-sample observations

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
ADVANC30	6.95	-1.16	2.17	3.59
ADVANC40	8.02	-6.65	1.43	5.40
ADVANC50	12.21	-9.47	3.91	8.45
CPALL30	17.56	-9.60	5.21	8.91
CPALL40	23.19	-4.15	7.10	9.77
CPALL50	25.00	-0.58	9.72	11.72
CPF30	23.18	-2.61	5.02	9.84
CPF40	30.30	-0.43	13.75	12.83

Table 18 Profit of the best strategy (first half of the year) with zero mutation rate when applied to out-of-sample observations

Stocks and investment plans	***Max(%)***	***Min (%)***	***Average (%)***	***Standard deviation***
CPF50	40.41	-0.43	17.02	14.81
IVL30	2.30	2.30	2.30	0.00
IVL40	25.35	25.35	25.35	0.00
IVL50	43.78	43.78	43.78	0.00
KBANK30	10.50	-2.24	5.83	4.56
KBANK40	11.25	-4.03	5.86	5.63
KBANK50	15.59	-9.45	9.58	9.48
PTT30	7.36	0.00	2.96	2.63
PTT40	6.03	1.04	3.08	2.25
PTT50	5.84	0.94	3.09	2.34
SCC30	22.63	-5.39	7.27	9.86
SCC40	23.75	-4.70	7.60	9.81
SCC50	27.82	-2.89	7.72	11.54
TCAP30	35.71	-2.14	14.48	12.18
TCAP40	55.10	-5.84	18.78	20.05
TCAP50	63.76	-5.42	18.72	23.50
Average of all stocks	22.65	-0.16	10.07	8.30

Source: Calculation using Genetic Algorithm written in Matlab

Next section is the calculation of the highest profit when the lowest price is known. In the first half of the year, the highest profit reaches 16% on average. The figure is higher than that of the whole year which is around 14%. Then, it can be seen that the first half of the year is more attractive for investors than other time in a year.

Table 19 Profit when buying at the known lowest price (first half of the year)

Stocks and investment plans	***Max(%)***	***Min (%)***	***Average (%)***	***Standard deviation***
ADVANC30	17.26	1.62	7.58	6.71
ADVANC40	17.26	1.44	8.11	6.41
ADVANC50	17.26	1.44	8.87	6.61
CPALL30	20.00	0.88	10.20	6.55
CPALL40	23.96	-0.95	11.49	9.10

Table 19 (continued)

Stocks and investment plans	*Max(%)*	*Min (%)*	*Average (%)*	*Standard deviation*
CPALL50	28.57	2.70	14.35	10.83
CPF30	24.49	3.70	10.85	8.83
CPF40	35.40	5.43	17.07	13.04
CPF50	40.41	5.43	20.35	14.37
IVL30	23.61	23.61	23.61	0.00
IVL40	30.88	30.88	30.88	0.00
IVL50	48.33	48.33	48.33	0.00
KBANK30	23.46	2.34	10.24	7.10
KBANK40	23.46	2.34	13.26	7.60
KBANK50	26.57	2.34	17.08	8.39
PTT30	13.08	3.96	7.98	3.59
PTT40	13.89	5.00	9.90	3.96
PTT50	17.71	6.06	11.64	4.14
SCC30	25.91	2.46	11.67	8.42
SCC40	31.28	2.46	13.08	10.66
SCC50	31.28	2.46	12.79	10.88
TCAP30	39.27	3.79	16.44	11.94
TCAP40	60.24	3.79	23.25	19.34
TCAP50	69.43	3.79	25.00	22.88
Average of all stocks	29.29	6.89	16.00	8.39

Note: The average value of all stocks is the mathematical mean. The study cannot calculate the geometric mean because of some negative values in the data.

Source: Calculation during the period of 2005 – 2011, excluding the period that the best strategy is discovered in order to match the time periods of the out-of-sample test.

One of the highlight in this study is the performance of genetic algorithm in the first half of the year. The algorithm extracts up to 62% of the highest profit. This figure breaks the record of 54% for the algorithm with zero mutation rate for the whole year.

Table 20 Comparison of the profit from genetic algorithm and the real data (first half of the year) with zero mutation rate

Stocks and investment plans	*Average profit from genetic algorithm in the out-of-sample tests (%)*	*Average potential profit from real data when buying at the lowest price (%)*	*Difference (percentage points)*	*Performance of genetic algorithm* (%)*
ADVANC30	2.17	7.58	-5.41	28.63
ADVANC40	1.43	8.11	-6.68	17.63
ADVANC50	3.91	8.87	-4.96	44.08
CPALL30	5.21	10.20	-4.99	51.08
CPALL40	7.10	11.49	-4.39	61.79
CPALL50	9.72	14.35	-4.63	67.74
CPF30	5.02	10.85	-5.83	46.27
CPF40	13.75	17.07	-3.32	80.55
CPF50	17.02	20.35	-3.33	83.64
IVL30	2.30	23.61	-21.31	9.74
IVL40	25.35	30.88	-5.53	82.09
IVL50	43.78	48.33	-4.55	90.59
KBANK30	5.83	10.24	-4.41	56.93
KBANK40	5.86	13.26	-7.4	44.19
KBANK50	9.58	17.08	-7.5	56.09
PTT30	2.96	7.98	-5.02	37.09
PTT40	3.08	9.90	-6.82	31.11
PTT50	3.09	11.64	-8.55	26.55
SCC30	7.27	11.67	-4.4	62.30
SCC40	7.60	13.08	-5.48	58.10
SCC50	7.72	12.79	-5.07	60.36
TCAP30	14.48	16.44	-1.96	88.08
TCAP40	18.78	23.25	-4.47	80.77
TCAP50	18.72	25.00	-6.28	74.88
Average of all stocks	10.07	16.00	-5.93	62.94

* The performance is the ratio of average out-of-sample profit to average potential profit.

Source: Calculation during the period of 2005-2011

4.5.2 XD dates in the second half of the year

This section will find the strategies and performance of genetic algorithm in the second half of the year. Even though it is obvious to the readers that the performance of the first half is superior to the second half of the year but it is still interesting to see how much the difference is.

With zero mutation rate and XD dates in the second half of the year, the regime switching appears less than in the first half of the year; only 10 out of 18 (55%) investment plans show the regime switching. It should be noted that the study skips CPALL and IVL for the investigation because there is only once in 6 years that the companies pay dividend twice a year.

The period of the switching during 31 – 40 days is dominant (40%). However, the announcement of XD dates and the dividend usually takes place just only 10 -15 days prior to the XD dates. It might be the effect of the speculation made by investors that raise the stock prices before the announcement of cooperate performance.

Table 21 Best strategy for buying stocks before XD dates in the second half of the year using zero mutation rate

Stocks and investment plans	*The best strategy (Lagged days to buy stocks)*	*Regime switching (lagged days before XD)*	*Profit in the year that the best strategy is found (%)*
ADVANC30	{30}	no signal	0.53
ADVANC40	{40, 39, 38}	38	9.46
ADVANC50	{50, 49}	49	8.53
CPALL30*	-	-	-
CPALL40*	-	-	-
CPALL50*	-	-	-
CPF30	{30, 29, 28, 27}	27	2.27
CPF40	{40, 39}	39	0.98
CPF50	{42, 40, 39, 38}	no signal	0.24
IVL30**	-	-	-
IVL40**	-	-	-
IVL50**	-	-	-
KBANK30	{26, 23, 20, 19, 18, 17, 16, 15, 13, 8, 6, 5, 4, 3}	3	-3.24
KBANK40	{40, 39}	39	-0.99
KBANK50	{50, 49, 48, 47, 46, 45, 44}	44	1.44
PTT30	{30}	no signal	1.71
PTT40	{40, 39, 38, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16}	16	0.34
PTT50	{50, 49, 48, 45, 44, 43, 42, 40, 38, 37, 36, 33, 32, 31, 30, 29, 27, 23, 22, 21, 18, 17, 12, 10, 8, 7, 6, 5, 4, 3}	3	-3.61

Table 21 (continued)

Stocks and investment plans	*The best strategy (Lagged days to buy stocks)*	*Regime switching (lagged days before XD)*	*Profit in the year that the best strategy is found (%)*
SCC30	{30, 28}	no signal	4.94
SCC40	{36}	no signal	8.73
SCC50	{49, 48}	no signal	9.54
TCAP30	{29}	no signal	-13.68
TCAP40	{40, 39}	39	14.39
TCAP50	{49}	no signal	4

Note: The study skips CPALL and IVL because there is only once that the companies pay dividend in the second half of the year. It is not sufficient to conduct the out-of-sample test.

Source: Calculation using Genetic Algorithm written in Matlab

Table 22 Concentration of regime switching before XD dates in the second half of the year with zero mutation rate

Days of regime switching (days)	**Frequency (times)**	**%**
1 – 10	2	20.00
11 – 20	1	10.00
21 – 30	1	10.00
31 – 40	4	40.00
41 – 50	2	20.00
Total	10	100.00

Note: Mutation rate = zero

The average profit from the out-of-sample test is around 7.62%. It is close to that of the whole year, 7.5%. The figure is not less than that of the whole year because the study does not include CPALL and IVL which tends to give small profits. The maximum profit approaches around 27% and the minimum profit is around minus 10%. These figures are also close to that of the whole year which are around 28% and minus 10.6%.

Table 23 Profit of the best strategy (second half of the year) with zero mutation rate when applied to out-of-sample observations

Stocks and investment plans	*Max (%)*	*Min (%)*	*Average (%)*	*Standard deviation*
ADVANC30	8.81	0.00	4.77	2.91
ADVANC40	10.17	-1.96	4.80	4.85
ADVANC50	15.89	0.78	8.73	6.63
CPALL30	-	-	-	-
CPALL40	-	-	-	-
CPALL50	-	-	-	-
CPF30	25.30	-11.30	9.60	13.74
CPF40	31.51	-16.47	10.27	16.21
CPF50	31.68	-15.96	10.32	16.19
IVL30	-	-	-	-
IVL40	-	-	-	-
IVL50	-	-	-	-
KBANK30	7.77	-5.10	1.34	4.71
KBANK40	20.16	-9.79	9.14	12.63
KBANK50	23.48	-6.58	7.59	11.80
PTT30	22.27	-7.43	5.44	10.90
PTT40	20.28	-3.83	5.74	9.33
PTT50	19.29	-2.75	5.53	8.43
SCC30	26.71	-13.64	4.98	12.98
SCC40	41.97	-15.35	9.00	18.88
SCC50	43.81	-16.59	7.45	20.48
TCAP30	44.22	-14.35	10.72	19.58
TCAP40	49.30	-20.24	9.38	27.11
TCAP50	51.43	-18.55	12.31	27.53
Average of all stocks	27.45	-9.95	7.62	13.61

Note: The study skips CPALL and IVL because there is only once that the companies pay dividend in the second half of the year. It is not sufficient to conduct the out-of-sample test.

Source: Calculation using Genetic Algorithm written in Matlab

Table 24 Profit when buying at the known lowest price (second half of the year)

Stocks and investment plans	*Max (%)*	*Min (%)*	*Average (%)*	*Standard deviation*
ADVANC30	9.76	3.76	7.55	1.97
ADVANC40	17.00	3.76	9.68	4.21

Table 24 (continued)

Stocks and investment plans	*Max (%)*	*Min (%)*	*Average (%)*	*Standard deviation*
ADVANC50	26.15	6.53	13.07	7.04
CPALL30	7.05	7.05	7.05	0.00
CPALL40	7.05	7.05	7.05	0.00
CPALL50	10.60	10.60	10.60	0.00
CPF30	26.79	3.83	15.95	8.90
CPF40	32.50	6.90	17.35	9.73
CPF50	48.04	6.90	20.37	14.81
IVL30	3.90	3.90	3.90	0.00
IVL40	3.90	3.90	3.90	0.00
IVL50	3.90	3.90	3.90	0.00
KBANK30	14.21	3.79	8.16	3.92
KBANK40	21.62	9.35	15.88	5.31
KBANK50	24.31	9.35	16.41	6.11
PTT30	22.27	4.85	13.13	7.67
PTT40	24.79	4.39	13.41	9.05
PTT50	24.79	4.85	14.17	8.23
SCC30	32.76	1.79	11.22	10.96
SCC40	43.01	1.79	14.20	14.64
SCC50	48.47	1.79	17.87	16.18
TCAP30	48.25	-4.37	15.32	17.97
TCAP40	51.43	-4.37	16.69	21.29
TCAP50	55.88	-4.37	20.60	22.73
Average of all stocks	25.35	4.04	12.39	7.95

Note: The average value of all stocks is the mathematical mean. The study cannot calculate the geometric mean because of some negative values in the data.

Source: Calculation during the period of 2005 – 2011, excluding the period that the best strategy is discovered in order to match the time periods of the out-of-sample test.

The performance of XD dates in the second half of the year is around 61% without CPALL and IVL in the sample. This is quite similar to the performance of the first half of the year (62%). It is because the highest potential profit in the second half is substantially lower than the first half; the figure is around 12% in the second half and 16% in the first half.

Table 25 Comparison of the profit from genetic algorithm and the real data (second half of the year) with zero mutation rate

Stocks and investment plans	*Average profit from genetic algorithm in the out-of-sample tests (%)*	*Average potential profit from real data when buying at the lowest price (%)*	*Difference (percentage points)*	*Performance of genetic algorithm* (%)*
ADVANC30	4.77	7.55	-2.78	63.18
ADVANC40	4.80	9.68	-4.88	49.59
ADVANC50	8.73	13.07	-4.34	66.79
CPALL30	-	7.05	-	-
CPALL40	-	7.05	-	-
CPALL50	-	10.60	-	-
CPF30	9.60	15.95	-6.35	60.19
CPF40	10.27	17.35	-7.08	59.19
CPF50	10.32	20.37	-10.05	50.66
IVL30	-	3.90	-	-
IVL40	-	3.90	-	-
IVL50	-	3.90	-	-
KBANK30	1.34	8.16	-6.82	16.42
KBANK40	9.14	15.88	-6.74	57.56
KBANK50	7.59	16.41	-8.82	46.25
PTT30	5.44	13.13	-7.69	41.41
PTT40	5.74	13.41	-7.67	42.80
PTT50	5.53	14.17	-8.64	39.03
SCC30	4.98	11.22	-6.24	44.39
SCC40	9.00	14.20	-5.2	63.38
SCC50	7.45	17.87	-10.42	41.69
TCAP30	10.72	15.32	-4.6	69.97
TCAP40	9.38	16.69	-7.31	56.20
TCAP50	12.31	20.60	-8.29	59.76
Average of all stocks	7.62	12.39	-4.77	61.50

* The performance is the ratio of average out-of-sample profit to average potential profit.

** The study skips CPALL and IVL because there is only once that the companies pay dividend in the second half of the year. It is not sufficient to conduct the out-of-sample test.

Source: Calculation during the period of 2005-2011