

## Downloadable appendix

of the paper “Price clustering and natural resistance points in the Dutch stock market: a natural experiment”, by Joep Sonnemans

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## Round number resistance points and stock price

Table A1 displays the effect for different stock prices. In the category of cheapest stocks the effect is (unsurprisingly) strong: very cheap stocks cannot cross the zero-boundary because prices are positive, and the nearest 0-crossing at 10 is often too high. Fortunately there are only very few stocks in this category (1.5%). In all price categories except one (mean price between 75 and 85) we find fewer 0-crossings than not-round-number crossings. Fewer 5-crossings than not-round-number crossings are found in all but two categories (mean price in interval 0-5 and 85-95). However, the effect seems to be larger for expensive stocks. This is in line with the literature on price clustering mentioned in section 2.

<i>Mean Price</i>	<i>Average number of not-round-number crossings (1,2,3,4,6,7,8,9)</i>	<i>Average number of crossings 5</i>	<i>Average number of crossings 0</i>	<i>Number of observations</i>
0-5	1.14	2.50	0.08	26
5-15	2.70	2.34	2.48	99
15-25	4.72	4.34	4.56	140
25-35	6.40	6.17	6.24	164
35-45	8.12	7.92	7.93	175
45-55	9.39	9.13	8.84	190
55-65	11.66	10.98	11.09	124
65-75	13.52	13.15	13.27	108
75-85	13.19	12.61	13.29	110
85-95	16.34	16.53	14.96	85
95-105	19.41	17.82	18.19	67
105-115	20.83	19.52	18.86	50
115-125	20.93	19.88	20.06	48
125-135	21.94	20.50	21.42	36
135-145	25.97	24.24	23.95	42
145-155	24.09	22.91	20.78	23
155-165	28.43	25.68	25.21	19
165-175	22.29	18.82	20.29	17
175-185	28.04	25.33	23.67	9
185-195	36.55	34.64	33.59	22
195-205	33.32	32.76	31.14	21
=205	42.02	38.06	35.99	207
Total	15.78	14.80	14.47	1782

**Table A1:** Average number of integer guilder crossings differentiated by the mean price of the stock in that year. Years 1990-1998.

### Round number resistance points in other markets (footnote 3 of paper)

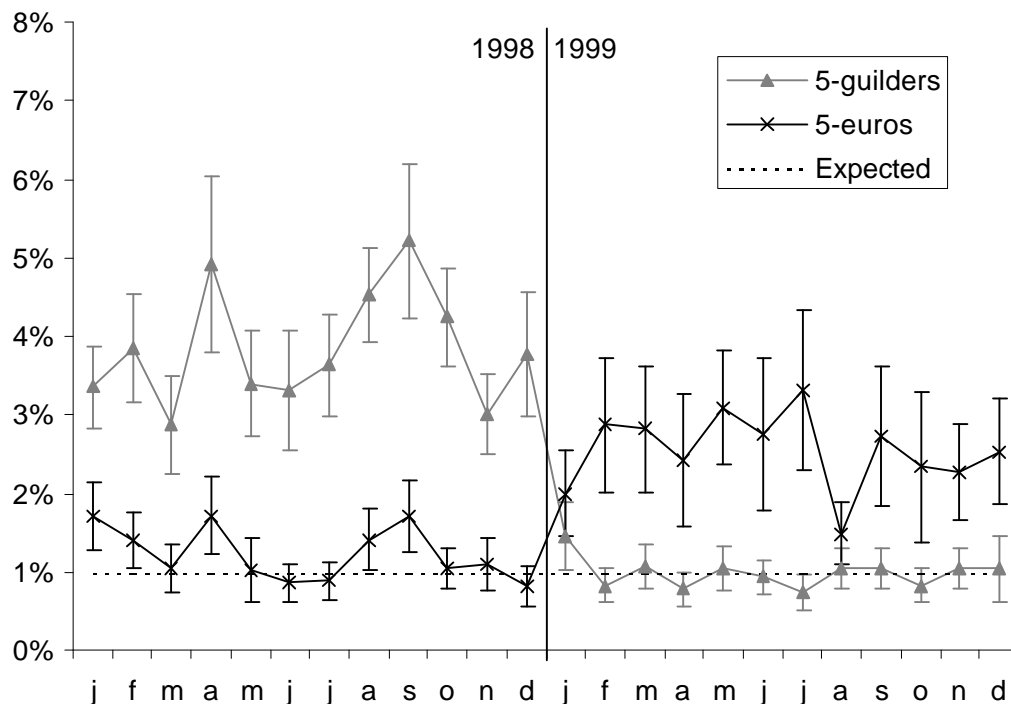
To study whether the round number resistance points found in the Dutch stock market are just a local anomaly, We looked at the American stocks that were at that time (2002) in the Standard and Poor 100 stock index.

Year	Average number of crossings(USA \$)										N
	1	2	3	4	5	6	7	8	9	0	
1990	10.60	11.61	11.90	12.28	<b>13.08</b>	<b>13.62</b>	<b>14.11</b>	<b>13.76</b>	<b>12.68</b>	10.94	90
1991	12.85	12.15	13.08	13.14	13.49	13.01	14.47	<b>15.32</b>	<b>15.95</b>	12.87	93
1992	11.60	12.59	<b>13.24</b>	<b>13.63</b>	12.83	13.32	<b>14.06</b>	<b>12.99</b>	<b>12.94</b>	11.67	96
1993	12.62	<b>14.32</b>	<b>15.12</b>	<b>14.62</b>	13.91	14.30	13.99	<b>14.11</b>	<b>14.52</b>	12.45	97
1994	11.02	11.28	12.50	11.92	11.43	11.37	11.20	11.66	12.47	11.86	98
1995	12.11	12.73	13.12	13.94	13.65	13.41	<b>14.00</b>	<b>13.85</b>	<b>14.10</b>	12.12	98
1996	<b>15.62</b>	<b>17.18</b>	<b>16.69</b>	<b>17.07</b>	15.99	15.85	<b>16.38</b>	<b>16.35</b>	<b>15.44</b>	14.12	100
1997	21.06	21.79	23.08	22.46	21.94	21.52	22.29	22.34	20.55	21.12	100
1998	24.71	25.42	25.74	26.28	25.72	<b>26.19</b>	<b>26.06</b>	<b>25.88</b>	<b>25.29</b>	23.83	100
1999	28.38	27.69	28.63	29.49	28.91	28.63	28.42	<b>29.24</b>	<b>28.35</b>	26.93	100
2000	31.21	31.24	31.32	32.51	30.90	31.48	31.61	31.53	31.41	30.53	100
2001	17.94	<b>19.23</b>	<b>19.83</b>	18.80	18.46	18.25	<b>19.73</b>	<b>20.22</b>	<b>18.79</b>	17.07	100

**Table A2:** Stocks pass 0 less often than other whole numbers. If we compare 0-crossings with 1, 2, 3, 4, 5, 6, 7, 8 and 9 crossings we find that 95 of 108 comparisons are in the expected direction (statistically significant  $p < .01$ , binomial test). Bold printed numbers differ statistically significantly from the 0-crossings (Wilcoxon tests, 2-sided,  $p < 0.05$ ).

### Transition from guilders to euros: clustering at 5-prices

Figure A1 shows clustering at round number prices 5, 15, 25 etc. guilders and euros. The figure is comparable to figure 3 of the paper: the clustering of guilder prices disappears and the clustering of euro prices appears immediately in January 1999.



**Figure A1:** Price-clustering in 1998-1999, percentage of prices at round numbers 5,15,25, etc., with standard errors. The 1999 euro-prices are rounded on the nearest 10 guilder-cents (the minimal tick size before 1999).

## Data collection

### *Calculating the crossings*

The crossings were determined as follows. Each price was compared to the previous price and if any whole number was between them that number was counted as ‘crossed’. In most cases this is obvious, for example, if the current price is 25.1 and previous price was 23.4, crossings are at 4 and 5 (the whole numbers 24 and 25 are crossed). In the situation in which a whole number is reached but not passed, that whole number is not (yet) counted as being crossed. However, if the following price change is in the same direction, a crossing is counted for that day. For example: if the current price is 33 and the previous price was 32.4, no crossing is recorded because 33 has not yet been crossed. If the following price is higher than 33, a crossing at 3 will be recorded (at that point). The program remembers the last price-change: in a price sequence of 26.6, 27, 27, 27, 27.2 a 7-crossing is counted at the last instance. A price-change of more than 10 is counted as one (but not more than one) crossing for all digits (a change from 74.2 to 87.3 counts one crossing for all 10 digits but not a double counted crossing for the 5 and 6).

Note that no effort was made to correct for stock splits or stocks going ex-dividend. The first day after a stock split *all* whole numbers are crossed (in the likely case of the original price of the stock being larger than 20) which would not influence the

statistics. There is no reason to expect that stocks going ex-dividend would lead prices to cross more or less often at specific numbers.

For a specific stock the number of crossings is not independent from one day to the next (e.g. a stock that moves between 26 and 29 guilders for some weeks will have no crossings at 0 or 5 but many at 27 and 28). Therefore the data were aggregated per stock and year (for the analyses in the transition period aggregation was per month).

#### *List of stocks*

AALBERTS INDS.	1990-2001	BETER BED HOLDING	1997-2001
ABN AMRO HOLDING	1990-2001	BEVER HDG.	1996-2001
ACCELL GROUP	1998-2001	BIJENKORF, KON.	1990-1999
AEGON	1990-2001	BLUE FOX ENTERPRISES	1999-2001
AFC AJAX	1998-2001	BLYDENSTEIN WILLINK	1990-2001
AHOLD KON.	1990-2001	BOBEL	1990-1990
AHREND(KON.) GP.CERTS.	1990-2000	BOLS,LUCAS CERTS.	1990-1993
AINO	2000-2001	BORSUMIJ WEHRY	1990-1995
AIR HOLLAND	1990-1991	BOSKALIS PF	1990-1993
AIRSPRAY NM	1998-2001	BOSKALIS WESTMINSTER	1990-2001
AKZO NOBEL	1990-2001	BQ.LX.INTERSHARE EUR.	1992-1993
AKZO WTS.86 91	1990-1990	BREDERO VERN.BEDR.	1990-1991
ALANHERI	1990-2001	BREEVAST CERTS.	1990-1999
ALGEMENE BK.NED.	1990-1990	BRILL (KON.)	1997-2001
ALLEG.PWR.CERT. (AMS)	1990-1993	BROCACEF HOLDING	1990-2000
AMBA	1991-1991	BRUNEL INTL.	1997-2001
AMRO BANK	1990-1990	BUHR. TETT.CERT.	1990-1993
AMSTELLAND CP	1995-2001	BUHRMANN	1990-2001
AMSTELLAND NV	1990-2001	BURGMAN HEYBROEK	1990-2001
AMSTERDAM COMMODITIES	1990-2001	C/TAC NM	1998-2001
AND INTL.PUBLISHERS(AMS)	1997-2001	CALVE DELFT	1990-2001
ANTILL. VERFFAB.	1990-1998	CALVE DELFT CERT.	1990-2001
AOT	1991-2001	CAP GEMINI GROUP	1990-2001
ARCADIS	1996-2001	CATE(KON.TEN)	1990-2001
ASM INTERNATIONAL	1997-2001	CDN.OS.INV.PF.	1990-2001
ASML HOLDING NV	1995-2001	CENTER PARCS	1990-1990
ASR VERZEKERINGSGROEP	1990-2001	CENTRIC KSI HOLDING	1990-2001
ASTRA INFORMATICA GROEP	1998-2000	CETECO CERT.	1994-2000
ATAG GROUP	1990-2001	CHAMOTTE UNIE	1991-1991
ATHLON GROEP	1990-2001	CINDU INTERNATIONAL	1990-1999
ATHLON GROEP CERT.	1990-1998	CMG (AMS)	1996-2001
AVALIX GROEP	1999-2000	COL.GAS SY.CERT. (AMS)	1997-1998
AVESCO	1990-1990	CONS.EDISN CERT. (AMS)	1997-2001
AXA STENMAN	1998-2001	CONTENT BEHEER	1990-1999
AXXICON GROEP	1995-2000	COPACO	1998-2001
BAAN	1995-2001	CR.LYONN.BK.NED RTS.	1990-1995
BALLAST NEDAM	1994-2001	CREYFS (AMS)	1999-2000
BAM GROEP	1990-2001	CRUCCELL	2000-2001
BATENBURG BEH.	1990-2001	CSM	1990-1993
BEERS	1990-2001	CSM CERT.	1993-2001
BEGEMANN KON.GROEP	1990-2001	CSS NM	1997-2001
BENCKISER'B'	1998-1999	CVG GEM.BEZ.	1990-2001
BERGHUIZER PAPIER.	1990-1994	DAF	1990-1992
BERKEL'S PATENT	1990-1990	DAF CONV.PREF.	1991-1992
BESI	1996-2001	DE VRIES ROBBE GROEP	1993-2001
BESOUW(VAN CERTS.)	1990-1995	DELFT INSTRUMENTS	1990-2001

DELTA LLOYD VAST FD.	1992-1992	HEIJMANS	1994-2001
DESSEAUX TAPIJT	1990-1992	HEINEKEN	1990-2001
DETRON GROUP	1999-2000	HES BEHEER	1992-2001
DIAL CORP. CERT. (AMS)	1990-1995	HIGHLIGHTDEV.	1991-1991
DICO INTL.	1990-2001	HIM FURNESS	1990-2000
DNC DE NED CO.	1990-2001	HITT NM	1998-2001
DOC DATA	1990-1992	HOECHST (AMS)	1996-2000
DOCDATA	1997-2001	HOEK'S MACHINE	1990-2000
DORDTSCHHE10% PF	1990-2001	HOLLAND COLOURS	1990-1999
DORP VAN DESPEC GROEP	1990-2001	HOMBURG HDG.CERTS.	1990-1990
DP ENERGYRESOURCES GW.	1990-2001	HOOGOVS	1990-1999
DPA HLDG. NM	1999-2001	HOOP EFFECTEN BK.	1992-2001
DRAKA HDG.	1992-2001	HUHTAMAKIVAN LEER (AMS)	1999-2000
DSM	1990-2001	HUNTER DOUGLAS	1990-2001
ECONOSTO KON.	1990-2001	ICT AUTOMATISERING	1997-2001
EHCO KLM KLEDING	1990-1993	IHC CALAND	1990-2001
EMBA	1990-2001	IMTECH	1990-2001
EMIS EURO.MARKETING	1992-2001	INCO CERT. (AMS)	1990-1997
ENDEMOL ENTERTAINMENT	1996-2000	INDUSTRIEELE MIJ.	1990-1990
ENRAF NONIUS	1990-1990	INFOTHEEK GROEP	1990-1991
ENVIRONMENT GW.FD.	1991-1993	ING BK.VAST.FD.	1990-1994
ERIKS GROUP	1990-2001	ING GROEP CERTS.	1990-2001
EUROACTIVIDADE (AMS)	1990-1990	INLAND NTRL.GS.CERT.(AMS)	1990-1994
EXACT HOLDING	1999-2001	INNOCONCEPTS NM	1998-2001
EXENDIS NV	1990-2001	INNOVEST	1990-1994
FIRST PACIFIC	1998-1998	INTL.BUS.MACH.CERT.(AMS)	1990-1997
FLA.PROGRESS CERT. (AMS)	1991-1997	INVESTERINGS MIJ NED.	1990-1990
FLEXOVIT INTL.	1990-1998	ISOTIS	2000-2001
FOKKER CERT.	1990-1997	ITT CERT.(AMS)	1997-1999
FORNIX BIOSCIENCES	1998-2001	JAPAN FD.25 O/O STOCK	1990-1990
FORTIS (AMS)	1990-2001	KAS ASSOCIATIE	1990-2001
FOX KIDS EUROPE	1999-2001	KEMPEN & CO	1990-2001
FRANS MAAS GROEP KON.	1990-2001	KENDRION	1990-2001
FREE RECORD SHOP	1990-2001	KLENE HLDG.	1990-1999
FUGRO	1992-2001	KLM	1990-2001
FURNESS	1990-1990	KNSF	1990-2000
FUTURGAM	1990-2001	KON BIJ. CERT.	1990-1990
GAMMA HOLDING	1990-2001	KON.BIJENKORF 10% PF.	1990-1991
GARZARELLI SECT.	1992-2001	KONDOR WESSELS GROEP	1990-1997
GBL (AMS)	1998-2000	KPN KON	1994-2001
GELDERSE PAPIERGROEP	1990-2000	KRASNAPOLSKY GRAND HOTEL	
GEN.PUB.UTILITIES	1990-1992		1990-2000
GENERAL ELECTRIC CO	1995-1997	KSI INTL.NM	1999-2001
GENERALE BANK PREF.2	1998-2000	KUHNE & HEITZ	1990-2001
GETRONICS	1990-2001	LANDIS GROUP	1998-2001
GEVEKE	1990-2001	LANDRE & MERREM	1990-1999
GIESSEN DE NOORD	1990-1997	LAURUS	1990-2001
GILLETTE CERT.(FL)	1991-1998	LCI TECHNOLOGY GROUP	1990-2001
GIST BROCADES CERT.	1990-1998	LETTERHAAVE	1996-1998
GOODYEAR (AMS)	1993-1993	MACINTOSH	1990-2001
GOUDA VUURVAST HOLDING	1990-2001	MAGNUS HDG.	1999-2001
GRASSO	1990-1991	MANAGEMENT SHARE	1990-2001
GROENIJK.YLCBN.	1990-1996	MAVERIX CAPITAL	1990-2001
GROLSCH (KON.)	1990-2001	MAXWELL PTL.	1990-2000
GRONTMIJ	1990-2001	MCA INC (AMS)	1990-1990
GT BERRY JAPAN FUND	1990-2001	MCGREGOR FASHION GROUP	1999-2001
GTE CORP CERTS. (AMS)	1996-2000	MEDICOPHARMA	1990-1991
GTI HOLDING	1990-2001	MENDES GANS	1990-2000
HAGEMEYER	1990-2001	MERCK CERT. (AMS)	1991-1995
HCS TECHNOLOGY	1990-1991	MIJN. CURAC. TST.2 1 CMT	1990-1990

MIJN.CURACAO TST.1	1990-1990	REESINK CERTS.	1990-2001
MIJNBOWWK.WERKEN	1990-1991	RING ROSANM	1998-2000
MOBIL CORP.CERT. (AMS)	1998-1999	RODAMCO	1990-1999
MOOLEN (VAN DER)	1990-2001	RODAMCO RETAIL NED.FD.	1994-2001
MULTI BINTANG INDO.(AMS)	1991-1997	ROOD TESTHOUSE	1991-2000
NAEFF	1991-2001	ROTO SMEETS DE BOER	1990-2001
NAGRON	1990-2001	ROYAL DUTCH PTL.	1990-2001
NAT. BORG MIJ	1990-1990	FALCON ROYAL DUTCH WTS.	1990-2001
NAT.INVESTERINGSBANK 'C'	1990-1999	RWE (AMS)	1996-1999
NAT.NEDERLANDEN	1990-1991	SAMAS CERT.	1990-2001
NATURAL RES.FD.1/ 5TH	1990-1992	SCALA BUSINESS	1998-2001
NEDAP	1990-2001	SCHUITEMA	1990-2001
NEDCON CERT	1990-2001	SEAGULL HOLDING	1999-2001
NEDGRAPHICS HOLDING NM	1998-2001	SIMAC TECHNIEK	1990-2001
NEDLLOYD	1990-2001	SLIGRO BEHEER	1990-2001
NEDSCHROEF DIV 90	1990-2001	SMIT INTL.CERTS.	1990-2001
NEDUFO (A) PARTS.	1990-1993	SMIT TRAF0 'A'	1994-2001
NEDUFO (B) PARTS.	1990-1993	SNT	2000-2001
NEVAS	1990-1993	SOC.GENERALE (AMS)	1998-1998
NEVAS 17%PREF.	1990-1993	SPHINX GUSTVBG.KON.	1990-1999
NEW EU.HTLS. (AMS)	2000-2001	STAAL BANKIERS	1990-1995
NEWAYS ELEC.INTL.	1991-2001	STERN GROEP	1990-2001
NKF HOLDING	1990-1999	STERN GROEP PREF.	1990-2000
FALCON NKF HOLDING	1990-1992	STOKVIS UNION	1990-1995
NMB DUTCH3% STK.SHS.	1990-2001	STORK	1990-2001
NMB POSTBANK GP.	1990-1991	TAS GROEP	1998-2000
NORIT	1990-2000	TELEGRAAF HDG.	1990-2001
NPM CAPITAL	1990-2000	TELEPLAN INTL.	1999-1999
NUMICO (KON.)	1990-2001	TEXAS UTILS.CERT. (AMS)	1999-2000
NUTRECO	1997-2001	TEXT LITEHDG.	1990-1990
NUTRICIA GEM.BEZ.	1990-1994	TEXTIELGRP TWENTE	1990-2001
NYLOPLAST	1998-2001	TIE HOLDINGS	2000-2001
OCE	1990-2001	TOOLEX INTERNATIONAL	1996-2001
OMNIUM EUROPE	1991-1999	TPG NV	1998-2001
OPG GROEP NV	1993-2001	TRANSAM.CERT. (AMS)	1998-1999
ORCO BANK	1990-1995	TULIP COMPUTERS	1990-2001
ORCURENT LX.B (AMS)	1990-1990	TWENTSCHE KABEL	1990-2001
ORDINA	1991-2001	UCC GROEPM	1998-2001
OTRA	1990-1999	UNILEVER CERTS.	1990-2001
P & C GROUP	1990-1998	UNIT 4 AGRESSO	1998-2001
PAKHOED, KON.	1990-1999	UNITED SERVICES GROUP	1990-2001
PALTHE	1990-1993	UTD.DUTCHGROUP	1990-1990
PETROFINA(AMS)	1998-1999	UTD.PAN EURO COMMS. 'A'	1999-2001
PETROPLUS INTL.	1998-2001	VAN HEEK TWEKA	1990-2001
PHARMING GROUP	1999-2001	VAN LANSCHOT	1999-2001
PHILIPS ELTN.KON.	1990-2001	VAN LEER,KON.	1996-2001
PHOENIX BEHEER	1990-1999	VAN MELLE	1990-2001
PIE MEDICAL	1990-1995	VAN OMMEREN (KON)	1990-1999
PINK ROCCADEF	1999-2001	VEDIOR	1997-2001
PIRELLI TYRE HOLDING	1990-1996	VENDEX KBB	1995-2001
POLYGRAM	1990-1998	VENTURE FONDS	1990-1991
POLYNORM	1990-2001	VERKADEF	1990-1990
PORCELEYNE FLES	1993-2001	VERN.GLAS.	1990-1995
PRIORITY TELECOM	2001-2001	VERN.TRANSATL.HYP.	1990-1991
PUBLIC STORAGE	1990-1992	VERSATEL TELECOM	1999-2001
R S V CERTS.	1990-1990	VERTO CERTS.	1990-1999
RABO OBL.INVESTERGF.	1990-1990	VIGILANTER HDG.	1990-1993
RANDSTAD FALCONS	1997-2000	VILENZO	1991-2001
RANDSTAD HLDG.	1990-2001	VIVENDI (AMS)	1999-2000
REED ELSEVIER (AMS)	1990-2001	VNU	1990-2001

VNU WTS.92	1990-1990
VOC WTS.A	1990-1990
VODAFONE LIBERTEL	1999-2001
VOLKER KON.ADRN	1990-2001
VOPAK KON.	1999-2001
VREDESTEIN	1990-2001
VRG GROEPMERGER	1990-1993
WEGENER ARCADE CERTS.	1990-2001
WELNA	1991-1999
WESSANEN CERTS. (HFL 2)	1990-1993
WESSANEN KON CERT.	1990-2001
WEWELER	1990-2001
WOLFF,HANDELMIJ JOH	1990-1994
WOLTERS KLUWER 4.5 PF.	1990-1995
WOLTERS KLUWER CERT	1990-2001
WORLD ONLINE INT.	2000-2000
WYERS CERTS.	1990-1996