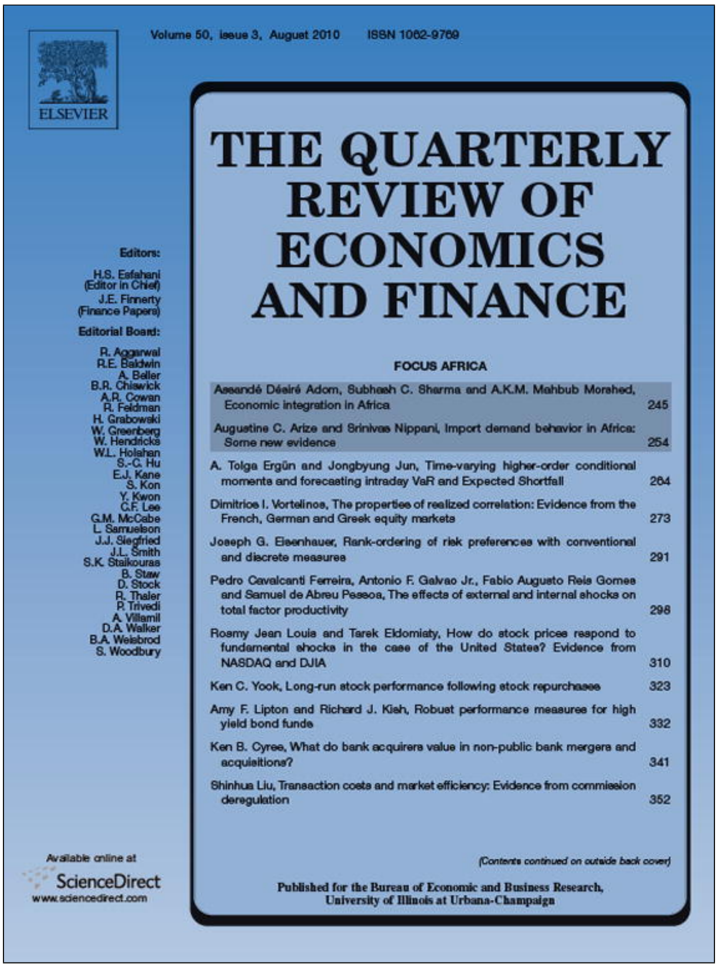

Volume 50, issue 3, August 2010 ISSN 1062-9769

ELSEVIER

THE QUARTERLY REVIEW OF ECONOMICS AND FINANCE

FOCUS AFRICA

(Contents continued on outside back cover)

Available online at ScienceDirect www.sciencedirect.com

Published for the Bureau of Economic and Business Research, University of Illinois at Urbana-Champaign

The Quarterly Review of Economics and Finance 50 (2010) 310–322

Contents lists available at ScienceDirect

The Quarterly Review of Economics and Finance

journal homepage: www.elsevier.com/locate/qref

How do stock prices respond to fundamental shocks in the case of the United States? Evidence from NASDAQ and DJIA

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ARTICLE INFO

Article history:
Received 31 July 2009
Received in revised form 10 March 2010
Accepted 17 March 2010
Available online 30 March 2010

Keywords:
DJIA
NASDAQ
Fundamental and non-fundamental variables
SVAR
SVECM

ABSTRACT

In this paper, we use both the Dow Jones and NASDAQ indices to test the robustness of Binswanger's (2004c) finding that US stock market dynamics are governed mostly by nonfundamental shocks or speculative bubbles after the 1982 debt crisis. We estimate a total of 72 SVAR models and 36 SVECM models. We determine that the findings are robust indeed and that fundamental shocks have become less and less important over the years, irrespective of which US stock market index is considered.

1. Introduction

The objective of this paper is to test the robustness of Binswanger's (2004a, 2004b, 2004c) findings that US stock price movements after the 1982 debt crisis are mainly governed by nonfundamental shocks. Binswanger uses both bivariate and trivariate structural vector autoregression (SVAR) models with fundamental variables ordered first and the S&P 500 index ordered last representing the stock market price for the US. Binswanger (2004a, 2004b) assumes that nonfundamental shocks have no long-run effects on fundamental variables (variables that indicate changes in market fundamentals). The variables considered are dividends, earnings, real interest rates, industrial production, and real GDP in SVAR models with stock prices. Binswanger's (2004c) work can be seen as complementary to previous works of Allen and Yang (2004), Binswanger (2004a, 2004b), Chung and Lee (1998), Groenewold (2004), Lee (1995a, 1995b, 1998) and Rapach (2001). These studies use a subset of fundamental variables instead to gauge the relative importance of fundamental and nonfundamental shocks for stock price movements. Binswanger's (2004c) study recognizes a shortcoming in the literature since the results of these studies are hardly comparable. This is due to the use of different fundamental variables along with stock prices in existing SVAR models identified with restrictions that are dissimilar over differing time spans and data frequency. Binswanger (2004c) offers a remedy to this problem by estimating SVAR models with quarterly data for 1953–2002, 1953–1982 and 1983–2002, and by obtaining forecast-error variance decomposition, to compare the determinants that underlie US stock market dynamics. In his view, the ability to make such comparison is in itself a check for robustness of the assumptions made in SVAR models employed in the existing literature (Fama, 1990). In this paper, we take Binswanger's (2004c) work one step further by considering both the NASDAQ and Dow Jones indices to test the robustness of his findings. That is, we examine whether one could reach the same conclusion – that US stock prices are mostly governed by speculative bubbles or irrational exuberance (Shiller, 2000) – if these two indices are used instead of the S&P 500.

There are compelling reasons to focus on both the NASDAQ and the Dow Jones as opposed to just the S&P 500 (unless there is perfect pairwise positive correlation between the three indices). First, the Dow Jones is the most widely watched index because it is simply easier to watch the performance of 30 than that of 500 companies. Second, the Dow Jones index is representative of a key component of the overall manufacturing industry in the US while the NASDAQ index fulfills the same role for the technology sector. The two

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1062-9769/$ – see front matter
doi:10.1016/j.qref.2010.03.004

Table 1
Johansen cointegration tests—NASDAQ (1972q3–2009q4).

Bivariate models										
H_0	Model I		Model II		Model III		Model IV		Critical values (95%)	
	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic
$r = 0$	19.40	13.20	15.31	9.21	20.47	16.21	15.18	11.49	25.87	19.40
$r \leq 1$	6.20	6.20	6.10	6.10	4.25	4.25	3.70	3.70	12.52	12.52
Trivariate models										
H_0	Model V		Model VI		Model VII		Model VIII		Critical values (95%)	
	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic
$r = 0$	37.21	17.05	26.81	11.85	35.40	19.04	41.47	20.47	42.92	25.82
$r \leq 1$	20.15	12.36	14.96	10.74	16.35	11.30	21.00	12.70	25.87	19.40
$r \leq 2$	7.80	7.80	4.21	4.21	5.05	5.05	8.30	8.30	12.52	12.52
H_0	Model IX		Model X		Model XI		Model XII		Critical values (95%)	
	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic
$r = 0$	40.03	23.25	40.06	19.51	42.45	22.14	40.27	23.31	42.92	25.82
$r \leq 1$	16.80	13.13	20.55	13.83	20.31	11.43	16.96	9.63	25.87	19.40
$r \leq 2$	3.66	3.66	6.72	6.72	8.90	8.90	7.34	7.34	12.52	12.52

Notes. All variables but the real interest rates are in log levels. The Johansen test was carried out with a linear deterministic trend. Both the trace statistic and the maximum eigenvalue statistic are shown in the table. Unrestricted VAR models were estimated in levels to arrive at the optimal lag length, which was chosen based on the Akaike information criterion.

indices together are the two important arteries of the US stock market, though it is still debatable whether they capture the overall performance of the US economy. Third, academics, professionals, policymakers, governments, and traders (nationally or internationally) pay close attention to all three indices as leading indicators of economic downturns or upturns. If one or two indices show signs of an upcoming US recession, stakeholders usually await the report on the second or third index in order to reach a definite consensus and build their strategies accordingly. Reports on the manufacturing and the technology sectors still capture the attention of stakeholders as they are constantly taking the US economy's pulse. Therefore, using both the NASDAQ and Dow Jones indices in revisiting Binswanger's (2004c) work can be seen as both a robustness test and a new contribution, which complements existing studies, to the literature.

Following the path of Binswanger (2004c), we use quarterly data for the period 1953–2009 for the SVAR models with Dow Jones and 1970–2009 for NASDAQ. Each sample is split into two subsamples to account for a structural break in 1982. We estimate a total of 72 SVAR models and 36 structural vector error correction models (SVECM). Surprisingly, although we use different stock price indices in the SVAR models, we arrive at results similar to Binswanger (2004c): "fundamental shocks became substantially less important during the period [1983–2009]." Therefore, we surmise that Binswanger's findings, that speculative bubbles or irrational exuberance (Shiller, 2000) are the main driving forces of

Table 2
Johansen cointegration tests—Dow Jones Index (1957q1–2009q4).

Bivariate models										
H_0	Model I		Model II		Model III		Model IV		Critical values (95%)	
	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic
$r = 0$	24.75	17.15	35.51	25.25	13.94	11.39	12.44	9.84	25.87	19.39
$r \leq 1$	7.6	7.6	10.25	10.25	2.55	2.55	2.60	2.60	12.52	12.52
Trivariate models										
H_0	Model V		Model VI		Model VII		Model VIII		Critical values (95%)	
	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic
$r = 0$	55.68	31.32	29.72	15.85	22.41	10.80	44.43	20.92	42.92	25.82
$r \leq 1$	24.36	17.30	13.87	11.32	11.61	8.69	23.51	14.83	25.87	19.39
$r \leq 2$	7.06	7.06	2.55	2.55	2.92	2.92	8.68	8.68	12.52	12.52
H_0	Model IX		Model X		Model XI		Model XII		Critical values (95%)	
	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic	Trace statistic	λ_{max} statistic
$r = 0$	40.31	25.58	55.90	30.48	49.58	24.06	43.19	23.33	42.92	25.82
$r \leq 1$	14.72	11.01	25.42	15.36	25.52	18.31	19.86	12.17	25.87	19.39
$r \leq 2$	3.71	3.71	10.06	10.06	7.21	7.21	7.69	7.69	12.52	12.52

Notes. All variables but the real interest rates are in log levels. The Johansen test was carried out with a linear deterministic trend. Both the trace statistic and the maximum eigenvalue statistic are shown in the table. Unrestricted VAR models were estimated in levels to arrive at the optimal lag length, which was chosen based on the Akaike information criterion.

Table 3
Stock price forecast error variance decomposition—NASDAQ.

Model I

Quarters-ahead	1972–2009		1972–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	21.08 (0.15)	78.92 (0.15)	52.80 (0.26)	47.20 (0.26)	10.67 (0.10)	89.33 (0.10)
2	21.87 (0.14)	78.13 (0.14)	50.29 (0.24)	49.71 (0.24)	15.64 (0.11)	84.36 (0.11)
3	22.10 (0.14)	77.90 (0.14)	51.10 (0.22)	48.90 (0.22)	16.21 (0.10)	83.79 (0.10)
4	22.11 (0.14)	77.89 (0.14)	53.40 (0.22)	46.60 (0.22)	16.48 (0.10)	83.52 (0.10)
5	22.31 (0.13)	77.69 (0.13)	52.14 (0.21)	47.86 (0.21)	16.43 (0.10)	83.57 (0.10)
10	22.71 (0.14)	77.29 (0.14)	52.97 (0.21)	47.03 (0.21)	16.47 (0.10)	83.53 (0.10)

Model II

Quarters-ahead	1972–2009		1972–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	26.65 (0.16)	73.35 (0.16)	60.78 (0.27)	39.22 (0.27)	19.56 (0.14)	80.44 (0.14)
2	24.94 (0.14)	75.06 (0.14)	52.29 (0.22)	47.71 (0.22)	20.12 (0.14)	79.88 (0.14)
3	25.12 (0.14)	74.88 (0.14)	52.90 (0.21)	47.10 (0.21)	20.00 (0.13)	80.00 (0.13)
4	25.13 (0.14)	74.88 (0.14)	52.86 (0.21)	47.14 (0.21)	19.98 (0.13)	80.02 (0.13)
5	25.49 (0.14)	74.51 (0.14)	52.65 (0.20)	47.35 (0.20)	19.86 (0.12)	80.14 (0.12)
10	25.97 (0.13)	74.03 (0.13)	53.20 (0.20)	46.80 (0.20)	19.97 (0.12)	80.03 (0.12)

Model III

Quarters-ahead	1972–2009		1972–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	0.86 (0.05)	99.14 (0.05)	8.71 (0.18)	91.29 (0.18)	0.12 (0.06)	99.88 (0.06)
2	0.83 (0.05)	99.17 (0.05)	8.20 (0.17)	91.80 (0.17)	0.18 (0.06)	99.82 (0.06)
3	1.46 (0.05)	98.54 (0.05)	12.79 (0.15)	87.21 (0.15)	0.29 (0.06)	99.71 (0.06)
4	1.79 (0.05)	98.21 (0.05)	12.65 (0.15)	87.35 (0.15)	1.19 (0.06)	98.81 (0.06)
5	2.92 (0.05)	97.08 (0.05)	13.81 (0.14)	86.19 (0.14)	3.18 (0.06)	96.82 (0.06)
10	4.78 (0.06)	95.22 (0.06)	14.24 (0.14)	85.76 (0.14)	5.47 (0.07)	94.53 (0.07)

Model IV

Quarters-ahead	1972–2009		1972–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	12.69 (0.12)	87.31 (0.12)	36.49 (0.26)	63.51 (0.26)	11.63 (0.13)	88.34 (0.13)
2	12.01 (0.11)	87.99 (0.11)	34.75 (0.15)	65.25 (0.15)	11.42 (0.12)	88.58 (0.12)
3	12.00 (0.11)	88.00 (0.11)	38.09 (0.15)	61.91 (0.15)	11.39 (0.12)	88.61 (0.12)
4	12.09 (0.11)	87.91 (0.11)	40.87 (0.14)	59.13 (0.14)	12.13 (0.12)	87.87 (0.12)
5	12.15 (0.11)	87.85 (0.11)	41.00 (0.14)	59.00 (0.14)	12.32 (0.12)	87.68 (0.12)
10	12.47 (0.11)	87.53 (0.11)	41.30 (0.14)	58.70 (0.14)	13.15 (0.12)	86.85 (0.12)

Model V

Quarters-ahead	1972–2009			1972–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	2.17 (0.07)	23.57 (0.15)	74.26 (0.15)	1.31 (0.15)	3.54 (0.24)	95.15 (0.23)	6.00 (0.10)	2.92 (0.10)	91.08 (0.13)
2	5.13 (0.07)	24.80 (0.14)	70.07 (0.14)	8.93 (0.14)	13.02 (0.21)	78.05 (0.20)	10.25 (0.11)	2.79 (0.10)	86.96 (0.12)
3	5.28 (0.07)	25.02 (0.13)	69.70 (0.13)	8.10 (0.13)	22.42 (0.20)	69.48 (0.18)	11.31 (0.10)	2.78 (0.09)	85.92 (0.12)
4	5.31 (0.07)	25.21 (0.13)	69.48 (0.13)	7.81 (0.13)	26.39 (0.19)	65.80 (0.17)	11.78 (0.10)	3.18 (0.09)	85.04 (0.11)
5	5.47 (0.07)	25.46 (0.13)	69.07 (0.13)	11.40 (0.12)	25.50 (0.18)	63.10 (0.16)	11.72 (0.10)	3.64 (0.09)	84.64 (0.11)
10	5.55 (0.07)	25.98 (0.12)	68.47 (0.13)	14.58 (0.12)	24.07 (0.18)	61.35 (0.16)	11.70 (0.10)	3.66 (0.09)	84.65 (0.11)

Table 3 (*Continued*)

Model VI

Quarters-ahead	1972–2009			1972–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	1.11 (0.10)	13.66 (0.10)	85.23 (0.13)	10.63 (0.19)	1.35 (0.18)	88.02 (0.23)	13.49 (0.10)	3.82 (0.11)	82.69 (0.13)
2	6.50 (0.09)	12.70 (0.08)	80.80 (0.12)	7.55 (0.17)	33.78 (0.16)	58.67 (0.17)	16.50 (0.12)	4.95 (0.11)	78.55 (0.11)
3	6.75 (0.09)	12.70 (0.08)	80.55 (0.11)	8.33 (0.17)	37.80 (0.16)	53.87 (0.16)	16.70 (0.12)	4.97 (0.11)	78.33 (0.10)
4	6.77 (0.09)	12.75 (0.08)	80.48 (0.11)	8.06 (0.16)	37.30 (0.15)	54.64 (0.15)	18.38 (0.13)	5.05 (0.12)	76.57 (0.10)
5	7.06 (0.09)	12.68 (0.08)	80.26 (0.11)	10.67 (0.15)	36.86 (0.15)	52.46 (0.15)	18.74 (0.13)	5.13 (0.11)	76.13 (0.10)
10	7.10 (0.09)	13.00 (0.08)	79.90 (0.11)	10.94 (0.15)	38.74 (0.14)	50.32 (0.14)	18.62 (0.13)	6.63 (0.13)	74.75 (0.10)

Model VII

Quarters-ahead	1972–2009			1972–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	11.33 (0.11)	0.67 (0.05)	88.00 (0.12)	56.22 (0.30)	2.18 (0.21)	41.60 (0.28)	10.72 (0.12)	4.95 (0.08)	84.33 (0.13)
2	10.77 (0.10)	0.67 (0.05)	88.57 (0.11)	39.22 (0.16)	7.77 (0.17)	53.01 (0.18)	10.48 (0.12)	4.79 (0.07)	84.73 (0.13)
3	10.78 (0.10)	1.38 (0.06)	87.84 (0.11)	41.13 (0.15)	7.65 (0.16)	51.23 (0.16)	10.44 (0.11)	5.16 (0.08)	84.40 (0.13)
4	10.72 (0.10)	1.89 (0.06)	87.38 (0.11)	41.77 (0.15)	9.43 (0.16)	48.80 (0.15)	10.45 (0.11)	6.58 (0.08)	82.96 (0.12)
5	10.71 (0.09)	2.81 (0.06)	86.48 (0.11)	41.34 (0.14)	10.54 (0.15)	48.12 (0.15)	10.52 (0.11)	8.20 (0.08)	81.28 (0.12)
10	11.43 (0.09)	4.02 (0.06)	84.55 (0.10)	39.73 (0.14)	12.20 (0.15)	48.08 (0.14)	11.71 (0.10)	9.39 (0.07)	78.90 (0.12)

Model VIII

Quarters-ahead	1972–2009			1972–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	2.37 (0.08)	24.95 (0.15)	72.68 (0.15)	0.02 (0.14)	8.44 (0.25)	91.54 (0.24)	5.35 (0.13)	7.67 (0.14)	86.98 (0.18)
2	6.22 (0.08)	22.91 (0.13)	70.87 (0.14)	2.66 (0.13)	36.87 (0.21)	60.47 (0.19)	7.19 (0.12)	7.45 (0.11)	85.36 (0.15)
3	6.31 (0.07)	23.10 (0.12)	70.60 (0.13)	2.70 (0.13)	44.16 (0.19)	53.14 (0.18)	7.32 (0.12)	7.62 (0.10)	85.06 (0.14)
4	6.34 (0.07)	23.27 (0.12)	70.39 (0.13)	2.87 (0.13)	43.03 (0.19)	54.10 (0.17)	7.25 (0.11)	8.34 (0.10)	84.42 (0.13)
5	6.55 (0.07)	23.61 (0.12)	69.84 (0.13)	5.21 (0.12)	42.71 (0.19)	52.09 (0.17)	7.98 (0.11)	8.26 (0.10)	83.76 (0.13)
10	6.66 (0.07)	23.98 (0.12)	69.36 (0.12)	7.27 (0.12)	41.94 (0.18)	50.79 (0.16)	8.25 (0.11)	8.30 (0.10)	83.45 (0.12)

Model IX

Quarters-ahead	1972–2009			1972–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Fundamental shocks	Non fundamental shocks
1	0.94 (0.06)	2.60 (0.07)	96.46 (0.09)	0.18 (0.19)	3.16 (0.17)	96.66 (0.23)	0.01 (0.6)	8.54 (0.06)	91.45 (0.08)
2	5.03 (0.06)	3.24 (0.06)	91.73 (0.08)	1.70 (0.15)	23.97 (0.14)	74.33 (0.18)	0.59 (0.09)	8.67 (0.10)	90.74 (0.10)
3	5.00 (0.06)	3.92 (0.06)	91.08 (0.08)	1.85 (0.14)	28.71 (0.14)	69.44 (0.16)	0.64 (0.10)	8.69 (0.10)	90.67 (0.10)
4	5.00 (0.06)	4.19 (0.06)	90.81 (0.08)	2.24 (0.13)	29.57 (0.13)	68.19 (0.15)	1.19 (0.10)	9.54 (0.11)	89.27 (0.10)
5	6.18 (0.06)	4.58 (0.06)	89.24 (0.08)	4.48 (0.13)	28.87 (0.12)	66.65 (0.15)	3.46 (0.10)	9.52 (0.10)	87.02 (0.10)
10	6.52 (0.06)	6.24 (0.06)	87.24 (0.08)	4.66 (0.12)	28.62 (0.12)	66.72 (0.14)	5.56 (0.09)	9.57 (0.10)	84.87 (0.10)

Model X

Quarters-ahead	1972–2009			1972–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	32.00 (0.17)	5.03 (0.08)	62.97 (0.17)	2.66 (0.25)	46.82 (0.27)	50.52 (0.26)	28.90 (0.15)	1.35 (0.07)	69.76 (0.16)
2	30.31 (0.16)	4.75 (0.08)	64.95 (0.16)	7.69 (0.20)	37.52 (0.18)	54.78 (0.18)	29.97 (0.15)	1.33 (0.07)	68.70 (0.16)
3	30.32 (0.15)	4.71 (0.08)	64.97 (0.15)	7.38 (0.19)	39.70 (0.18)	52.91 (0.17)	29.75 (0.14)	1.36 (0.07)	68.90 (0.15)
4	30.17 (0.15)	5.18 (0.07)	64.65 (0.15)	7.38 (0.17)	39.65 (0.17)	52.97 (0.17)	29.47 (0.13)	2.29 (0.07)	68.24 (0.14)
5	30.74 (0.15)	5.45 (0.07)	63.81 (0.14)	8.28 (0.16)	40.00 (0.16)	51.72 (0.15)	29.13 (0.13)	2.98 (0.07)	67.89 (0.14)
10	31.02 (0.14)	6.10 (0.07)	62.88 (0.14)	11.60 (0.15)	37.83 (0.14)	50.57 (0.14)	29.05 (0.12)	3.78 (0.06)	67.16 (0.13)

Table 3 (*Continued*)

Model XI									
Quarters-ahead	1972–2009			1972–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	23.75 (0.16)	7.00 (0.09)	69.25 (0.16)	2.70 (0.25)	22.27 (0.26)	75.04 (0.26)	13.87 (0.11)	1.18 (0.08)	84.95 (0.13)
2	25.42 (0.15)	6.63 (0.08)	69.96 (0.16)	13.43 (0.19)	22.95 (0.17)	63.62 (0.17)	20.32 (0.11)	1.07 (0.07)	78.61 (0.13)
3	25.48 (0.15)	6.58 (0.08)	67.94 (0.15)	12.94 (0.18)	26.95 (0.17)	60.12 (0.16)	20.56 (0.11)	1.08 (0.07)	78.36 (0.12)
4	25.42 (0.15)	6.90 (0.08)	67.70 (0.15)	12.55 (0.18)	28.84 (0.16)	58.61 (0.16)	20.54 (0.10)	2.14 (0.07)	77.32 (0.11)
5	25.87 (0.14)	7.10 (0.08)	67.04 (0.14)	13.22 (0.17)	28.80 (0.16)	57.98 (0.15)	20.36 (0.10)	3.13 (0.07)	76.51 (0.11)
10	26.00 (0.14)	7.57 (0.08)	66.43 (0.14)	16.79 (0.16	28.00 (0.14)	55.21 (0.14)	20.12 (0.10)	4.18 (0.07)	75.71 (0.11)

Model XII									
Quarters-ahead	1972–2009			1972–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	19.20 (0.14)	0.77 (0.06)	80.03 (0.14)	68.19 (0.27)	0.66 (0.13)	31.16 (0.25)	26.64 (0.10)	0.08 (0.07)	73.28 (0.12)
2	20.10 (0.13)	0.75 (0.06)	79.15 (0.14)	63.92 (0.24)	0.62 (0.12)	35.46 (0.22)	29.71 (0.11)	1.90 (0.07)	68.39 (0.12)
3	20.58 (0.13)	1.04 (0.06)	78.38 (0.13)	63.74 (0.21)	1.36 (0.12)	34.90 (0.20)	29.30 (0.10)	2.65 (0.07)	68.05 (0.11)
4	20.66 (0.12)	1.14 (0.06)	78.20 (0.13)	64.43 (0.20)	2.81 (0.12)	32.76 (0.18)	30.06 (0.10)	2.72 (0.07)	67.22 (0.11)
5	20.58 (0.12)	2.96 (0.06)	76.46 (0.12)	61.44 (0.19)	4.15 (0.11)	34.40 (0.17)	30.55 (0.10)	4.26 (0.07)	65.18 (0.10)
10	20.42 (0.12)	4.92 (0.06)	74.66 (0.12)	61.14 (0.18)	4.41 (0.11)	34.44 (0.16)	30.20 (0.09)	6.07 (0.07)	63.74 (0.10)

US stock markets, are robust irrespective of the stock price index used. The SVECM estimation results indicate that the dominance of nonfundamental shocks does not limit itself to the post-debt crisis period only, but rather to the entire period under consideration.

In the rest of the paper Section 2 presents the methodology, Section 3 discusses the empirical results, and Section 4 concludes.

2. The SVAR methodology

This paper uses the structural vector autoregression technique to uncover US stock price dynamics. This methodology has been used extensively in economics since Bernanke (1986) and Sims (1986) used short-run restrictions and Blanchard and Quah (1989) used long-run restrictions to model the innovations using economic analysis. The distinction between the short-run and the long-run restrictions comes in response to Cooley and Leroy's (1985) critique of Sims's (1980) unidentified VAR. Further improvement in the SVAR technique was brought about with the work of Gali (1992) that combines short- and long-run restrictions to identify the model. Our SVAR exposition follows Enders (2004) and considers both bivariate and trivariate models. The bivariate models contain a fundamental variable, x_t, and a stock price index, p_t, while the trivariate models consist of two fundamental variables, x_t, y_t, and the stock price index, p_t.

Assuming Z_t is a vector of either $(x_t, p_t)'$ or $(x_t, y_t, p_t)'$ driven by both fundamental and nonfundamental shocks, ε_t (fundamental shock $I = \varepsilon^f_{1t}$, fundamental shock $II = \varepsilon^f_{2t}$, nonfundamental shock $= \varepsilon^{nf}_t$), which are assumed to follow a normal distribution with covariance matrix equal to the identity matrix, I. Simply put, $E(\varepsilon_t\varepsilon_t') = I$. Let $B(L)$ be the polynomial lag matrix. Hence, by ignoring the mean values, the system can be written for either a bivariate or a trivariate VAR as

$$B(L)Z_t = \varepsilon_t \tag{1}$$

If $B(L)$ is invertible, a condition that holds if and only if the polynomial lag matrix of the reduced-form model is invertible, then one can write the infinite Wold moving average [MA(∞)] of the structural system as

$$Z_t = R(L)\varepsilon_t \tag{2}$$

where $R(L) = B(L)^{-1}$. However, since the structural model cannot be estimated because ε_t is not observable, one has to first estimate the reduced-form model and transform its residuals in order to obtain an estimate of ε_t. The reduced-form VAR representation is as follows:

$$\psi(L)Z_t = e_t \tag{3}$$

where $\psi(L) = \psi_0 + \psi_1 L + \psi_2 L^2 + \ldots + \psi_p L^p$; L is the lag-operator with $L^i Z_t = Z_{t-i}$, and ψ_0 is the identity matrix, e_t is the reduced-form residuals set with covariance matrix, Ω, being symmetric. Briefly, $E(e_t e_t') = \Omega$. Assuming $\psi(L)$ is invertible, one can write the reduced-form MA(∞) representation as

$$Z_t = C(L)e_t. \tag{4}$$

where $C(L) = \psi(L)^{-1}$. Following Blanchard and Quah (1989), the relationship between the structural shocks and the reduced-form shocks can be established by equating (2) and (4), the MA(∞) of both systems. It follows that

$$R(L)\varepsilon_t = C(L)e_t \tag{5}$$

Since $C(0)$ is equal to I and this equation holds for all t, it is straightforward that

$$R(0)\varepsilon_t = e_t \tag{6}$$

By squaring both sides and taking expectations, one finds that

$$R(0)R(0)' = \Omega \tag{7}$$

and by substituting Equation (6) in Equation (5):

$$R(L)\varepsilon_t = C(L)R(0)\varepsilon_t \tag{8}$$

and by dividing both sides of Equation (8) by ε_t:

$$R(L) = C(L)R(0) \tag{9}$$

Since Ω is symmetric, Eq. (7) places $n(n+1)/2[=3(3+1)/2=6]$ restrictions on the elements of $R(0)$, the additional

Table 4
Stock price forecast error variance decomposition—Dow Jones.

Model I

Quarters-ahead	1958–2009		1958–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	41.07 (0.12)	58.93 (0.12)	51.41 (0.16)	48.60 (0.16)	28.22 (0.15)	71.78 (0.15)
2	42.46 (0.12)	57.54 (0.12)	54.24 (0.15)	45.76 (0.15)	28.19 (0.15)	71.81 (0.15)
3	42.48 (0.12)	57.52 (0.12)	53.95 (0.15)	46.05 (0.15)	28.62 (0.14)	71.36 (0.14)
4	42.61 (0.11)	57.40 (0.11)	54.76 (0.15)	45.24 (0.15)	28.29 (0.14)	71.71 (0.14)
5	42.68 (0.11)	57.32 (0.11)	54.86 (0.14)	45.12 (0.14)	28.63 (0.13)	71.37 (0.13)
10	42.70 (0.11)	57.31 (0.11)	54.87 (0.14)	45.13 (0.14)	28.61 (0.13)	71.39 (0.13)

Model II

Quarters-ahead	1958–2009		1958–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	45.34 (0.13)	54.66 (0.13)	58.38 (0.15)	41.62 (0.15)	28.55 (0.14)	71.45 (0.14)
2	45.54 (0.13)	54.46 (0.13)	59.25 (0.14)	40.75 (0.14)	28.52 (0.14)	71.48 (0.14)
3	45.71 (0.12)	54.30 (0.13)	59.20 (0.14)	40.80 (0.14)	29.70 (0.12)	70.30 (0.12)
4	46.11 (0.12)	54.90 (0.12)	59.95 (0.14)	40.05 (0.14)	29.50 (0.12)	70.50 (0.12)
5	46.18 (0.12)	53.82 (0.12)	60.02 (0.13)	39.98 (0.13)	29.46 (0.12)	70.54 (0.12)
10	46.26 (0.12)	53.74 (0.12)	60.18 (0.13)	39.82 (0.13)	12.54 (0.12)	70.46 (0.12)

Model III

Quarters-ahead	1958–2009		1958–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	25.94 (0.12)	74.06 (0.12)	48.24 (0.17)	51.76 (0.17)	2.30 (0.10)	97.70 (0.10)
2	25.65 (0.12)	74.35 (0.12)	46.08 (0.16)	53.92 (0.16)	2.30 (0.10)	97.70 (0.10)
3	27.12 (0.11)	72.88 (0.11)	48.10 (0.15)	51.90 (0.15)	3.58 (0.10)	96.42 (0.10)
4	26.98 (0.11)	73.02 (0.11)	48.15 (0.14)	51.85 (0.14)	5.46 (0.10)	94.54 (0.10)
5	27.26 (0.11)	72.74 (0.11)	48.03 (0.14)	51.97 (0.14)	6.05 (0.09)	93.95 (0.09)
10	27.42 (0.11)	72.58 (0.11)	47.97 (0.14)	52.03 (0.14)	6.58 (0.09)	93.42 (0.09)

Model IV

Quarters-ahead	1958–2009		1958–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	12.64 (0.09)	87.36 (0.09)	50.13 (0.16)	49.87 (0.16)	3.86 (0.10)	96.14 (0.10)
2	13.19 (0.09)	86.81 (0.08)	48.87 (0.14)	51.13 (0.14)	8.32 (0.10)	91.68 (0.10)
3	13.41 (0.08)	86.59 (0.08)	50.22 (0.14)	49.78 (0.14)	10.77 (0.10)	89.23 (0.10)
4	13.41 (0.08)	86.59 (0.08)	51.40 (0.14)	48.60 (0.14)	10.86 (0.10)	89.14 (0.10)
5	13.43 (0.08)	86.57 (0.08)	51.67 (0.13)	48.33 (0.13)	12.02 (0.10)	87.98 (0.10)
10	13.73 (0.08)	86.27 (0.08)	51.63 (0.12)	48.37 (0.13)	13.30 (0.10)	86.71 (0.10)

Model V

Quarters-ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.41 (0.09)	26.07 (0.11)	73.52 (0.11)	9.60 (0.12)	17.05 (0.14)	73.35 (0.15)	26.17 (0.15)	0.34 (0.10)	73.49 (0.15)
2	5.60 (0.09)	25.25 (0.11)	69.15 (0.10)	20.57 (0.11)	15.17 (0.13)	64.26 (0.14)	26.15 (0.14)	0.76 (0.10)	73.09 (0.14)
3	6.16 (0.09)	25.37 (0.10)	68.47 (0.10)	19.85 (0.11)	16.74 (0.13)	63.41 (0.14)	26.42 (0.13)	0.98 (0.10)	72.60 (0.14)
4	7.24 (0.08)	25.40 (0.10)	67.37 (0.10)	19.17 (0.10)	19.56 (0.12)	61.27 (0.13)	26.13 (0.11)	1.07 (0.09)	72.80 (0.12)
5	7.53 (0.08)	25.47 (0.09)	67.00 (0.10)	19.42 (0.10)	19.90 (0.12)	60.68 (0.13)	26.26 (0.11)	1.13 (0.08)	72.60 (0.12)
10	7.61 (0.08)	25.61 (0.10)	66.78 (0.10)	19.58 (0.10)	19.90 (0.12)	60.53 (0.13)	26.23 (0.11)	1.20 (0.08)	72.57 (0.12)

Table 4 (*Continued*)

Model VI

Quarters-ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.00 (0.05)	7.54 (0.06)	92.46 (0.08)	5.23 (0.10)	14.60 (0.11)	80.17 (0.13)	11.95 (0.08)	0.01 (0.09)	88.04 (0.09)
2	2.28 (0.05)	10.81 (0.06)	86.91 (0.07)	8.58 (0.09)	17.00 (0.10)	74.42 (0.12)	13.07 (0.08)	1.91 (0.07)	85.02 (0.09)
3	4.21 (0.05)	10.46 (0.06)	85.33 (0.07)	8.01 (0.09)	19.92 (0.11)	72.07 (0.12)	15.57 (0.08)	2.42 (0.06)	82.01 (0.09)
4	5.71 (0.05)	10.87 (0.06)	83.42 (0.07)	7.74 (0.09)	22.42 (0.11)	69.84 (0.12)	16.16 (0.08)	2.63 (0.07)	81.21 (0.09)
5	5.97 (0.05)	10.85 (0.06)	83.18 (0.07)	7.83 (0.10)	23.90 (0.11)	68.28 (0.11)	16.56 (0.08)	4.38 (0.07)	79.06 (0.09)
10	6.08 (0.05)	11.06 (0.06)	82.86 (0.07)	8.01 (0.10)	24.30 (0.11)	67.69 (0.11)	16.32 (0.10)	6.70 (0.10)	76.98 (0.09)

Model VII

Quarters-ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	16.43 (0.11)	14.36 (0.11)	69.22 (0.13)	59.77 (0.19)	9.61 (0.17)	30.62 (0.15)	3.81 (0.10)	0.52 (0.07)	95.67 (0.12)
2	16.84 (0.10)	13.98 (0.10)	69.18 (0.12)	57.83 (0.16)	9.85 (0.15)	32.32 (0.15)	7.27 (0.10)	0.92 (0.07)	91.81 (0.12)
3	16.31 (0.09)	17.08 (0.10)	66.61 (0.11)	58.64 (0.16)	10.16 (0.15)	31.20 (0.14)	8.11 (0.09)	4.82 (0.07)	87.07 (0.12)
4	16.20 (0.09)	17.10 (0.09)	66.70 (0.11)	59.02 (0.15)	10.30 (0.14)	30.68 (0.14)	8.25 (0.09)	5.92 (0.07)	85.83 (0.11)
5	16.14 (0.09)	17.28 (0.09)	66.58 (0.11)	58.08 (0.14)	12.00 (0.12)	29.93 (0.13)	9.21 (0.09)	5.93 (0.07)	84.86 (0.11)
10	16.41 (0.09)	17.35 (0.09)	66.23 (0.11)	58.00 (0.12)	12.44 (0.11)	29.57 (0.12)	10.80 (0.09)	6.23 (0.07)	82.97 (0.11)

Model VIII

Quarters-ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	1.31 (0.11)	26.54 (0.13)	72.15 (0.12)	9.88 (0.14)	18.60 (0.16)	71.52 (0.16)	31.27 (0.11)	0.86 (0.09)	67.87 (0.13)
2	5.72 (0.10)	25.35 (0.11)	68.93 (0.11)	16.70 (0.13)	18.25 (0.15)	65.06 (0.15)	31.47 (0.10)	0.88 (0.09)	67.65 (0.12)
3	6.05 (0.10)	25.67 (0.11)	67.28 (0.11)	15.96 (0.12)	20.05 (0.15)	63.99 (0.15)	31.66 (0.10)	2.23 (0.09)	66.11 (0.12)
4	6.72 (0.10)	26.25 (0.11)	67.03 (0.11)	15.41 (0.12)	22.68 (0.15)	61.91 (0.14)	31.10 (0.09)	2.36 (0.08)	66.55 (0.10)
5	6.92 (0.10)	26.48 (0.11)	66.61 (0.11)	15.32 (0.11)	23.72 (0.14)	60.96 (0.13)	31.14 (0.09)	2.44 (0.08)	66.42 (0.10)
10	6.96 (0.09)	26.75 (0.11)	66.29 (0.11)	15.71 (0.11)	23.66 (0.13)	60.63 (0.13)	31.12 (0.08)	2.63 (0.08)	66.24 (0.09)

Model IX

Quarters-ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.85 (0.08)	19.17 (0.10)	79.98 (0.10)	8.70 (0.12)	10.70 (0.15)	80.60 (0.16)	7.42 (0.07)	0.00 (0.05)	92.58 (0.09)
2	3.55 (0.07)	19.55 (0.09)	76.90 (0.10)	9.66 (0.11)	16.58 (0.13)	73.76 (0.13)	7.37 (0.07)	0.06 (0.05)	92.58 (0.08)
3	3.45 (0.07)	21.96 (0.09)	74.59 (0.10)	9.48 (0.11)	20.70 (0.13)	69.82 (0.13)	8.14 (0.07)	0.60 (0.06)	91.26 (0.09)
4	5.47 (0.06)	21.39 (0.09)	73.14 (0.09)	9.78 (0.10)	21.16 (0.13)	69.06 (0.12)	10.10 (0.07)	0.62 (0.06)	89.27 (0.08)
5	6.50 (0.06)	21.21 (0.09)	72.29 (0.09)	12.36 (0.10)	20.53 (0.12)	67.11 (0.12)	10.75 (0.07)	0.62 (0.06)	88.63 (0.08)
10	6.62 (0.06)	21.20 (0.09)	72.20 (0.09)	12.77 (0.10)	20.34 (0.12)	66.89 (0.11)	11.00 (0.07)	1.25 (0.07)	87.75 (0.09)

Model X

Quarters-ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	48.28 (0.13)	0.01 (0.03)	51.71 (0.13)	18.62 (0.17)	41.30 (0.18)	40.08 (0.15)	41.57 (0.16)	0.23 (0.06)	58.20 (0.16)
2	48.24 (0.13)	1.71 (0.03)	50.05 (0.13)	20.60 (0.15)	40.18 (0.16)	39.22 (0.13)	39.97 (0.15)	3.36 (0.06)	56.67 (0.15)
3	48.01 (0.12)	2.92 (0.04)	49.07 (0.12)	19.86 (0.14)	41.90 (0.15)	38.24 (0.12)	39.82 (0.12)	7.49 (0.06)	52.69 (0.12)
4	48.36 (0.12)	2.98 (0.04)	48.66 (0.12)	19.14 (0.13)	43.95 (0.14)	36.91 (0.11)	39.48 (0.12)	8.01 (0.06)	52.51 (0.12)
5	48.38 (0.12)	3.21 (0.04)	48.41 (0.12)	18.90 0.13)	44.53 (0.14)	36.58 (0.11)	38.86 (0.11)	9.40 (0.06)	51.74 (0.11)
10	48.16 (0.12)	3.64 (0.04)	48.20 (0.12)	18.78 (0.13)	45.06 (0.13)	36.17 (0.10)	39.01 (0.11)	10.06 (0.06)	50.93 (0.11)

Table 4 (*Continued*)

Model XI

Quarters-ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	42.15 (0.13)	1.94 (0.05)	55.92 (0.12)	8.95 (0.16)	38.88 (0.16)	52.17 (0.14)	29.80 (0.14)	1.10 (0.06)	69.10 (0.15)
2	44.13 (0.12)	3.14 (0.04)	52.73 (0.12)	13.20 (0.15)	37.06 (0.15)	49.75 (0.13)	28.36 (0.13)	5.20 (0.06)	66.45 (0.14)
3	44.00 (0.12)	3.74 (0.04)	52.26 (0.11)	12.63 (0.13)	39.54 (0.14)	47.83 (0.12)	27.55 (0.13)	9.27 (0.07)	63.18 (0.13)
4	44.23 (0.11)	3.72 (0.04)	52.05 (0.11)	12.08 (0.13)	42.12 (0.13)	45.80 (0.11)	27.12 (0.12)	9.91 (0.06)	62.97 (0.13)
5	44.40 (0.11)	3.74 (0.04)	51.86 (0.11)	12.38 (0.12)	42.44 (0.12)	45.18 (0.10)	27.00 (0.12)	11.64 (0.07)	61.36 (0.12)
10	44.28 (0.11)	4.13 (0.04)	51.59 (0.11)	12.67 (0.12)	42.55 (0.12)	44.78 (0.10)	27.27 (0.11)	12.51 (0.07)	60.22 (0.11)

Model XII

Quarters-ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	42.70 (0.14)	4.64 (0.08)	52.66 (0.12)	61.12 (0.18)	5.25 (0.12)	33.62 (0.14)	27.47 (0.14)	10.45 (0.10)	62.08 (0.15)
2	43.65 (0.13)	4.95 (0.08)	51.40 (0.12)	61.55 (0.17)	7.10 (0.11)	31.35 (0.13)	27.40 (0.13)	10.43 (0.10)	62.18 (0.14)
3	42.92 (0.13)	6.63 (0.08)	50.45 (0.11)	59.82 (0.16)	9.92 (0.12)	30.26 (0.12)	27.08 (0.13)	11.53 (0.10)	61.40 (0.14)
4	42.80 (0.13)	7.07 (0.08)	50.13 (0.11)	60.31 (0.16)	9.83 (0.11)	29.86 (0.12)	26.57 (0.12)	13.07 (0.09)	60.36 (0.13)
5	42.52 (0.12)	7.94 (0.07)	49.53 (0.11)	59.90 (0.15)	10.48 (0.11)	29.62 (0.11)	27.44 (0.11)	13.00 (0.08)	59.56 (0.13)
10	42.44 (0.12)	8.11 (0.07)	49.45 (0.11)	59.81 (0.15)	10.48 (0.11)	29.70 (0.11)	27.35 (0.11)	13.62 (0.08)	59.03 (0.12)

$n(n-1)/2[=3(3-1)/2=3]$ restrictions needed are taken from economic theory in order to fully identify $R(0)$ for a trivariate model. Accordingly, one additional restriction is needed to identify the bivariate models. Knowledge of the $R(0)$ matrix enables us to recover (i) $R(L)$ given that $C(L)$ is already known from Eq. (4); and (ii) ε_t from Eq. (6). We impose the long-run restrictions that (a) shocks to stock prices have no permanent effects on real economic variables x_t and y_t; and (b) disturbances to y_t do not affect x_t permanently. These are the same restrictions used in Binswanger (2004c), which are borrowed from Lee (1995a, 1995b, 1998) and Chung and Lee (1998). For the trivariate models, the SVAR takes the following form:

$$\begin{bmatrix} \Delta x_t \\ \Delta y_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} R_{11}(L) & R_{12}(L) & R_{13}(L) \\ R_{21}(L) & R_{22}(L) & R_{23}(L) \\ R_{31}(L) & R_{32}(L) & R_{33}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{1t}^{f} \\ \varepsilon_{2t}^{f} \\ \varepsilon_t^{nf} \end{bmatrix} \tag{10}$$

Table 5
Short-run restrictions based on Swanson–Granger identification scheme.

	1958–2009	1958–1982	1983–2009
Model II = (IP, *P*)′	$\begin{bmatrix} * & * \\ 0 & * \end{bmatrix}$	$\begin{bmatrix} * & * \\ 0 & * \end{bmatrix}$	$\begin{bmatrix} * & * \\ 0 & * \end{bmatrix}$
Model V = (*Y*, *R*, *P*)′	Type equation here. $\begin{bmatrix} 0 & * & * \\ 0 & * & * \\ * & 0 & * \end{bmatrix}$	$\begin{bmatrix} * & * & * \\ 0 & 0 & * \\ * & 0 & * \end{bmatrix}$	$\begin{bmatrix} * & * & 0 \\ 0 & * & * \\ * & 0 & 0 \end{bmatrix}$
Model VIII = (IP, *R*, *P*)′	$\begin{bmatrix} * & 0 & * \\ * & * & 0 \\ 0 & * & * \end{bmatrix}$	$\begin{bmatrix} * & * & * \\ 0 & * & 0 \\ 0 & * & * \end{bmatrix}$	$\begin{bmatrix} * & 0 & * \\ 0 & * & 0 \\ 0 & 0 & * \end{bmatrix}$
Model X = (IP, EARN, *P*)′	$\begin{bmatrix} * & 0 & * \\ * & * & * \\ 0 & 0 & * \end{bmatrix}$	$\begin{bmatrix} * & 0 & * \\ * & * & * \\ 0 & 0 & * \end{bmatrix}$	$\begin{bmatrix} * & 0 & * \\ 0 & * & * \\ 0 & * & * \end{bmatrix}$
Model XI = (*Y*, EARN, *P*)′	$\begin{bmatrix} * & 0 & * \\ 0 & * & * \\ 0 & * & * \end{bmatrix}$	$\begin{bmatrix} * & 0 & * \\ * & * & * \\ 0 & 0 & * \end{bmatrix}$	$\begin{bmatrix} * & 0 & * \\ 0 & * & * \\ 0 & * & * \end{bmatrix}$
Model XII = (*Y*, *D*, *P*)	$\begin{bmatrix} * & 0 & * \\ * & * & * \\ 0 & 0 & * \end{bmatrix}$	$\begin{bmatrix} * & 0 & * \\ * & * & * \\ 0 & 0 & * \end{bmatrix}$	$\begin{bmatrix} * & 0 & * \\ 0 & * & 0 \\ 0 & 0 & * \end{bmatrix}$

IP, industrial production index; *P*, real Dow Jones industrial average; *Y*, real GDP; *r*, real interest rate; EARN, real earnings; *D*, real dividends. All variables but the real interest rate are in natural log levels and the time series subscript (t) is dropped for convenience. Since there is evidence of a long-term relationship between the variables in these models, the Swanson–Granger causality test was therefore used to justify the short-term restrictions needed to identify the structural vector error correction models. A zero was imposed for the contemporaneous impact wherever we failed to reject the null hypothesis of no Granger causality. The log likelihood ratio tests of the over identifying restrictions in Models V, VIII, and XII for the period 1983–2009 were performed, and appropriate adjustments were made accordingly as reflected in the corresponding tables of forecast error variance decomposition.

Table 6
SVECM results based on Swanson–Granger causality identification scheme—Dow Jones.

Model II

Quarters-ahead	1958–2009		1958–1982		1983–2009	
	Percentage of variance attributable to		Percentage of variance attributable to		Percentage of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shock
1	0.00 (0.00)	100.00 (0.00)	0.00 (0.00)	100.00 (0.00)	0.00 (0.00)	100.00 (0.00)
2	0.20 (0.01)	99.80 (0.01)	0.44 (0.01)	99.56 (0.01)	0.02 (0.01)	99.98 (0.01)
3	0.10 (0.01)	99.80 (0.01)	0.48 (0.02)	99.52 (0.02)	1.53 (0.03)	98.47 (0.03)
4	0.27 (0.01)	99.73 (0.01)	1.28 (0.03)	98.72 (0.03)	1.71 (0.03)	98.29 (0.03)
5	0.28 (0.01)	99.72 (0.01)	1.84 (0.03)	98.16 (0.03)	2.88 (0.03)	97.12 (0.03)
10	0.28 (0.02)	99.72 (0.02)	1.85 (0.03)	98.15 (0.03)	3.08 (0.04)	96.92 (0.04)

Model V

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0 (0.00)	2.63 (0.02)	0 (0.02)	0 (0.00)	7.07 (0.06)	92.93 (0.06)	0 (0.00)	0.06 (0.06)	99.94 (0.06)
2	0.12 (0.02)	6.82 (0.04)	97.37 (0.04)	3.46 (0.06)	15.18 (0.06)	81.36 (0.07)	0.18 (0.04)	0.35 (0.06)	99.47 (0.07)
3	0.4 (0.02)	6.84 (0.04)	93.05 (0.04)	4.41 (0.05)	14.59 (0.05)	81 (0.06)	0.22 (0.04)	0.45 (0.06)	99.33 (0.07)
4	0.95 (0.02)	7.42 (0.04)	92.76 (0.04)	5.91 (0.06)	14.22 (0.06)	79.87 (0.08)	2.28 (0.06)	0.57 (0.06)	97.14 (0.08)
5	1.19 (0.02)	8.04 (0.04)	91.63 (0.04)	7.29 (0.06)	15.01 (0.06)	77.71 (0.08)	2.56 (0.06)	0.65 (0.06)	96.8 (0.08)
10	1.24 (0.03)	8.3 (0.04)	90.47 (0.04)	7.5 (0.06)	15.67 (0.06)	76.84 (0.08)	2.59 (0.07)	0.92 (0.06)	96.49 (0.08)

Model VIII

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.44 (0.01)	1.31 (0.02)	98.25 (0.02)	0.05 (0.02)	1.95 (0.03)	98.01 (0.03)	0.03 (0.02)	0.16 (0.01)	99.81 (0.02)
2	0.53 (0.01)	4.29 (0.03)	95.19 (0.03)	0.07 (0.02)	4.39 (0.04)	95.54 (0.04)	0.06 (0.02)	0.30 (0.02)	99.64 (0.03)
3	0.55 (0.01)	4.59 (0.03)	94.86 (0.03)	0.29 (0.02)	4.46 (0.04)	95.25 (0.04)	2.64 (0.04)	0.29 (0.02)	97.07 (0.04)
4	0.56 (0.01)	5.58 (0.03)	93.85 (0.03)	1.31 (0.03)	4.53 (0.04)	94.16 (0.05)	3.90 (0.04)	0.88 (0.03)	95.22 (0.05)
5	0.59 (0.01)	6.40 (0.03)	93.01 (0.03)	1.45 (0.03)	6.16 (0.04)	92.39 (0.05)	5.61 (0.05)	0.87 (0.03)	93.52 (0.05)
10	0.60 (0.01)	6.51 (0.03)	92.89 (0.03)	2.19 (0.03)	6.79 (0.04)	91.02 (0.05)	5.79 (0.05)	1.24 (0.03)	92.97 (0.06)

Model X

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.00 (0.00)	0.00 (0.00)	100.00 (0.00)	0.00 (0.00)	0.00 (0.00)	100.00 (0.00)	0.00 (0.00)	81.84 (0.28)	18.16 (0.28)
2	0.12 (0.01)	1.88 (0.02)	98.00 (0.02)	0.33 (0.02)	4.56 (0.03)	95.11 (0.04)	0.61 (0.02)	79.43 (0.26)	19.96 (0.26)
3	0.36 (0.01)	3.72 (0.02)	95.92 (0.03)	0.80 (0.02)	5.11 (0.03)	94.09 (0.04)	5.22 (0.04)	73.38 (0.22)	21.41 (0.21)
4	0.66 (0.01)	3.98 (0.02)	95.35 (0.03)	3.04 (0.04)	5.03 (0.03)	91.93 (0.05)	5.18 (0.04)	73.16 (0.21)	21.66 (0.20)
5	1.02 (0.01)	4.59 (0.03)	94.39 (0.03)	4.77 (0.04)	4.95 (0.03)	90.28 (0.05)	5.09 (0.04)	71.37 (0.19)	23.54 (0.19)
10	1.17 (0.01)	5.03 (0.03)	93.79 (0.03)	5.00 (0.04)	5.13 (0.03)	89.87 (0.05)	5.85 (0.04)	68.81 (0.18)	25.34 (0.18)

Model XI

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.00 (0.00)	80.88 (0.18)	19.12 (0.18)	0.00 (0.00)	93.85 (0.23)	6.15 (0.23)	0.00 (0.00)	79.90 (0.31)	20.10 (0.31)
2	0.65 (0.01)	80.14 (0.18)	19.21 (0.17)	0.34 (0.01)	93.10 (0.23)	6.56 (0.23)	0.69 (0.02)	76.59 (0.28)	22.72 (0.28)
3	1.77 (0.02)	78.80 (0.15)	19.43 (0.15)	2.35 (0.02)	91.48 (0.22)	6.17 (0.22)	1.42 (0.03)	74.74 (0.24)	23.84 (0.24)
4	2.67 (0.02)	78.10 (0.14)	19.22 (0.14)	4.28 (0.02)	88.84 (0.21)	6.88 (0.21)	1.70 (0.03)	74.48 (0.23)	23.82 (0.23)
5	3.66 (0.02)	76.59 (0.14)	19.75 (0.14)	4.71 (0.02)	88.06 (0.21)	7.22 (0.21)	2.67 (0.04)	72.73 (0.21)	24.60 (0.21)
10	3.78 (0.02)	75.44 (0.13)	20.78 (0.13)	5.04 (0.02)	87.43 (0.21)	7.53 (0.21)	3.09 (0.04)	70.83 (0.20)	26.08 (0.20)

Table 6 (*Continued*)

Model XII

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.00 (0.00)	0.00 (0.00)	100.00 (0.00)	0.00 (0.00)	0.00 (0.00)	100.00 (0.00)	0.00 (0.00)	0.00 (0.00)	100.00 (0.00)
2	1.34 (0.02)	0.46 (0.01)	98.20 (0.02)	2.73 (0.03)	2.47 (0.03)	94.81 (0.04)	0.24 (0.02)	0.03 (0.02)	99.73 (0.02)
3	1.32 (0.02)	2.11 (0.02)	96.57 (0.03)	2.77 (0.03)	4.89 (0.05)	92.33 (0.06)	0.29 (0.02)	1.56 (0.03)	98.15 (0.03)
4	1.36 (0.02)	2.72 (0.02)	95.92 (0.03)	3.39 (0.04)	4.83 (0.05)	91.78 (0.06)	0.97 (0.03)	3.13 (0.04)	95.90 (0.05)
5	1.55 (0.02)	3.54 (0.03)	94.91 (0.03)	3.47 (0.04)	5.48 (0.05)	91.05 (0.06)	1.04 (0.03)	3.37 (0.04)	95.59 (0.05)
10	1.58 (0.02)	3.66 (0.03)	94.76 (0.03)	3.48 (0.04)	5.59 (0.05)	90.93 (0.06)	1.20 (0.03)	3.70 (0.04)	95.10 (0.05)

with $R_{12}(1)=R_{13}(1)=R_{23}(1)=0$. Analogously, $R_{12}(1)=0$ for the bivariate models.

Finally, the variance decomposition follows from Eq. (2) after first differencing the variables and is given by

$$\frac{\sum_{k=0}^{t-1} r_{ij}(k)^2}{\sum_{k=0}^{t-1}\sum_{j=1}^{m} r_{ij}(k)^2} \times 100$$

We estimate the following bivariate and trivariate models. The first seven models reflect those presented in Binswanger. The remaining five models were those left out, which we incorporate in our robustness tests. Each model contains the real stock prices, p_t, as a second variable (in the case of the bivariates) or as a third variable (in the case of the trivariates).

Bivariate SVAR models	Trivariate SVAR models	
Model I: x = real GDP	Model V: x = real GDP	Model IX: x = real dividends
	y = real interest rate	y = real interest rate
Model II: x = industrial production	Model VI: x = real earnings	Model X: x = industrial production
	y = real interest rate	y = real earnings
Model III: x = real dividends	Model VII: x = real earnings	Model XI: x = real GDP
	y = real dividends	y = real earnings
Model IV: x = real earnings	Model VIII: x = industrial production	Model XII: x = real GDP
	y = real interest rate	y = real dividends

3. Empirical results

3.1. Data analysis and cointegration tests

The Dow Jones quarterly data set used for the empirical analysis covers the period 1958–2009. AS for the NASDAQ data, we inherit a shorter sample that spans from the third quarter of 1972 to the last quarter of 2009. In both cases, we split the sample into two subsamples to account for a structural break in the data. One subsample covers up to 1982 and the other covers the period 1983–2009. This is done to capture the switch from a period of decline to the start of a booming era in US stock markets documented in Binswanger (1999, 2004b, 2004c) and Ibbotson and Sinquefield (1994). The data on the Dow Jones Index were extracted from the company's web site while the data on the NASDAQ index was obtained directly from NASDAQ's economics department.[2] Data on the consumer price index (CPI), real GDP and industrial production are seasonally adjusted with a base year of 2000. They were downloaded from the International Financial Statistics (IFS) web site. The data on earnings and dividends came from Robert Shiller's web page. We use the 3-month Treasury bill rate reported by IFS and, to obtain the real interest rate, subtract from it the inflation rate. We follow Shiller's strategy and convert all the variables to the same base year using the last quarter of 2009 as the reference point for the calculation. Briefly, all variables are effectively in 2009 dollars. We use the logarithmic transformation for all real variables except the real interest rate.

We tested the series for unit roots using the Augmented Dickey-Fuller (ADF), DF-GLS, and Phillips-Perron (PP) tests, and these were found to be integrated of order 1 or nonstationary.[3] We achieve stationarity by taking the first differences. We perform two sets of cointegration tests using the Johansen's (1995) methodology under the assumption of a linear deterministic trend in the data. The first set involves the Dow Jones and the second set involves the NASDAQ index. The optimal lag length suggested by the Akaike Info criteria is used. The results based on NASDAQ are presented in Table 1, which shows that there is no cointegration between the variables included in the 12 models. Table 2 shows the cointegration tests with Dow Jones. In 6 of the 12 models, the null hypothesis of no cointegration is rejected. However, a number of discrepancies arise: (a) Models VIII, XI, and XII display cointegration based on the trace statistic but not on the maximum eigenvalue statistic; and (b) Models II, V, and X are subjected to the information criteria, hence the optimal lag lengths. Since our results based on NASDAQ do not show any convincing evidence of cointegration (which concurs with Binswanger) and in light of the confusing results that emerge with the Dow Jones information, we have adopted two strategies. First, we intentionally ignored the cointegration results and estimated pure SVAR models. Second, we test the robustness of the results by estimating structural vector error correction models (SVECM) for the 6 models that show signs of cointegration of the variables.

3.2. The SVAR analysis

For each sample period, we estimate 24 SVAR models in first differences with four lags each, to get rid of possible residual autocorrelation. The results of the forecast error variance decomposition are reported in Table 3 for NASDAQ and Table 4 for the Dow Jones. Over the full sample range and the period 1983–2009 (irrespective of whether we focus on NASDAQ or Dow Jones) non-fundamental shocks stochastically dominate fundamental shocks in explaining stock price dynamics. That dominance is even more pronounced during the period 1983–2009 (over 80 percent on average), which presents clear evidence that fundamental shocks have become less important as reported in Binswanger.

[2] We thank Dr. Frank Hathway, Chief Economist at NASDAQ, for supplying the data.

[3] Unit root results are available upon request.

Table 7
SVECM results based on Binswanger's identification scheme—Dow Jones.

Model II

Quarters ahead	1958–2009		1958–1982		1983–2009	
	Percent of variance attributable to		Percent of variance attributable to		Percent of variance attributable to	
	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks	Fundamental shocks	Non fundamental shocks
1	1.61 (0.02)	98.39 (0.02)	1.13 (0.02)	98.87 (0.02)	0.02 (0.01)	99.98 (0.01)
2	1.98 (0.02)	98.02 (0.02)	1.32 (0.03)	98.68 (0.03)	0.03 (0.02)	99.97 (0.02)
3	1.97 (0.02)	98.03 (0.02)	1.49 (0.03)	98.51 (0.03)	1.55 (0.03)	98.45 (0.03)
4	2.10 (0.02)	97.90 (0.02)	3.21 (0.04)	96.79 (0.04)	1.72 (0.03)	98.28 (0.03)
5	2.12 (0.02)	97.88 (0.02)	4.26 (0.05)	95.74 (0.05)	2.88 (0.04)	97.12 (0.04)
10	2.12 (0.02)	97.88 (0.02)	4.42 (0.05)	95.58 (0.05)	3.09 (0.04)	96.92 (0.04)

Model V

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.97 (0.01)	1.66 (0.02)	97.37 (0.02)	6.04 (0.04)	1.03 (0.04)	92.93 (0.06)	0.05 (0.02)	0.05 (0.01)	99.90 (0.02)
2	1.90 (0.02)	5.05 (0.03)	93.05 (0.04)	9.53 (0.04)	9.11 (0.06)	81.36 (0.07)	0.05 (0.02)	0.08 (0.02)	99.87 (0.03)
3	1.92 (0.02)	5.32 (0.03)	92.76 (0.04)	9.06 (0.04)	9.94 (0.05)	81.00 (0.06)	0.27 (0.02)	0.22 (0.02)	99.51 (0.03)
4	1.88 (0.02)	6.49 (0.03)	91.63 (0.04)	9.35 (0.07)	10.78 (0.05)	79.87 (0.08)	1.13 (0.03)	1.41 (0.03)	97.46 (0.04)
5	1.88 (0.02)	7.35 (0.04)	90.77 (0.04)	9.37 (0.07)	12.92 (0.05)	77.71 (0.08)	1.63 (0.03)	1.40 (0.03)	96.97 (0.04)
10	1.89 (0.02)	7.58 (0.04)	90.53 (0.04)	9.72 (0.07)	13.44 (0.05)	76.84 (0.08)	1.70 (0.04)	1.49 (0.03)	96.81 (0.04)

Model VIII

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.37 (0.01)	1.76 (0.02)	97.87 (0.02)	0.00 (0.02)	1.99 (0.03)	98.01 (0.03)	0.10 (0.02)	0.09 (0.01)	99.81 (0.02)
2	0.36 (0.01)	6.17 (0.04)	93.47 (0.04)	0.01 (0.02)	4.45 (0.04)	95.54 (0.04)	0.10 (0.02)	0.25 (0.02)	99.64 (0.03)
3	0.52 (0.01)	6.34 (0.04)	93.14 (0.04)	0.14 (0.02)	4.61 (0.04)	95.25 (0.05)	2.15 (0.03)	0.78 (0.03)	97.07 (0.04)
4	0.87 (0.02)	6.55 (0.03)	92.57 (0.04)	1.27 (0.03)	4.58 (0.04)	94.16 (0.05)	2.61 (0.04)	2.17 (0.03)	95.22 (0.05)
5	0.98 (0.02)	6.74 (0.03)	92.28 (0.04)	1.61 (0.03)	6.01 (0.04)	92.39 (0.05)	4.09 (0.04)	2.39 (0.03)	93.52 (0.05)
10	1.06 (0.02)	7.25 (0.03)	91.69 (0.04)	2.23 (0.03)	6.75 (0.05)	91.02 (0.05)	4.15 (0.04)	2.87 (0.04)	92.97 (0.05)

Model X

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.04 (0.01)	0.01 (0.01)	99.95 (0.01)	0.85 (0.03)	7.55 (0.05)	91.60 (0.05)	1.15 (0.02)	0.03 (0.02)	98.82 (0.03)
2	0.05 (0.01)	0.50 (0.01)	99.45 (0.02)	0.88 (0.03)	8.58 (0.05)	90.54 (0.05)	1.45 (0.03)	3.33 (0.04)	95.22 (0.05)
3	0.67 (0.02)	5.40 (0.03)	93.92 (0.03)	1.66 (0.03)	8.04 (0.04)	90.30 (0.05)	3.82 (0.04)	7.47 (0.06)	88.71 (0.07)
4	0.96 (0.02)	6.52 (0.03)	92.53 (0.04)	3.93 (0.04)	7.87 (0.04)	88.19 (0.06)	3.80 (0.04)	7.63 (0.06)	88.57 (0.07)
5	1.33 (0.02)	8.13 (0.03)	90.54 (0.04)	5.65 (0.04)	7.75 (0.04)	86.60 (0.05)	3.78 (0.04)	8.24 (0.06)	87.98 (0.07)
10	1.80 (0.02)	9.00 (0.04)	89.20 (0.04)	5.92 (0.05)	7.92 (0.04)	86.16 (0.06)	4.12 (0.04)	8.46 (0.06)	87.42 (0.07)

Model XI

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	3.33 (0.03)	0.16 (0.01)	96.51 (0.03)	3.29 (0.02)	0.45 (0.07)	96.25 (0.07)	0.97 (0.02)	0.00 (0.02)	99.03 (0.03)
2	5.14 (0.03)	3.00 (0.02)	91.87 (0.04)	4.72 (0.04)	5.87 (0.09)	89.41 (0.08)	1.34 (0.03)	3.93 (0.04)	94.74 (0.05)
3	5.13 (0.03)	3.98 (0.03)	90.89 (0.04)	4.88 (0.04)	7.87 (0.09)	87.25 (0.09)	1.51 (0.03)	7.18 (0.05)	91.31 (0.05)
4	5.44 (0.03)	4.04 (0.03)	90.52 (0.04)	6.76 (0.04)	8.53 (0.10)	84.70 (0.09)	1.73 (0.03)	7.29 (0.05)	90.99 (0.06)
5	5.78 (0.03)	4.27 (0.03)	89.95 (0.04)	6.98 (0.04)	8.88 (0.10)	84.14 (0.09)	2.42 (0.04)	7.93 (0.05)	89.65 (0.06)
10	5.98 (0.03)	4.78 (0.03)	89.24 (0.04)	8.35 (0.04)	10.70 (0.10)	80.95 (0.09)	2.75 (0.04)	8.19 (0.05)	89.06 (0.06)

Table 7 (*Continued*)

Model XII

Quarters ahead	1958–2009			1958–1982			1983–2009		
	Percent of variance attributable to			Percent of variance attributable to			Percent of variance attributable to		
	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks	Fundamental shocks I	Fundamental shocks II	Non fundamental shocks
1	0.55 (0.01)	2.16 (0.02)	97.29 (0.03)	0.62 (0.02)	4.22 (0.04)	95.16 (0.04)	0.41 (0.02)	4.19 (0.05)	95.39 (0.05)
2	0.69 (0.01)	2.35 (0.03)	96.97 (0.03)	0.65 (0.03)	4.77 (0.05)	94.57 (0.05)	0.41 (0.02)	4.67 (0.05)	94.92 (0.05)
3	1.38 (0.02)	3.26 (0.03)	95.36 (0.03)	3.74 (0.04)	5.56 (0.05)	90.71 (0.06)	0.48 (0.02)	5.27 (0.05)	94.25 (0.05)
4	2.25 (0.02)	4.43 (0.03)	93.32 (0.04)	7.82 (0.05)	5.43 (0.05)	86.75 (0.07)	0.84 (0.02)	14.99 (0.06)	84.17 (0.07)
5	3.32 (0.02)	6.40 (0.03)	90.28 (0.04)	8.78 (0.05)	5.72 (0.05)	85.50 (0.07)	1.39 (0.03)	18.27 (0.07)	80.35 (0.07)
10	3.35 (0.02)	6.79 (0.03)	89.86 (0.04)	9.61 (0.05)	6.07 (0.05)	84.33 (0.07)	2.12 (0.03)	20.10 (0.07)	77.77 (0.07)

For the period prior to 1983, we find some other interesting results: (a) fundamental shocks are more important than nonfundamental shocks in explaining stock price movements in bivariate models with real GDP and industrial production while the opposite is observed in models with dividends and earnings[4]; (b) fundamental shocks are superior in magnitude in models with fundamental variables to those in models with dividends and earnings; and (c) in trivariate models V, VI, VII, IX (where real interest rate is incorporated as a second variable), fundamental shocks to real interest rate dominate all other fundamental shocks in their contribution to stock price dynamics. This indicates that stock markets are more sensitive to monetary policy news.

For trivariate models X, XI, and XII, over all the sample periods, fundamental shocks inherent to real earnings show a cyclical pattern in their contribution to stock prices. Over the full sample, they are less than those from industrial production and real GDP. Prior to 1983, they were greater, and thereafter they become smaller again. This pattern is not observed for fundamental shocks to real dividends, which remain less important over all sample periods. Since we did not estimate a trivariate model with real industrial production, real dividends, and real stock prices, we can only infer that the same pattern observed for the model with real GDP will materialize since it seems to be the case in other models. The message these results send is separate from irrational exuberance. The latter asserts that the bulk of stock price variations, from 1983 onwards, are due to real fundamental variables that bear more weight than do shocks to real dividends or real earnings. In fact, model VII with real earnings, real dividends, and real stock prices concur with that: fundamental shocks from the first two variables could barely explain 20 percent of the total stock prices variation for the period 1983–2009.

3.3. The SVECM analysis

The SVECM is a two-step approach. In the first step, a reduced-form of VECM is estimated following Johansen's (1995) procedures:

$$\Delta z_t = \mu + \alpha\beta' z_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta z_{t-1} + e_t \qquad (11)$$

where z_t is an n-dimensional vector of variables integrated of order 1 that becomes stationary after differencing; μ_t is a vector of parameters containing intercepts and trends; β is the matrix of long-run equilibrium relationships between the variables, whereas α is the matrix of adjustment coefficients when the variables in the system are in disequilibrium; Γ_i is the matrix of parameters capturing the short-run dynamics; and e_t is a vector of reduced-form residuals. The VECM is the same as a VAR with differenced variables, except for the error correction term. In the second step, procedures similar to the ones described in the methodology can be used to solve the identification problem. First, we use the causal approach to residual orthogonalization in vector autoregressions proposed by Swanson and Granger (1997) to identify the different models and present the matrices in Table 5.[5] Zeros are assigned wherever we failed to reject the null hypothesis of no Granger-causality, indicating the absence of contemporaneous impact since the cointegration test had already shown a long-run relationship among the variables. The likelihood ratio tests were also used to test for over identification. Second, in order to test the robustness of our results, we imposed a lower triangular structure to the response matrix in Equation 10, allowing the stock prices (DJIA) to be the only variables influenced by both fundamental and non-fundamental shocks. This identification scheme is similar to Binswanger's (2004c), except that Binswanger imposed long-run restrictions. These alternative short-run restrictions, by and large, make sense in implying that (a) the fundamental variables such as real GDP and industrial production index are not affected by shocks to other fundamental and nonfundamental variables in the first quarter and (b) nonfundamental shocks have no instantaneous impact on real interest rate, real dividends, and real earnings.

We present the forecast error variance decomposition results of the SVECM estimation in Tables 6 and 7 for Models II, V, VIII, X, XI, and XII of Table 2 that shows cointegration of the variables when the Dow Jones is used as the stock price index. Our results conspicuously show that, irrespective of the identification scheme adopted—whether it is Swanson and Granger's (1997) causal reduced-form residual structure (Table 6) or the short-run version of Binswanger's (2004c) lower triangular structure—nonfundamental shocks explain the bulk of the stock price variations over most sample and subsamples. Two cases, however, stand out: (a) Model X with industrial production index, earnings, and DJIA shows a dominance of real earnings fundamental shocks for 1983–2009; and (b) Model XI with real GDP, real earnings, and DJIA display similar results over all sample periods.

Our research findings therefore concur with the findings of Binswanger (2004c) and those on which his paper is based (Binswanger, 2004a, 2004b; Chung & Lee, 1998; Lee, 1995a, 1995b, 1998; Shiller, 2000 among others) that *stock prices after 1982 have been governed by nonfundamental factors such as speculative bubbles or irrational exuberance*. More strongly, we argue that the findings of Binswanger (2004a, 2004b, 2004c) are robust irrespective of the

[4] For the regressions with Dow Jones, it is more inclined towards a tie.

[5] According to this approach, one first needs to estimate a VAR and obtain the residuals, the causal structure among the elements of the vector of reduced-form residuals (e_t) corresponds to the causal structure among the contemporaneous elements of vector of dependent variables (z_t).

basic price index used for the US, though the structural vector error correction models indicate that the dominance of nonfundamental shocks does not limit itself to the post-debt crisis period only, but rather to the entire period under consideration.

4. Conclusion

This paper has revisited the work of Binswanger (2004c) by focusing on the dynamics of the NASDAQ and the Dow Jones, as opposed to the S&P 500. Although we use different stock price indices, we arrive at similar results: "fundamental shocks became substantially less important during the period [1983–2009]." Robustness tests confirm that nonfundamental shocks have been the dominant driver of stock price movement irrespective of the sample period considered. Therefore, we surmise that Binswanger's findings that speculative bubbles or irrational exuberance (Shiller, 2000) the main driving forces of US stock markets are robust irrespective of the stock price index used.

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