

BOPS Project

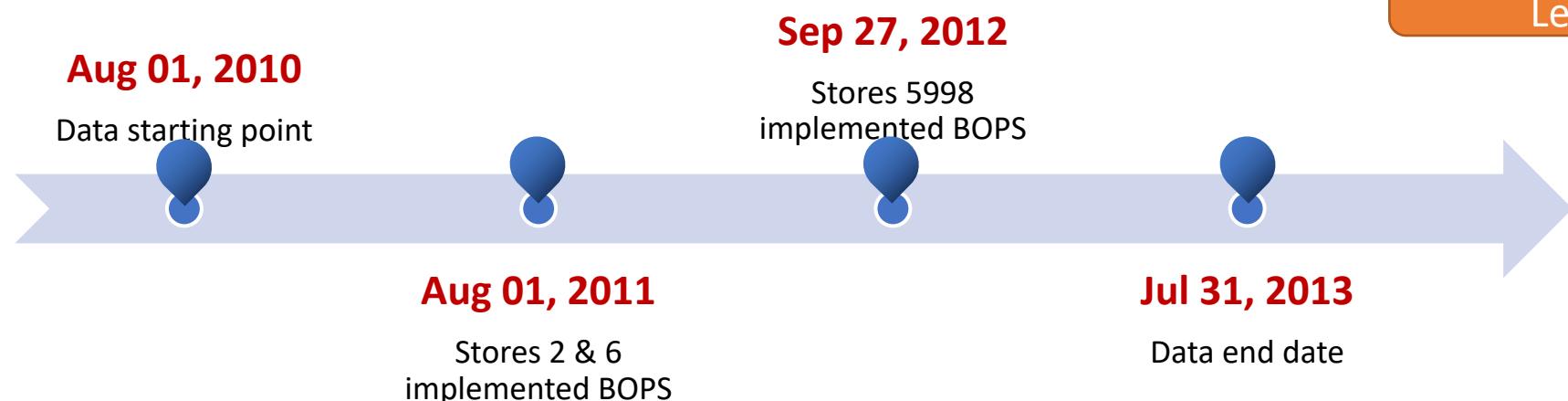
Shilpa Chotwani

Agenda

- Overview
- Part 1: Impact of BOPS on online channel
 - Sales
 - Returns
- Part 2: Impact of BOPS on consumer behavior
 - Purchase behavior
 - Return Behavior
- Part 3: Impact of BOPS on product categories
 - Sales & Return on overall product categories
 - Sales & Return on product categories
- Final Conclusion
- Limitations & Suggestions

Overview

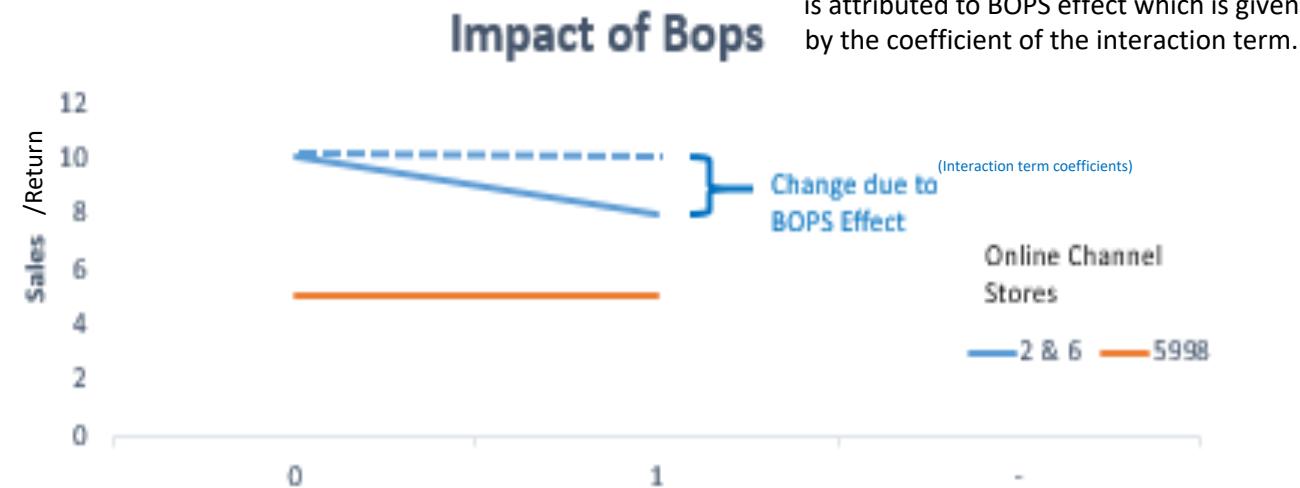
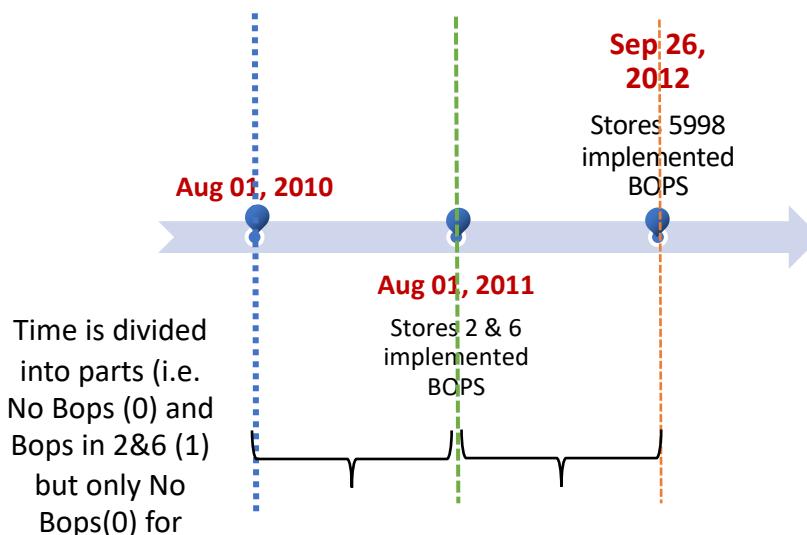
- National jewelry retailer
- What is the impact of BOPS (Buy Online and Pickup in Store) on
 - Online channel sales & return
 - Consumer purchase & return behavior
 - Product level sales & return
- Three online channel stores: 2, 6 and 5998



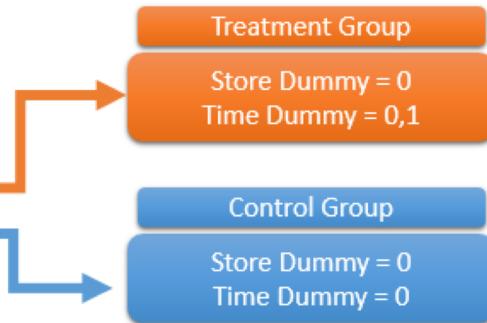
How we measured ‘Impact of BOPS’ on sales and returns for different questions?

Figure below is for online channel sales/returns (Q1,Q2).

We have used similar analogy to answer Q3,Q5 and Q6.



	Stores	Time Period
Available Dataset	2 & 6	Aug 26, 2010 – July 31, 2013
	5998	Aug 01, 2010 – July 31, 2013
Considered Dataset	5998	Aug 01, 2010 – Sep 26, 2012
		Aug 01, 2010 – Sep 26, 2012



Measured impact of BOPS strategy on online channels - Interaction term coefficient

If the lines are parallel. It implies that change in sales/returns are due to the same external factors like economic boom etc.. If there is change in slope of line, that is attributed to BOPS effect which is given by the coefficient of the interaction term.

Q1.What is the impact of implementing BOPS Strategy on online channel sales?

Q1 (A) – Sales Value (\$)	
Dependent Variable	
Question 2A – Sales Value	
Key Independent Variable	
TimeDummy*StoreDummy	
Control Variables	
Factor(Month dummy)	Avg. female
Avg. age	Avg. income
Avg. homeowner	Avg. childowner

Q1 (B) – Sales Quantity	
Dependent Variable	
Question 2B – Sales Quantity	
Key Independent Variable	
TimeDummy*StoreDummy	
Control Variables	
Factor(Month dum my)	Avg. female
Avg. age	Avg. income
Avg. homeowner	Avg. childowner

Final Model

For BOPS impact on sales value:
 $\log Sales Value \sim TimeDummy * StoreDummy + Control variables$

Final Model

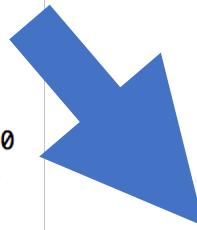
For BOPS impact on sales quantity:
 $Salesquantity \sim TimeDummy * StoreDummy + Control variables$

Key summary statistics

Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
store_number	2,858	1,635.6	2,668.4	2	2	6	5,998	5,998
year	2,858	2,011.6	0.9	2,010	2,011	2,012	2,012	2,013
month_index	2,858	31.0	10.2	13	22	31	40	48
month_dummy	2,858	6.5	3.5	1	3	6	10	12
bops_in_effect	2,858	0.6	0.5	0	0	1	1	1
day	2,858	564.6	311.0	1	298.2	564	837	1,096
salesvalue	2,858	99,619.0	180,986.6	0.0	8,157.6	18,157.7	152,580.9	1,685,114.0
returnvalue	2,858	15,346.2	26,160.0	0.0	799.0	2,646.6	24,473.5	200,464.5
salesquantity	2,858	584.9	1,146.3	1	43	106	784.2	11,630
returnquantity	2,858	59.1	106.5	0	4	10	89.8	895
avg_female	2,265	0.5	0.2	0.0	0.5	0.5	0.6	1.0
avg_age	2,345	4.9	1.7	0.0	4.5	5.0	5.5	13.0
avg_income	2,334	5.3	0.9	1.0	5.1	5.4	5.6	9.0
avg_homeowner	2,334	0.7	0.2	0.0	0.6	0.7	0.7	1.0
avg_residency	2,334	7.0	2.1	0.0	6.7	7.1	7.5	15.0
avg_childowner	2,334	0.4	0.2	0.0	0.3	0.4	0.4	1.0

Raw data



Data considered for analysis, Missing Value are set to Mean (till Sep 27,2012)

Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
store_number	2,011	1,580.7	2,639.8	2	2	6	5,998	5,998
year	2,011	2,011.2	0.7	2,010	2,011	2,011	2,012	2,012
month_index	2,011	25.8	7.3	13	20	26	32	38
month_dummy	2,011	6.6	3.4	1	4	7	9	12
bops_in_effect	2,011	0.4	0.5	0	0	0	1	1
day	2,011	406.0	221.7	1	216	412	595	787
salesvalue	2,011	91,467.2	163,956.5	0.0	7,252.5	16,249.7	148,955.1	1,413,919.0
returnvalue	2,011	14,406.5	24,436.1	0.0	683.6	2,387.7	24,059.6	192,876.8
salesquantity	2,011	522.9	988.2	1	38	99	762	8,933
returnquantity	2,011	55.2	97.7	0	3	10	88.5	876
avg_female	2,011	0.5	0.2	0.0	0.5	0.5	0.6	1.0
avg_age	2,011	5.0	1.5	0.0	4.7	4.9	5.5	13.0
avg_income	2,011	5.4	0.8	1.0	5.2	5.3	5.5	9.0
avg_homeowner	2,011	0.7	0.2	0.0	0.6	0.7	0.7	1.0
avg_residency	2,011	7.0	1.9	0.0	6.8	7.0	7.3	15.0
avg_childowner	2,011	0.4	0.1	0.0	0.3	0.4	0.4	1.0
TimeDummy	2,011	0.6	0.5	0	0	1	1	1
StoreDummy	2,011	0.7	0.4	0	0	1	1	1
logsalesvalue	2,011	9.9	2.2	0.0	8.9	9.7	11.9	14.2
logreturnvalue	2,011	7.4	3.1	0.0	6.5	7.8	10.1	12.2

Analysis

Dependent variable:

logsalesvalue
HW-Robust SE

avg_female -1.140*
(0.478)

avg_age -0.190***
(0.047)

avg_income 0.286**
(0.100)

avg_homeowner -0.548
(0.490)

avg_childowner 0.722
(0.596)

TimeDummy:StoreDummy -0.491**
(0.168)

Constant 8.330***
(0.662)

Observations 2,011

R2 0.177

Adjusted R2 0.169

Residual Std. Error 1.968

F Statistic 22.524***

Note: *p<0.05; **p<0.01; ***p<0.001
> |



Implementing BOPS is associated with an average 49.1% decrease in online channel sales (value \$) for store number 2 and 6

Q1 (A) - Sales Value (\$)

Dependent variable:

salesquantity
HW-Robust SE

avg_age 0.84***
(0.02)

avg_income 1.32***
(0.04)

avg_homeowner 0.49***
(0.18)

avg_childowner 0.86
(0.23)

TimeDummy:StoreDummy 0.67**
(0.11)

Constant 58.00***
(0.26)

Observations 2,011
Log Likelihood -13,320.12
theta 0.64*** (0.02)
Akaike Inf. Crit. 26,680.23

Note: *p<0.05; **p<0.01; ***p<0.001
> |



For stores 2 and 6, BOPS Implementation is associated with a 33% decrease in sales quantity.

Q1 (B) - Sales Quantity

Q2. What is the impact of implementing BOPS strategy on online channel returns?

Q2 (A) - Return Value (\$)	
Dependent Variable	
Question 2A - Return Value	
Key Independent Variable	
TimeDummy*StoreDummy	
Control Variables	
Factor(Month dummy)	Avg. female
Avg. age	Avg. income
Avg. homeowner	Avg. childowner
salesvalue	

Final Model

For BOPS impact on **return value**:
 $\text{logReturn Value} \sim \text{TimeDummy} * \text{StoreDummy} + \text{Control variables}$

Q2 (B) - Return Quantity	
Dependent Variable	
Question 2B - Return Quantity	
Key Independent Variable	
TimeDummy*StoreDummy	
Control Variables	
Factor(Month dum my)	Avg. female
Avg. age	Avg. income
Avg. homeowner	Avg. childowner
Sales quantity	

Final Model

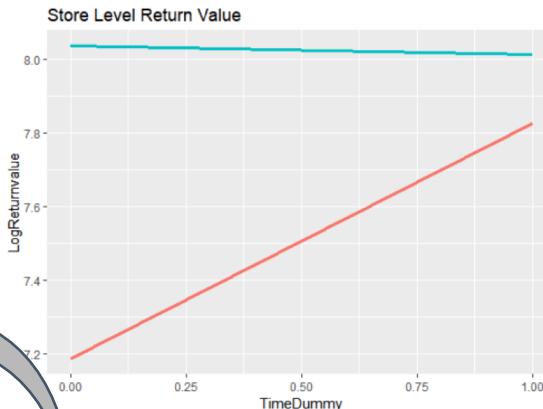
For BOPS impact on **return quantity**:
 $\text{Returnquantity} \sim \text{TimeDummy} * \text{StoreDummy} + \text{Control variables}$

Analysis

Q2 (A) - Return Value (\$)

Dependent variable:	
	Logreturnvalue HW-Robust SE
avg_income	0.051 (0.063)
avg_homeowner	-0.183 (0.310)
avg_childowner	0.392 (0.320)
logsalesvalue	1.242*** (0.028)
TimeDummy:StoreDummy	-0.664*** (0.199)
Constant	-5.555*** (0.493)
Observations	2,011
R2	0.790
Adjusted R2	0.788
Residual Std. Error	1.426
F Statistic	373.682***

Note: *p<0.05; **p<0.01; ***p<0.001

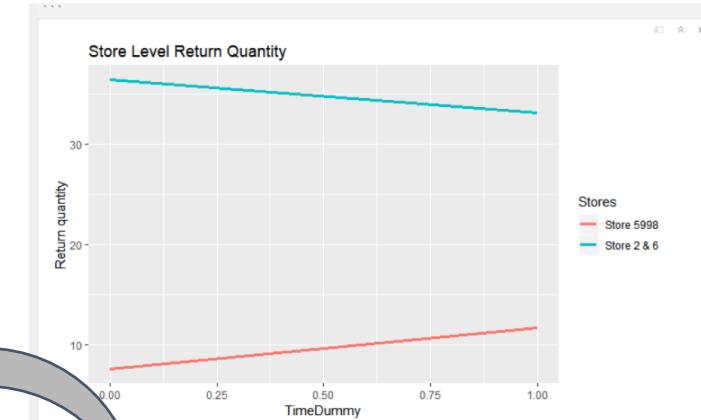


BOPS strategy is associated with 66.4% decrease in online channel returns (value \$) for store number 2 and 6.

Q2 (B) - Return Quantity

Dependent variable:	
	returnquantity HW-Robust SE
avg_income	1.16*** (0.03)
avg_homeowner	0.62** (0.14)
avg_childowner	1.42* (0.16)
salesquantity	1.00*** (0.0000)
TimeDummy:StoreDummy	0.59*** (0.10)
Constant	3.63*** (0.21)
Observations	2,011
Log Likelihood	-8,142.40
theta	1.07*** (0.04)
Akaike Inf. Crit.	16,326.79

Note: *p<0.05; **p<0.01; ***p<0.001



For store number 2 and 6, BOPS implementation is associated with 41% decrease in return quantity

Q3. What is the impact of using the BOPS service on online customer purchase behavior?

Key summary statistics

Descriptive Statistics

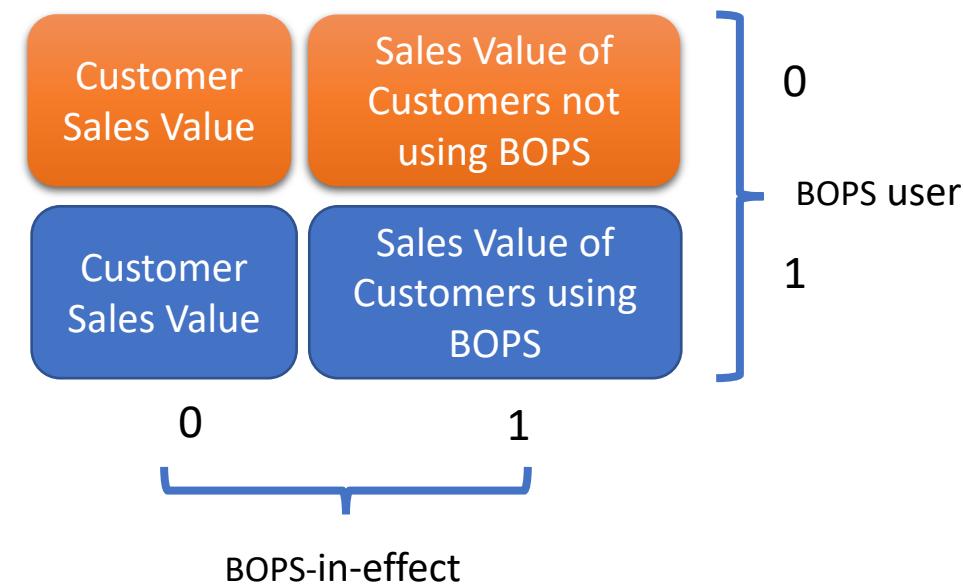
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
customer_id	84,420	60,707,965,648.0	198,215,133,553.0	103,465	18,418,146	26,079,925	27,885,126	919,600,001,722
store_number	84,420	208.3	1,092.2	2	2	2	2	5,998
age_band	81,454	4.9	3.9	0.0	0.0	5.0	8.0	13.0
est_income_code	81,434	5.5	2.2	1.0	4.0	6.0	7.0	9.0
length_of_residence	81,434	7.3	5.4	0.0	2.0	6.0	13.0	15.0
female	74,518	0.4	0.5	0.0	0.0	0.0	1.0	1.0
bops_in_effect	84,420	0.5	0.5	0	0	0.5	1	1
salesvalue	84,420	392.7	930.7	0.0	99.0	198.0	388.9	82,226.2
salesquantity	84,420	2.5	7.6	1	1	1	3	1,474
purchase_time_period	84,420	2.9	4.2	1	1	1	2	24
bops_user	84,420	0.2	0.4	0	0	0	0	1
logsalesvalue	84,420	5.3	1.1	0.0	4.6	5.3	6.0	11.3

Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
customer_id	84,420	60,707,965,648.0	198,215,133,553.0	103,465	18,418,146	26,079,925	27,885,126	919,600,001,722
store_number	84,420	208.3	1,092.2	2	2	2	2	5,998
age_band	84,420	4.9	3.9	0	0	5	8	13
est_income_code	84,420	5.5	2.2	1	4	6	7	9
length_of_residence	84,420	7.3	5.3	0	2	6	13	15
female	74,518	0.4	0.5	0.0	0.0	0.0	1.0	1.0
bops_in_effect	84,420	0.5	0.5	0	0	0.5	1	1
salesvalue	84,420	392.7	930.7	0.0	99.0	198.0	388.9	82,226.2
salesquantity	84,420	2.5	7.6	1	1	1	3	1,474
purchase_time_period	84,420	2.9	4.2	1	1	1	2	24
bops_user	84,420	0.2	0.4	0	0	0	0	1
logsalesvalue	84,420	5.3	1.1	0.0	4.6	5.3	6.0	11.3
homeowner_code_dummy	81,434	0.7	0.5	0.0	0.0	1.0	1.0	1.0
child_dummy	81,434	0.4	0.5	0.0	0.0	0.0	1.0	1.0

Missing Values

Missing values replaced with median for discrete variables, dummy variables not replaced.



Variables & Conceptual Model



Q3 (A) - Sales Value (\$)	
Dependent Variable	
Sales Value	
Key Independent Variable	
bops_in_effect*bops_user	
Control Variables	
Female	
factor(store_number)	age_band
est_income_code	homeowner_code_dummy
child_dummy	purchase_time_period

Final Model

For BOPS user impact on **sales value**:

`logSalesValue ~bops_in_effect*bops_user
+ Control variables`

Q3 (B) - Sales Quantity	
Dependent Variable	
Sales Quantity	
Key Independent Variable	
bops_in_effect*bops_user	
Control Variables	
Female	
factor(store_number)	age_band
est_income_code	homeowner_code_dummy
child_dummy	purchase_time_period

Final Model

For BOPS user impact on **sales quantity**:

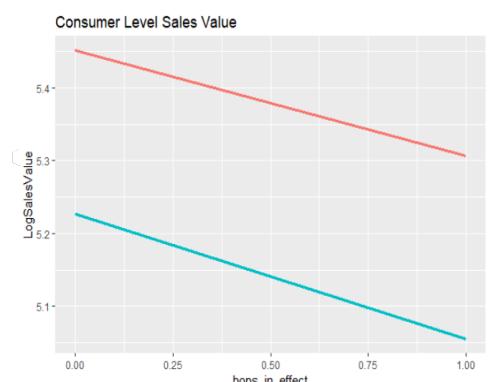
`SalesQuantity ~bops_in_effect*bops_user
+ Control variables`

Analysis

3A –Sales Value (\$)

Consumer Sales Value Results without considering female	
	Dependent variable:
	logsalesvalue HW-Robust SE
bops_in_effect	-0.144*** (0.008)
bops_user	-0.222*** (0.013)
factor(store_number)6	-0.098*** (0.013)
factor(store_number)5998	0.341** (0.128)
age_band	0.005*** (0.001)
est_income_code	0.008*** (0.002)
homeowner_code_dummy	-0.004 (0.008)
child_dummy	-0.045*** (0.007)
purchase_time_period	0.106*** (0.001)
bops_in_effect:bops_user	-0.044* (0.018)
Constant	5.083*** (0.011)
Observations	81,434
R2	0.172
Adjusted R2	0.172
Residual Std. Error	0.977
F Statistic	1,689.924***

Note: *p<0.05; **p<0.01; ***p<0.001



Implementing BOPS service is associated with 4.4% decrease in sales value of customer for store 2 and 6 (without considering the variable female)

Consumer Sales Value Regression Results

	Dependent variable:
	logsalesvalue HW-Robust SE
bops_in_effect	-0.146*** (0.008)
bops_user	-0.216*** (0.013)
factor(store_number)6	-0.079*** (0.014)
factor(store_number)5998	0.201 (0.146)
age_band	0.007*** (0.001)
est_income_code	0.006*** (0.002)
homeowner_code_dummy	-0.001 (0.008)
child_dummy	-0.042*** (0.007)
purchase_time_period	0.105*** (0.001)
female	-0.153*** (0.007)
bops_in_effect:bops_user	-0.035 (0.019)
Constant	5.145*** (0.012)
Observations	74,504
R2	0.173
Adjusted R2	0.173
Residual Std. Error	0.969
F Statistic	1,418.846***

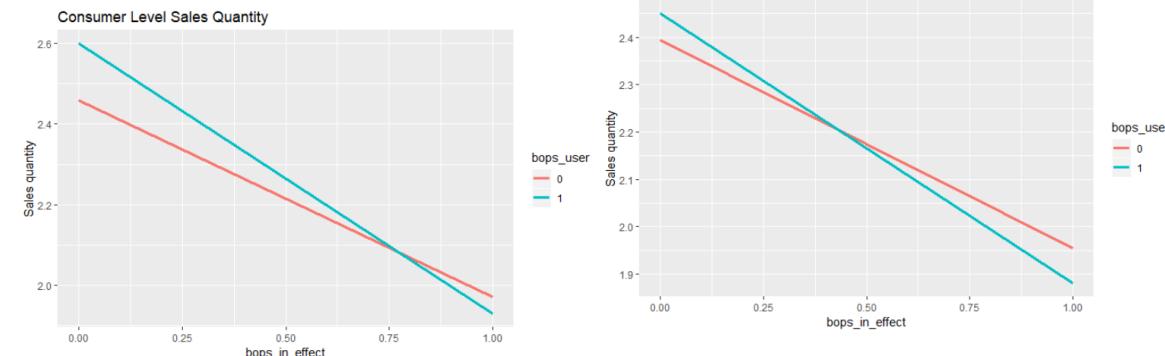
Note: *p<0.05; **p<0.01; ***p<0.001

Interaction term insignificant with female as control variable in model.

3B –Sales Quantity

Consumer Sales Quantity Neg.Bin Results without considering female	
	Dependent variable:
	salesquantity IRRs
bops_in_effect	0.8115*** (0.0070)
bops_user	1.0308** (0.0109)
factor(store_number)6	1.0238* (0.0119)
factor(store_number)5998	0.7535 (0.1800)
age_band	0.9990 (0.0008)
est_income_code	1.0128** (0.0014)
homeowner_code_dummy	0.9964 (0.0071)
child_dummy	1.0023 (0.0063)
purchase_time_period	1.1250** (0.0006)
bops_in_effect:bops_user	0.9586** (0.0153)
Constant	1.5909*** (0.0098)
Observations	81,434
Log Likelihood	-149,141.0000
theta	3.5620*** (0.0328)
Akaike Inf. Crit.	298,304.0000

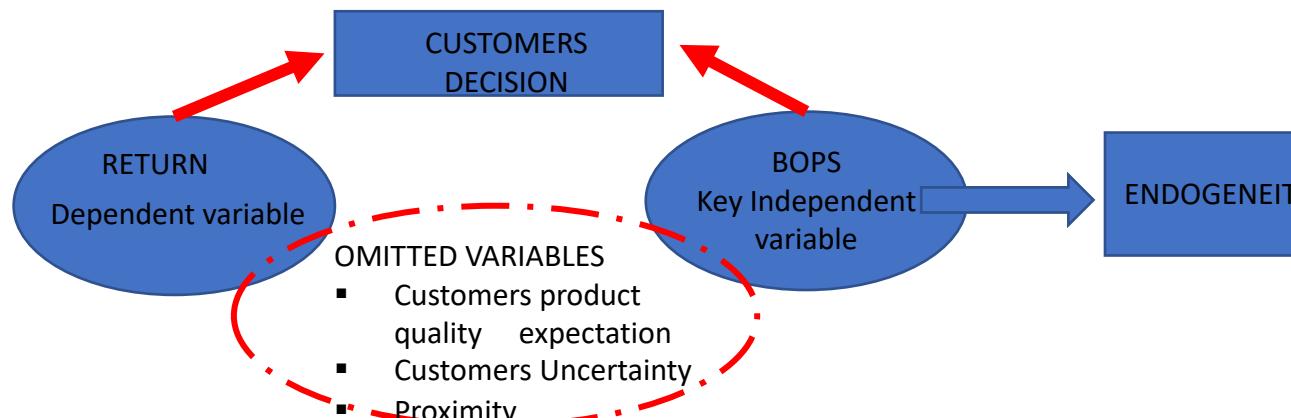
Note: *p<0.05; **p<0.01; ***p<0.001



Implementing BOPS service is associated with 4.14% decrease in the sales quantity of consumer for store 2 and 6 (considering female)

Implementing BOPS service is associated with 3.3% decrease in the sales quantity of consumer for store 2 and 6 (considering female)

Q4. What is the impact of using the BOPS service on online customer purchase behavior?



Instrument Variable :-

Length of residence – Conceptually *length of residence* is not correlated with *dependent variable* and is correlated with *BOPS* user as customer staying at his current address for more time is well aware of the store locations near by so he is more likely to opt. for the bops service then the customer who is new at his current address

Variables & Conceptual Model

Dependent Variable	Key Independent Variable	
Return	BOPS	
Control Variables		
Price		
Store Number	Month dummy	Product_Category
Female	Age Band	Homeowner_dummy
Est_Income_Code	Year	Child_dummy

Instrument Variable Correlation Relationship			
Instrument Variable	Return	BOPS	Good Instrument
Length_Of_Residence	NO	YES	YES

Final Model

Return~BOPS +Control variables

Analysis

Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
customer_id	1,170,568	23,247,802,315.0	125,423,860,663.0	100,348	28,454,419	31,964,480	35,423,835	919,650,001,519
transaction_id	1,170,568	3,751,126.0	561,621.2	50,002	3,262,163.0	3,787,321	4,236,822.0	4,702,552
store_number	1,170,568	180.4	1,017.9	2	2	2	2	5,998
price	1,170,568	170.2	323.4	0.0	44.2	90.0	187.0	39,422.0
sku	1,170,568	18,424,852.0	1,380,845.0	11,373,024	17,951,286	18,214,460	18,697,427	80,006,100
return	1,170,568	0.1	0.3	0	0	0	0	1
age_band	1,127,979	4.8	4.0	0.0	0.0	5.0	8.0	13.0
est_income_code	1,131,739	5.4	2.3	1.0	4.0	6.0	7.0	9.0
length_of_residence	1,131,739	7.2	5.4	0.0	2.0	6.0	13.0	15.0
year	1,170,568	2,012.1	0.7	2,011	2,012	2,012	2,013	2,013
month_index	1,170,568	37.0	6.6	25	30	39	42	48
product_category	1,170,564	10.1	6.5	1.0	5.0	9.0	12.0	21.0
month_dummy	1,170,568	7.4	4.0	1	4	8	12	12
week_index	1,170,568	107.1	28.7	53	78	117	129	157
bops	1,170,568	0.2	0.4	0	0	0	0	1
female	987,102	0.5	0.5	0.0	0.0	0.0	1.0	1.0

Raw Data

Missing Values

Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
customer_id	1,170,568	23,247,802,315.0	125,423,860,663.0	100,348	28,454,419	31,964,480	35,423,835	919,650,001,519
transaction_id	1,170,568	3,751,126.0	561,621.2	50,002	3,262,163.0	3,787,321	4,236,822.0	4,702,552
store_number	1,170,568	180.4	1,017.9	2	2	2	2	5,998
price	1,170,568	170.2	323.4	0.0	44.2	90.0	187.0	39,422.0
sku	1,170,568	18,424,852.0	1,380,845.0	11,373,024	17,951,286	18,214,460	18,697,427	80,006,100
return	1,170,568	0.1	0.3	0	0	0	0	1
age_band	1,170,568	4.8	3.9	0	0	5	8	13
est_income_code	1,170,568	5.4	2.2	1	4	6	7	9
length_of_residence	1,170,568	7.1	5.3	0	2	6	13	15
year	1,170,568	2,012.1	0.7	2,011	2,012	2,012	2,013	2,013
month_index	1,170,568	37.0	6.6	25	30	39	42	48
product_category	1,170,568	10.1	6.5	1	5	9	12	21
month_dummy	1,170,568	7.4	4.0	1	4	8	12	12
week_index	1,170,568	107.1	28.7	53	78	117	129	157
bops	1,170,568	0.2	0.4	0	0	0	0	1
female	987,102	0.5	0.5	0.0	0.0	0.0	1.0	1.0
logprice	1,170,568	4.5	1.2	0.0	3.8	4.5	5.2	10.6
homeowner_code_dummy	1,131,739	0.7	0.5	0.0	0.0	1.0	1.0	1.0
child_dummy	1,131,739	0.4	0.5	0.0	0.0	0.0	1.0	1.0

Final Data considered for analysis

Missing Values
Set to Median for discrete variables

Regression Results

Dependent variable:	
	return
	IVreg Model
bops	0.4948*** (0.1179)
factor(store_number)6	0.0427*** (0.0115)
factor(store_number)5998	-0.1520*** (0.0312)
log(price + 1)	0.0277*** (0.0004)
factor(product_category)2	0.0432*** (0.0030)
factor(product_category)3	-0.0019 (0.0045)
factor(product_category)4	0.0154 (0.0093)
factor(product_category)5	0.0011 (0.0093)
factor(product_category)6	0.0165*** (0.0036)

Interpretation:-

Customers using BOPS have **49.48 pp** higher propensity to return than the customers opting for home delivery.

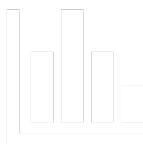
Q5. What is the impact of implementing BOPS strategy on product-level sales and returns?

Q5 (A) - Sales Value (\$)		Q5 (B) - Sales Quantity		Q5 (C) - Return Value (\$)		Q5 (D) - Return Quantity	
Dependent Variable		Dependent Variable		Dependent Variable		Dependent Variable	
Sales Value		Sales Quantity		Return value		Return Quantity	
Key Independent Variable		Key Independent Variable		Key Independent Variable		Key Independent Variable	
TimeDummy*StoreDummy		TimeDummy*StoreDummy		TimeDummy*StoreDummy		TimeDummy*StoreDummy	
Control Variables		Control Variables		Control Variables		Control Variables	
product_category	month_dummy	product_category	month_dummy	product_category	month_dummy	product_category	month_dummy
avg_female	avg_age	avg_female	avg_age	avg_female	avg_age	avg_female	avg_age
avg_income	avg_homeowner	avg_income	avg_homeowner	avg_income	avg_homeowner	avg_income	avg_homeowner
avg_childowner		avg_childowner		avg_childowner	Salesvalue	avg_childowner	salesquantity
Final Models		Final Models		Final Models		Final Models	
$\text{logSalesvalue} \sim \text{TimeDummy*StoreDummy} + \text{Control variables}$		$\text{Salesquantity} \sim \text{TimeDummy*StoreDummy} + \text{Control variables}$		$\text{logreturnvalue} \sim \text{TimeDummy*StoreDummy} + \text{Control variables}$		$\text{returnquantity} \sim \text{TimeDummy*StoreDummy} + \text{Control variables}$	

Key summary statistics

Descriptive Statistics								
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
store_number	30,475	1,398.8	2,533.2	2	2	6	6	5,998
year	30,475	2,011.6	0.9	2,010	2,011	2,012	2,012	2,013
month_index	30,475	31.1	10.3	13	22	31	40	48
product_category	30,475	9.3	6.3	1	4	7	13	21
month_dummy	30,475	6.5	3.6	1	3	6	10	12
bops_in_effect	30,475	0.6	0.5	0	0	1	1	1
day	30,475	566.6	313.4	1	292	569	846	1,096
salesvalue	30,475	9,342.4	20,865.0	0.0	546.3	1,950.7	8,952.2	424,294.6
returnvalue	30,475	1,439.1	3,166.5	0.0	0.0	199.0	1,398.9	52,508.2
salesquantity	30,475	54.8	162.8	1	3	9	34	5,111
returnquantity	30,475	5.5	13.5	0	0	1	5	380
avg_female	23,277	0.5	0.3	0.0	0.3	0.5	0.7	1.0
avg_age	23,795	4.9	2.1	0.0	4.0	4.9	5.9	13.0
avg_income	23,763	5.3	1.2	1.0	4.8	5.3	5.8	9.0
avg_homeowner	23,763	0.6	0.3	0.0	0.5	0.7	0.8	1.0
avg_residency	23,763	6.9	2.8	0.0	5.6	6.9	8.0	15.0
avg_childowner	23,763	0.4	0.2	0.0	0.2	0.4	0.5	1.0

Raw Data



Descriptive Statistics								
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
store_number	21,078	1,285.4	2,457.8	2	2	6	6	5,998
year	21,078	2,011.2	0.7	2,010	2,011	2,011	2,012	2,012
month_index	21,078	25.7	7.3	13	19	26	32	38
product_category	21,078	9.4	6.3	1	4	7	13	21
month_dummy	21,078	6.7	3.5	1	4	7	10	12
bops_in_effect	21,078	0.4	0.5	0	0	0	1	1
day	21,078	401.1	223.0	1	205	409	590	787
salesvalue	21,078	8,726.7	19,144.5	0.0	508.5	1,857.3	8,533.4	402,473.4
returnvalue	21,078	1,374.5	2,994.0	0.0	0.0	194.5	1,376.6	51,973.1
salesquantity	21,078	49.9	139.7	1	2	9	32	4,474
returnquantity	21,078	5.3	12.5	0	0	1	5	380
avg_female	21,078	0.5	0.3	0.0	0.4	0.5	0.6	1.0
avg_age	21,078	5.0	1.9	0.0	4.4	4.9	5.7	13.0
avg_income	21,078	5.3	1.1	1.0	5.0	5.3	5.7	9.0
avg_homeowner	21,078	0.6	0.2	0.0	0.6	0.6	0.7	1.0
avg_residency	21,078	6.9	2.5	0.0	6.0	6.9	7.5	15.0
avg_childowner	21,078	0.4	0.2	0.0	0.3	0.4	0.4	1.0
TimeDummy	21,078	0.6	0.5	0	0	1	1	1
StoreDummy	21,078	0.8	0.4	0	1	1	1	1
logreturnvalue	21,078	4.1	3.5	0.0	0.0	5.3	7.2	10.9

Data Subset considered for analysis (till Sep 27, 2012)



Fig1: How we got impact of BOPS strategy on online channels.

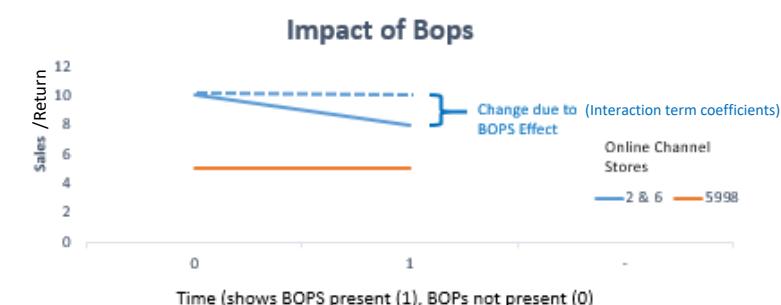


Fig2: How we measured impact of BOPS strategy on PRODUCT LEVEL sales/return. (Interaction term coefficient - TimeDummy*StoreDummy)

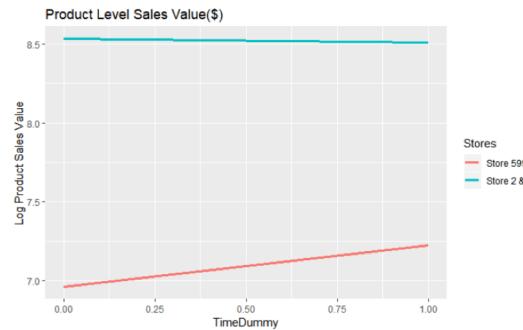
Analysis

Q5 (A) – Sales Value (\$)

Dependent variable:	
	logsalesvalue Normal SE
avg_income	0.100*** (0.015)
avg_homeowner	-0.202** (0.077)
avg_childowner	0.075 (0.071)
TimeDummy:StoreDummy	-0.288*** (0.042)
Constant	6.993*** (0.103)
Observations	21,078
R2	0.323
Adjusted R2	0.322
Residual Std. Error	1.607
F Statistic	278.516***

Note: *p<0.05; **p<0.01; ***p<0.001

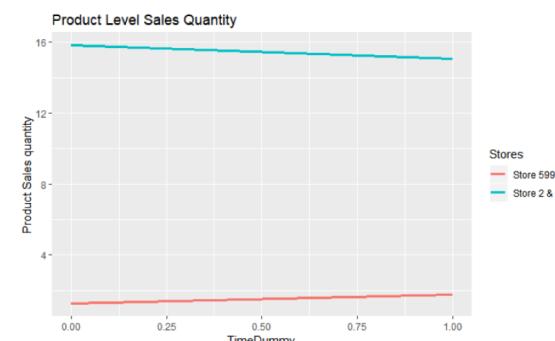
For store number 2 and 6,BOPS implementation is associated with 28.8% decrease in product sales value



Q5 (B) - Sales Quantity

Dependent variable:	
	salesquantity Normal SE
avg_age	0.88*** (0.004)
avg_income	1.23*** (0.01)
avg_homeowner	0.61*** (0.03)
avg_childowner	1.04 (0.03)
TimeDummy:StoreDummy	0.68*** (0.04)
Constant	1.23** (0.07)
Observations	21,078
Log Likelihood	-87,356.85
theta	0.74*** (0.01)
Akaike Inf. Crit.	174,787.70

For store number 2 and 6,BOPS implementation is associated with 32% decrease in product sales quantity



Q5 (C) - Return Quantity

Dependent variable:	
	logreturnvalue Normal SE
avg_homeowner	-0.071 (0.089)
avg_childowner	-0.090 (0.084)
logsalesvalue	1.349*** (0.011)
TimeDummy:StoreDummy	-0.327*** (0.083)
Constant	-7.281*** (0.165)
Observations	21,078
R2	0.604
Adjusted R2	0.603
Residual Std. Error	2.218
F Statistic	867.501***

Note: *p<0.05; **p<0.01; ***p<0.001

For store number 2 and 6,BOPS implementation is associated with 32.7% decrease in product return value

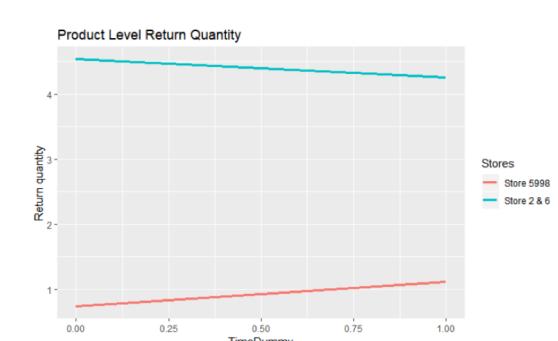


Q5 (D) - Return Quantity

Dependent variable:	
	returnquantity HW-Robust SE
avg_homeowner	0.78*** (0.04)
avg_childowner	0.96 (0.03)
salesquantity	1.01*** (0.0001)
TimeDummy:StoreDummy	0.62*** (0.06)
Constant	0.49*** (0.07)
Observations	21,078
Log Likelihood	-43,251.76
theta	0.91*** (0.01)
Akaike Inf. Crit.	86,579.52

Note: *p<0.05; **p<0.01; ***p<0.001

For store number 2 and 6,BOPS implementation is associated with 38% decrease in product return quantity.



Q6. What is the impact of implementing BOPS strategy on product-level sales and returns?

Q6 (A) - Sales Value (\$)

Dependent Variable

Sales Value

Key Independent Variable

TimeDummy*StoreDummy*product_category

Control Variables

avg_age	month_dummy
---------	-------------

avg_female	avg_childowner
------------	----------------

avg_income	avg_homeowner
------------	---------------

Final Models

logSalesvalue~

**TimeDummy*StoreDummy*factorproduct_categ
ory + Control variables**

Q6 (B) - Return Value (\$)

Dependent Variable

Return value

Key Independent Variable

TimeDummy*StoreDummy*product_category

Control Variables

Salesvalue	month_dummy
------------	-------------

avg_female	avg_age
------------	---------

avg_income	avg_homeowner
------------	---------------

avg_childowner	
----------------	--

Final Models

logreturnvalue~

**TimeDummy*StoreDummy*factorproduct_categ
ory + Control variables**

Q6 How does impact of BOPS vary across Product Categories (Sales Value) ?

	Dependent variable:					
	logsalesvalue					
	Model14 (1)	Model4 (2)	Model21 (3)	Model2 (4)	Model1 (5)	Model12 (6)
TimeDummy:StoreDummy	-1.129*** (0.207)	-0.619*** (0.143)	-0.396** (0.137)	-0.389** (0.148)	-0.315* (0.154)	-0.313* (0.148)
Constant	4.468*** (0.420)	7.259*** (0.520)	6.590*** (0.561)	4.512*** (0.439)	6.955*** (0.340)	6.320*** (0.637)
Observations	1,083	1,844	1,841	1,491	1,386	1,842
R2	0.112	0.227	0.255	0.139	0.104	0.240
Adjusted R2	0.096	0.219	0.247	0.128	0.091	0.232
Residual Std. Error	1.897	1.664	1.620	1.581	1.580	1.711
F Statistic	7.034***	28.126***	32.817***	12.528***	8.302***	30.330***

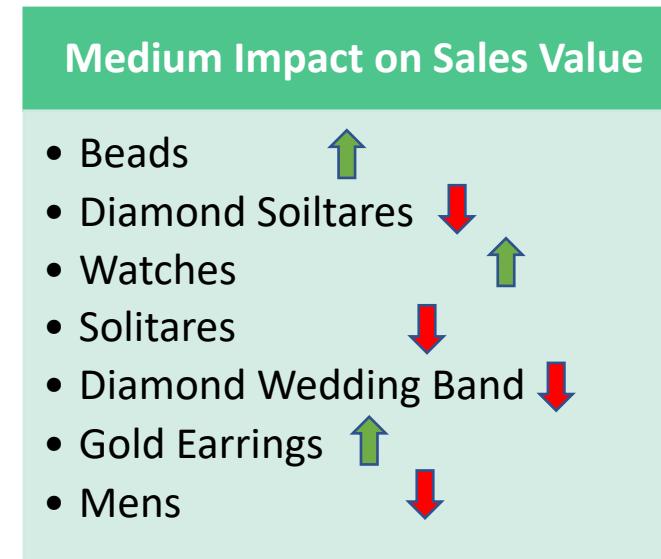
Note: *p<0.05; **p<0.01; ***p<0.001

	Dependent variable:						
	logsalesvalue						
	Model9 (1)	Model11 (2)	Model13 (3)	Model3 (4)	Model20 (5)	Model7 (6)	Model6 (7)
TimeDummy:StoreDummy	0.368 (0.376)	-0.170 (0.155)	0.121 (0.143)	-0.069 (0.154)	-0.052 (0.135)	0.008 (0.156)	-0.028 (0.137)
Constant	3.424*** (0.579)	6.592*** (0.348)	6.619*** (0.325)	7.552*** (0.376)	6.492*** (0.307)	4.622*** (0.293)	5.411*** (0.367)
Observations	520	1,431	1,423	1,344	1,398	1,163	1,501
R2	0.228	0.171	0.175	0.159	0.165	0.131	0.143
Adjusted R2	0.199	0.160	0.164	0.147	0.153	0.116	0.132
Residual Std. Error	1.697	1.599	1.425	1.495	1.443	1.443	1.518
F Statistic	7.768***	15.296***	15.681***	13.195***	14.301***	9.062***	13.026***

Note: *p<0.05; **p<0.01; ***p<0.001

	Dependent variable:				
	logsalesvalue				
	Model5 (1)	Model8 (2)	Model10 (3)	Model15 (4)	Model17 (5)
TimeDummy:StoreDummy	-0.272 (0.141)				
Constant	6.714*** (0.541)	6.943*** (0.346)	5.037*** (0.754)	4.447* (2.227)	9.224*** (0.300)
Observations	1,847	321	126	25	492
R2	0.234	0.244	0.299	0.426	0.075
Adjusted R2	0.226	0.201	0.188	-0.531	0.041
Residual Std. Error	1.648	1.122	0.964	1.630	0.961
F Statistic	29.430***	5.742***	2.708***	0.445	2.247**

Note: *p<0.05; **p<0.01; ***p<0.001



Results & Insights (Q6 Sales)

Product Category	Beta Values Significant	Name	Mean Price
14	-1.129	Pre-Owned	97.68682
4	-0.619	Diamond Fashion	270.991
21	-0.396	Silver	96.251
2	-0.389	Gold Wed Bands	138.5335
1	-0.315	Bridal	932.8661
12	-0.313	Gold Jewelery	104.7122

HIGH IMPACT Product Categories
are mostly LOW price items

CONCLUSION: Sales Value of Low Price Items
decreases significantly

Product Category	Beta Values Insignificant	Name	Price
9	0.368	Beads	31.10507
13	0.121	Watches	205.7221
5	-0.272	Semi Precious	106.3857
11	-0.17	Diamond Jewelry	362.5608
3	-0.069	Solitaires	906.3018
20	-0.052	Diamond Wedding Band	450.9833
6	-0.028	Mens	255.2957
7	0.008	Gold Jewelry	24.71342
8	NA	In House Special Event	452.4416
10	NA	Piercing	577.2384
15	NA	Specialized Jewelry	361.8
17	NA	Events	2246.32

LOW IMPACT Product Categories are
mostly MID-HIGH PRICE items

Q 6 How does impact of BOPS vary across Product Categories (Return Value) ?

	Dependent variable:			
	logreturnvalue			
	Product4 (1)	Product13 (2)	Product20 (3)	Product21 (4)
TimeDummy:StoreDummy	-0.95*** (0.24)	-0.83** (0.30)	-0.90** (0.30)	-0.53* (0.22)
Constant	-6.97*** (0.59)	-7.48*** (0.53)	-10.05*** (0.52)	-6.70*** (0.47)

Observations 1,844 1,423 1,398 1,841
R2 0.63 0.53 0.63 0.65
Adjusted R2 0.63 0.52 0.63 0.64
Residual Std. Error 2.14 2.22 2.22 1.92
F Statistic 156.16*** 79.45*** 119.67*** 165.62***

Note: *p<0.05; **p<0.01; ***p<0.001
>

	Dependent variable:				
	logreturnvalue				
	Product1 (1)	Product2 (2)	Product9 (3)	Product11 (4)	Product14 (5)
TimeDummy:StoreDummy	-0.38 (0.24)	0.22 (0.28)	0.49 (0.61)	0.35 (0.30)	-0.42 (0.36)
Constant	-11.82*** (0.59)	-5.73*** (0.49)	-3.01*** (0.74)	-7.62*** (0.53)	-3.70*** (0.43)

Observations 1,386 1,491 520 1,431 1,083
R2 0.59 0.67 0.46 0.55 0.64
Adjusted R2 0.59 0.66 0.44 0.55 0.64
Residual Std. Error 2.58 1.89 1.79 2.38 1.85
F Statistic 99.76*** 145.97*** 21.03*** 87.24*** 96.17***

Note: *p<0.05; **p<0.01; ***p<0.001

	Dependent variable:				
	logreturnvalue				
	Product3 (1)	Product5 (2)	Product6 (3)	Product7 (4)	Product12 (5)
TimeDummy:StoreDummy	-0.13 (0.24)	-0.03 (0.21)	-0.02 (0.31)	-0.04 (0.21)	-0.30 (0.20)
Constant	-10.72*** (0.59)	-6.14*** (0.47)	-7.49*** (0.49)	-3.31*** (0.36)	-5.25*** (0.44)

Observations 1,344 1,847 1,501 1,163 1,842
R2 0.55 0.66 0.59 0.35 0.68
Adjusted R2 0.54 0.66 0.58 0.34 0.67
Residual Std. Error 2.62 1.93 2.18 1.66 1.80
F Statistic 80.31*** 178.15*** 105.68*** 30.46*** 190.15***

Note: *p<0.05; **p<0.01; ***p<0.001

Product Category

High impact product category:

- Diamond Fashion
- Watches
- Diamond -Wedding Band
- Sterling Silver

Medium impact product category

- Bridal
- Gold Wed Bands
- Beads
- Diamond-Solitaires Jewelry
- Diamond -Wedding Band

Low impact product category

- Solitaires
- Semi Precious
- Mens
- Gold Earrings
- Gold Chain / Jewelry

Results & Insights (Returns)

Product Category	Name	Beta Values Significant	Mean Price
4	Diamond Fashion	-0.95	270.99097
13	Watches	-0.83	205.72213
20	Diamond - Wedding Band	-0.9	450.98334
21	Sterling Silver	-0.53	96.25109

HIGH IMPACT Product Categories are mostly MEDIUM price items

Return Value(\$)
After Bops strategy implement, the returnvalue of Diamond fashion decrease by 95%
After Bops strategy implement, the returnvalue of Watches decrease by 83%.
After Bops strategy implement, the returnvalue of Diamond wedding band decrease by 90%.
After Bops strategy implement, the returnvalue of Sterling Silver decrease by 53%.

Final Conclusion

- BOPS Strategy **decreases** the Sales for online channels.
- Implementing BOPS **decreases** the Returns which can be attributed to decrease in sales.
- The average customer purchase using the BOPS Service is less compared to customers not using the BOPS service.

Explanation:

Channel-shift effect – Customers use the online channel to view the inventory information but prefer to purchase the product in store - ROPO (Research Online Purchase Offline) (Gallino, Santiago, and Antonio Moreno. "Integration of Online and Offline Channels in Retail: The Impact of Sharing Reliable Inventory Availability Information." Management Science, vols. Vol. 60, June 2014.)

- Impact of BOPS varies across product categories
 - **Most Low Price Items** have a significant **decrease** in sales value compared to high price items.
 - **Most Mid Price Items** have a significant **decrease** in return value compared to other items.
- We conclude that BOPS has a negative impact on online channel but a possible reason can be the transfer of online sales to physical store sales as explained above.

Limitations & Suggestions

- The above analysis is done in isolation i.e. online channel only. In order to capture the overall effect of BOPS we should consider its impact on the other channels like retail (offline) channel. It may be possible that the customers are visiting nearby stores after checking it online (Consumer behavior: research online, purchase offline). This may decrease the online sales/returns but may increase offline sales/returns. To get the net effect we should include other channels data in our analysis.
- Omitted variables: Customers product quality expectation (perceived and objective), customers uncertainty, proximity, return policy period, data about consumers who use both bops and home delivery after bops is implemented.
- Missing values:
 - Transaction and customer data (15% of the female data is missing).

Thank You

