

B Online appendix

This on-line appendix is for the article titled, “*Innovation and growth in the UK pharmaceuticals: the case of product and marketing introductions*” by Bokhari, Mariuzzo and Bennato.

B.1 Regression coefficients

A shorter version of this table is included in the main paper (see Table 4) where it shows the coefficient of selected variables. This appendix contains regression coefficients on all the variables.

Table B-1: FD Growth Models[†]

	OLS			IV			(4) By sub-samples (IV)			
	(1)	(2)	(3)	(4)	(5)	(6)	(4S)	(4M)	(4L)	(4X)
$s_{b,t-1}$: Size (Lagged Size of Bus. Unit)	-1.06 ^a (0.016)	-1.05 ^a (0.016)	-1.05 ^a (0.034)	-0.76 ^a (0.099)	-0.71 ^a (0.12)	-0.71 ^a (0.12)	-0.77 ^a (0.13)	-0.77 ^a (0.18)	-1.12 ^a (0.35)	-0.79 ^a (0.10)
p_{bt} : Products	0.28 ^a (0.041)	0.30 ^a (0.044)	0.27 ^a (0.043)	0.26 ^a (0.044)	0.25 ^a (0.070)	0.25 ^a (0.070)	0.58 ^a (0.10)	0.40 ^a (0.12)	0.15 ^b (0.057)	0.15 ^a (0.024)
v_{bt} : Variety	0.16 ^a (0.018)	0.15 ^a (0.018)	0.14 ^a (0.019)	0.14 ^a (0.019)	0.17 ^a (0.034)	0.18 ^a (0.035)	0.32 ^a (0.053)	0.25 ^a (0.055)	0.079 ^a (0.021)	0.074 ^a (0.012)
$p_{bt}v_{bt}$: Interaction (Products \times Variety) ($\times 10^{-2}$)	-0.70 ^a (0.13)	-0.70 ^a (0.13)	-0.65 ^a (0.12)	-0.63 ^a (0.12)	-0.77 ^a (0.26)	-0.80 ^a (0.26)	-3.40 ^a (0.90)	-1.60 ^a (0.54)	-0.30 ^a (0.11)	-0.31 ^a (0.064)
$g_{b,t-1}$: Growth (Lag 1)			-0.0030 (0.026)	-0.28 ^a (0.098)	-0.34 ^a (0.11)	-0.34 ^a (0.11)	-0.36 ^a (0.12)	-0.19 (0.17)	0.22 (0.34)	-0.29 ^a (0.098)
x_{1bt} : Any PI Sales? (1/0 Dummy, 1 if true)	0.12 ^a (0.026)	0.12 ^a (0.026)	0.12 ^a (0.025)	0.11 ^a (0.026)	0.13 ^a (0.035)	0.13 ^a (0.035)	0.16 ^c (0.085)	0.11 ^a (0.037)	0.081 ^b (0.032)	0.099 ^a (0.023)
x_{2bt} : Any generic products? (1/0 Dummy, 1 if true)	-0.0039 (0.11)	-0.099 (0.088)	-0.071 (0.095)	-0.057 (0.098)	0.031 (0.12)	0.034 (0.12)	-0.41 (0.44)	0.24 (0.22)	-0.13 ^b (0.052)	-0.049 (0.071)
x_{3bt} : Log Price (Lag 2 Wt avg price of BU drugs)	0.0072 (0.027)	-0.0016 (0.024)	0.050 ^b (0.024)	0.027 (0.024)	0.017 (0.034)	0.020 (0.033)	-0.026 (0.028)	0.12 ^c (0.068)	0.052 (0.032)	0.040 ^c (0.023)
$x_{1c,t-1}$: Products in Class ($\times 10^{-2}$) (Lag 1 of Products by Others)	-0.53 (0.42)	-0.63 (0.45)	-0.71 (0.46)	-0.59 (0.46)	-0.37 (0.71)	-0.36 (0.71)	-0.54 (1.30)	0.085 (0.940)	-1.20 ^b (0.510)	-0.74 ^c (0.390)
$x_{2c,t-1}$: Varieties in Class ($\times 10^{-2}$) (Lag 1 of Varieties by Others)	-0.11 (0.19)	-0.033 (0.19)	0.014 (0.20)	-0.019 (0.19)	-0.46 (0.34)	-0.42 (0.34)	0.41 (0.48)	0.48 (0.45)	-0.32 ^c (0.19)	0.09 (0.18)
$x_{3c,t-1}$: HHI (Lag 1)	0.34 ^b (0.17)	0.30 ^c (0.18)	0.41 ^b (0.18)	0.41 ^b (0.18)	0.30 (0.22)	0.30 (0.22)	0.28 (0.18)	0.68 (0.45)	0.25 (0.46)	0.40 ^b (0.17)
$x_{4c,t-1}$: Firms in Class (Lag 1) ($\times 10^{-2}$)	0.87 (0.92)	0.61 (0.90)	0.57 (0.91)	0.30 (0.92)	-0.10 (1.20)	-0.061 (1.30)	0.96 (2.50)	-1.30 (1.70)	0.80 (1.10)	0.047 (0.790)
(Lags)										
Observations	48,799	44,856	42,994	42,994	23,035	23,035	12,567	14,815	15,612	38,345
R-squared	0.510	0.507	0.508	0.502	0.512	0.512	0.556	0.461	0.425	0.560

[†]Standard errors are in parenthesis and clustered by business unit (firm-ATC4 combination). Superscripts *a, b, c* indicate significance at 1%, 5% and 10%, respectively.

Specification (1) does not include any lags, (2) is a distributed lag model and includes up to four lags of products, varieties and interactions. Specification (3) is an augmented distributed lag model that also includes four lags of the dependent variable (i.e., growth). Specification (4) treats only the first lag of growth as endogenous, (5) treats the first lag of growth, as well as products, and varieties, and their interaction and all four lags of each of these as endogenous variables (total 16), and specification (6) treats the first lag of growth and only the contemporaneous values of products, varieties and interaction as endogenous variables (total of 4 endogenous variables). Specifications (4S), (4M), and (4L) are same as (4), but on sub-samples by initial size of business unit being (s)mall, (m)edium and (l)arge, while (4X) restricts (4) to BUs that do not exit the sample.

Table B-1: FD Growth Models[†]

	OLS			IV			(4) By sub-samples (IV)			
	(1)	(2)	(3)	(4)	(5)	(6)	(4S)	(4M)	(4L)	(4X)
$g_{b,t-2}$: Growth (Lag 2)			-0.13 ^a (0.033)	-0.34 ^a (0.087)	-0.42 ^a (0.093)	-0.42 ^a (0.092)	-0.41 ^a (0.12)	-0.26 ^b (0.13)	0.059 (0.24)	-0.37 ^a (0.086)
$g_{b,t-3}$: Growth (Lag 3)			-0.15 ^a (0.033)	-0.28 ^a (0.065)	-0.35 ^a (0.072)	-0.35 ^a (0.072)	-0.33 ^a (0.093)	-0.21 ^b (0.088)	-0.029 (0.15)	-0.32 ^a (0.066)
$g_{b,t-4}$: Growth (Lag 4)			-0.019 (0.012)	-0.076 ^a (0.025)	-0.11 ^a (0.030)	-0.11 ^a (0.030)	-0.11 ^a (0.031)	-0.018 (0.052)	0.063 (0.065)	-0.082 ^a (0.027)
$p_{b,t-1}$: Products (Lag 1)		0.10 ^a (0.021)	0.089 ^a (0.021)	0.081 ^a (0.021)	0.042 (0.032)	0.077 ^a (0.026)	0.22 ^b (0.091)	0.15 ^b (0.070)	0.019 (0.017)	0.074 ^a (0.021)
$p_{b,t-2}$: Products (Lag 2)		0.030 (0.025)	0.059 ^b (0.023)	0.044 ^b (0.022)	0.11 ^b (0.056)	0.070 ^b (0.029)	0.14 ^b (0.061)	0.058 (0.060)	0.028 (0.030)	0.031 ^c (0.017)
$p_{b,t-3}$: Products (Lag 3)		-0.018 (0.016)	-0.00073 (0.016)	-0.022 (0.019)	-0.033 (0.025)	-0.037 ^c (0.021)	-0.033 (0.069)	-0.015 (0.053)	0.0095 (0.019)	-0.026 (0.016)
$p_{b,t-4}$: Products (Lag 4)		0.050 (0.031)	-0.00099 (0.019)	-0.028 (0.023)	-0.021 (0.031)	-0.044 ^c (0.024)	-0.058 (0.082)	0.038 (0.053)	0.0038 (0.018)	-0.041 ^c (0.022)
$v_{b,t-1}$: Variety (Lag 1)		0.033 ^a (0.0088)	0.029 ^a (0.0086)	0.021 ^b (0.0088)	0.020 (0.014)	0.025 ^b (0.012)	0.048 (0.033)	0.082 ^a (0.031)	0.010 (0.0090)	0.022 ^a (0.0075)
$v_{b,t-2}$: Variety (Lag 2) ($\times 10^{-2}$)		0.90 (0.79)	1.80 ^b (0.89)	0.66 (0.90)	1.90 (2.30)	0.082 (1.20)	2.80 (2.80)	2.40 (2.20)	1.50 (1.30)	0.50 (0.61)
$v_{b,t-3}$: Variety (Lag 3) ($\times 10^{-2}$)		0.55 (0.61)	0.42 (0.65)	-0.79 (0.81)	-1.40 (1.10)	-1.40 ^c (0.85)	0.40 (3.40)	0.30 (1.90)	0.17 (0.79)	-1.20 (0.73)
$v_{b,t-4}$: Variety (Lag 4) ($\times 10^{-2}$)		1.90 ^a (0.66)	0.025 (0.66)	-1.20 (0.80)	0.14 (1.20)	-0.68 (0.88)	-2.10 (3.20)	0.48 (2.00)	0.66 (0.73)	-1.70 ^b (0.70)
$p_{b,t-1}v_{3,t-1}$: Interaction (Products \times Variety, Lag 1) ($\times 10^{-2}$)		-0.23 ^a (0.054)	-0.20 ^a (0.051)	-0.17 ^a (0.049)	-0.060 (0.12)	-0.21 ^a (0.075)	-1.20 (0.77)	-0.88 ^c (0.51)	-0.034 (0.037)	-0.14 ^a (0.043)
$p_{2,t-2}v_{3,t-2}$: Interaction (Products \times Variety, Lag 2) ($\times 10^{-2}$)		-0.082 ^c (0.047)	-0.13 ^a (0.049)	-0.090 ^b (0.045)	-0.24 (0.17)	-0.13 ^c (0.064)	-0.60 (0.59)	-0.56 ^a (0.20)	-0.062 (0.060)	-0.070 ^b (0.033)
$p_{2,t-3}v_{3,t-3}$: Interaction (Products \times Variety, Lag 3) ($\times 10^{-2}$)		0.036 (0.037)	0.0071 (0.037)	0.062 (0.043)	0.082 (0.084)	0.10 ^c (0.054)	-0.57 (0.63)	0.051 (0.27)	-0.0046 (0.038)	0.068 ^c (0.036)
$p_{2,t-4}v_{3,t-4}$: Interaction (Products \times Variety, Lag 4) ($\times 10^{-2}$)		-0.11 ^c (0.065)	0.0035 (0.042)	0.064 (0.049)	-0.059 (0.093)	0.078 (0.057)	-0.51 (0.67)	-0.23 (0.22)	-9.0e-04 (0.033)	0.087 ^b (0.042)
τ_{1t} : Yr 2004 (1/0 Dummy, 1 if true)	0.0056 (0.012)			-0.014 (0.023)	-0.068 ^b (0.031)	-0.066 ^b (0.032)	0.020 (0.063)	-0.048 (0.037)	0.0083 (0.029)	0.025 (0.023)
τ_{2t} : Yr 2005 (1/0 Dummy, 1 if true)		-0.029 ^c (0.016)	-0.016 (0.018)	-0.028 (0.018)	-0.071 ^a (0.022)	-0.070 ^a (0.022)	-0.0042 (0.036)	-0.047 (0.032)	-0.024 (0.027)	0.0086 (0.017)
τ_{3t} : Yr 2006 (1/0 Dummy, 1 if true)	0.017 (0.013)	-0.019 (0.016)	-0.0063 (0.017)	-0.021 (0.019)	-0.071 ^a (0.023)	-0.070 ^a (0.023)	-0.018 (0.040)	-0.044 (0.033)	-0.0093 (0.024)	0.038 ^b (0.018)
τ_{4t} : Yr 2007	0.023 ^b	-0.011	0.00097	-0.017	-0.074 ^a	-0.072 ^a	-0.011	-0.027	-0.012	0.016
Observations	48,799	44,856	42,994	42,994	23,035	23,035	12,567	14,815	15,612	38,345
R-squared	0.510	0.507	0.508	0.502	0.512	0.512	0.556	0.461	0.425	0.560

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Table B-1: FD Growth Models[†]

	OLS			IV			(4) By sub-samples (IV)			
	(1)	(2)	(3)	(4)	(5)	(6)	(4S)	(4M)	(4L)	(4X)
(1/0 Dummy, 1 if true)	(0.011)	(0.014)	(0.017)	(0.018)	(0.023)	(0.023)	(0.036)	(0.032)	(0.026)	(0.017)
τ_{5t} : Yr 2008 (1/0 Dummy, 1 if true)	0.023 ^c (0.012)	-0.011 (0.015)	-0.0018 (0.017)	-0.016 (0.018)	-0.069 ^a (0.023)	-0.067 ^a (0.023)	0.017 (0.039)	-0.037 (0.031)	-0.023 (0.025)	0.021 (0.017)
τ_{6t} : Yr 2009 (1/0 Dummy, 1 if true)	0.0037 (0.012)	-0.026 ^c (0.015)	-0.010 (0.017)	-0.025 (0.018)	-0.077 ^a (0.022)	-0.075 ^a (0.022)	-0.0099 (0.037)	-0.058 ^c (0.032)	-0.013 (0.023)	0.0099 (0.017)
τ_{7t} : Yr 2010 (1/0 Dummy, 1 if true)	0.0083 (0.011)	-0.019 (0.015)	-0.0050 (0.017)	-0.017 (0.018)	-0.071 ^a (0.024)	-0.070 ^a (0.024)	-0.0031 (0.035)	-0.033 (0.033)	-0.0099 (0.026)	0.012 (0.017)
τ_{8t} : Yr 2011 (1/0 Dummy, 1 if true)	-0.0097 (0.011)	-0.035 ^b (0.015)	-0.016 (0.016)	-0.030 ^c (0.018)	-0.075 ^a (0.023)	-0.074 ^a (0.023)	-0.012 (0.037)	-0.040 (0.032)	-0.030 (0.026)	0.0046 (0.017)
τ_{9t} : Yr 2012 (1/0 Dummy, 1 if true)	0.022 ^c (0.012)	-0.0098 (0.014)	0.0021 (0.017)	-0.0086 (0.018)	-0.058 ^b (0.024)	-0.055 ^b (0.024)	0.030 (0.036)	-0.039 (0.032)	-0.017 (0.025)	0.020 (0.017)
τ_{10t} : Yr 2013 (1/0 Dummy, 1 if true)	0.022 (0.018)	-0.0015 (0.022)	0.012 (0.023)							
τ_{11t} : Qtr 2 (1/0 Dummy, 1 if true)	0.065 ^a (0.0087)	0.081 ^a (0.0088)	0.072 ^a (0.0084)	0.071 ^a (0.0084)	0.081 ^a (0.012)	0.081 ^a (0.012)	0.031 ^c (0.017)	0.085 ^a (0.016)	0.088 ^a (0.012)	0.060 ^a (0.0071)
τ_{12t} : Qtr 3 (1/0 Dummy, 1 if true)	0.065 ^a (0.013)	0.055 ^a (0.012)	0.042 ^a (0.0081)	0.043 ^a (0.0082)	0.045 ^a (0.011)	0.045 ^a (0.011)	0.045 ^b (0.018)	0.044 ^a (0.016)	0.027 ^b (0.013)	0.037 ^a (0.0069)
τ_{13t} : Qtr 4 (1/0 Dummy, 1 if true)	0.053 ^a (0.011)	0.053 ^a (0.011)	0.050 ^a (0.0087)	0.050 ^a (0.0088)	0.060 ^a (0.012)	0.060 ^a (0.012)	0.039 ^c (0.021)	0.071 ^a (0.015)	0.033 ^a (0.011)	0.040 ^a (0.0075)
x_{0t} : Constant	-0.094 ^a (0.011)	-0.070 ^a (0.014)	-0.082 ^a (0.017)	-0.067 ^a (0.015)	-0.019 (0.018)	-0.020 (0.018)	-0.084 ^a (0.030)	-0.064 ^b (0.027)	-0.058 ^b (0.025)	-0.072 ^a (0.015)
Observations	48,799	44,856	42,994	42,994	23,035	23,035	12,567	14,815	15,612	38,345
R-squared	0.510	0.507	0.508	0.502	0.512	0.512	0.556	0.461	0.425	0.560

[†]Standard errors are in parenthesis and clustered by business unit (firm-ATC4 combination). Superscripts *a, b, c* indicate significance at 1%, 5% and 10%, respectively.

Specification (1) does not include any lags, (2) is a distributed lag model and includes up to four lags of products, varieties and interactions. Specification (3) is an augmented distributed lag model that also includes four lags of the dependent variable (i.e., growth). Specification (4) treats only the first lag of growth as endogenous, (5) treats the first lag of growth, as well as products, and varieties, and their interaction and all four lags of each of these as endogenous variables (total 16), and specification (6) treats the first lag of growth and only the contemporaneous values of products, varieties and interaction as endogenous variables (total of 4 endogenous variables). Specifications (4S), (4M), and (4L) are same as (4), but on sub-samples by initial size of business unit being (s)mall, (m)edium and (l)arge, while (4X) restricts (4) to BUs that do not exit the sample.

Table B-2 First stage and other tests for instruments

	(4)	(5)	(6)	(4S)	(4M)	(4L)	(4X)
<u>Weak instruments tests</u>							
Endogenous Variable(s)	First-stage F-statistics						
$g_{b,t-1}$: Growth (Lag 1)	59.42	13.45	30.39	37.97	15.19	15.19	31.18
$p_{b,t}$: Products		37.80	69.33				
$v_{b,t}$: Variety		80.94	218.1				
$p_{bt} * v_{bt}$: Interaction		32.26	64.16				
$p_{b,t-1}$: Products (Lag 1)		64.98					
$p_{b,t-2}$: Products (Lag 2)		86.81					
$p_{b,t-3}$: Products (Lag 3)		84.42					
$p_{b,t-4}$: Products (Lag 4)		91.59					
$v_{b,t-1}$: Variety (Lag1)		76.66					
$v_{b,t-2}$: Variety (Lag2)		74.63					
$v_{b,t-3}$: Variety (Lag3)		70.51					
$v_{b,t-4}$: Variety (Lag4)		72.31					
$p_{b,t-1} * v_{b,t-1}$: Interaction (Lag 1)		37.18					
$p_{b,t-2} * v_{b,t-2}$: Interaction (Lag 2)		55.30					
$p_{b,t-3} * v_{b,t-3}$: Interaction (Lag 3)		39.25					
$p_{b,t-4} * v_{b,t-4}$: Interaction (Lag 4)		34.47					
<u>Under and Over Identification Tests</u>							
(Ho: Model is under identified)							
Under-id $\chi^2(df)$	169.01 (1)	139.6 (6)	133.9 (2)	92.62 (1)	56.59 (1)	22.28 (1)	121.54 (1)
P-value	< .000	< .000	< .000	< .000	< .000	< .000	< .000
(Ho: Model is over identified)							
Over-id $\chi^2(df)$	.	6.06 (5)	1.54 (1)	.	.	.	.
P-value	.	0.306	0.215	.	.	.	.

Table B-3 Instruments test w./ alternative clustering

Clustering at the Firm level							
	(4)	(5)	(6)	(4S)	(6M)	(6L)	(6X)
Endogenous Variable(s)	First-stage F-statistics						
$g_{b,t-1}$: Growth (Lag 1)	34.06	59.49	36.17	34.13	12.08	14.58	14.84
$p_{b,t}$: Products		926.4	211.4				
$v_{b,t}$: Variety		3804	131.1				
$p_{bt} * v_{bt}$: Interaction		1426	172.1				
$p_{b,t-1}$: Products (Lag 1)		1701					
$p_{b,t-2}$: Products (Lag 2)		1663					
$p_{b,t-3}$: Products (Lag 3)		2762					
$p_{b,t-4}$: Products (Lag 4)		1094					
$v_{b,t-1}$:Variety (Lag1)		9204					
$v_{b,t-2}$:Variety (Lag2)		5728					
$v_{b,t-3}$:Variety (Lag3)		808.9					
$v_{b,t-4}$:Variety (Lag4)		505.6					
$p_{b,t-1} * v_{b,t-1}$: Interaction (Lag 1)		1515					
$p_{b,t-2} * v_{b,t-2}$: Interaction (Lag 2)		1828					
$p_{b,t-3} * v_{b,t-3}$: Interaction (Lag 3)		5879					
$p_{b,t-4} * v_{b,t-4}$: Interaction (Lag 4)		3677					
<u>Under and Over Identification Tests</u>							
Ho: Model is under identified							
Under-id $\chi^2(df)$	44.10 (1)	25.27 (6)	17.18 (2)	33.66 (1)	27.08 (1)	13.58 (1)	36.32 (1)
P-value	< .000	< .000	< .000	< .000	< .000	< .000	< .000
Ho: Model is over identified							
Over-id $\chi^2(df)$	.	7.23 (5)	0.48 (1)	.	.	.	.
P-value	.	0.204	0.490	.	.	.	.
<u>Clustering at the ATC4 level</u>							
	(4)	(5)	(6)	(4S)	(4M)	(4L)	(4X)
Endogenous Variable(s)	First-stage F-statistics						
$g_{b,t-1}$: Growth (Lag 1)	54.33	21.40	23.89	30.51	16.17	15.17	29.95
$p_{b,t}$: Products		49.31	48.58				
$v_{b,t}$: Variety		88.42	198.89				
$p_{bt} * v_{bt}$: Interaction		90.75	54.19				
$p_{b,t-1}$: Products (Lag 1)		80.49					
$p_{b,t-2}$: Products (Lag 2)		90.57					
$p_{b,t-3}$: Products (Lag 3)		71.44					
$p_{b,t-4}$: Products (Lag 4)		71.57					
$v_{b,t-1}$:Variety (Lag1)		109.8					
$v_{b,t-2}$:Variety (Lag2)		79.19					
$v_{b,t-3}$:Variety (Lag3)		71.93					
$v_{b,t-4}$:Variety (Lag4)		77.17					
$p_{b,t-1} * v_{b,t-1}$: Interaction (Lag 1)		104.6					
$p_{b,t-2} * v_{b,t-2}$: Interaction (Lag 2)		127.4					
$p_{b,t-3} * v_{b,t-3}$: Interaction (Lag 3)		73.21					
$p_{b,t-4} * v_{b,t-4}$: Interaction (Lag 4)		50.32					
<u>Under and Over Identification Tests</u>							
(Ho: Model is under identified)							
Under-id $\chi^2(df)$	77.82 (1)	79.79 (6)	77.88(2)	61.62 (1)	42.99 (1)	18.71 (1)	62.30 (1)
P-value	< .000	< .000	< .000	< .000	< .000	< .000	< .000
(Ho: Model is over identified)							
Over-id $\chi^2(df)$	.	5.92 (5)	1.58 (1)	.	.	.	.
P-value	.	0.314	0.209	.	.	.	.