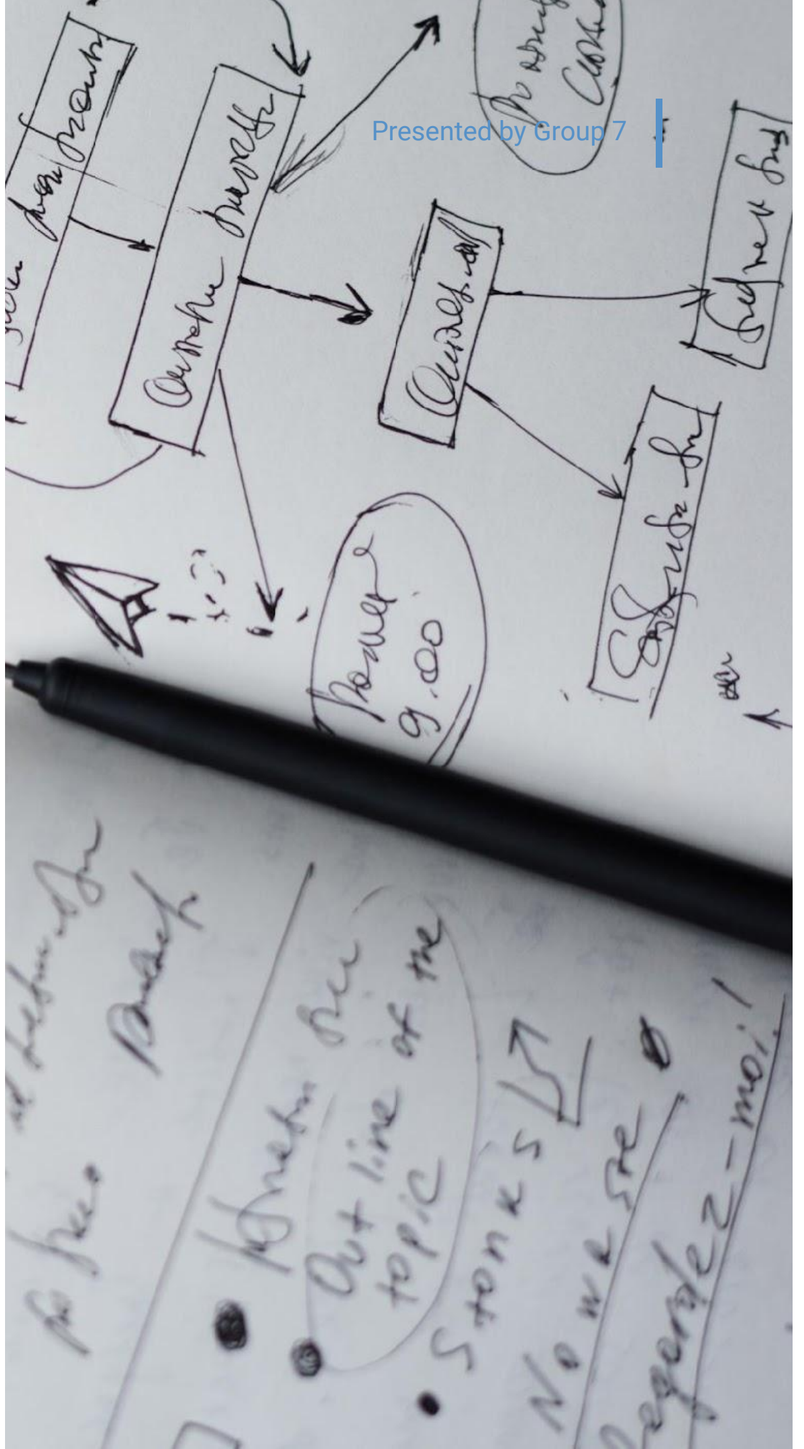
Overview of Demand

in Taiwan's Wholesale Fruit Market

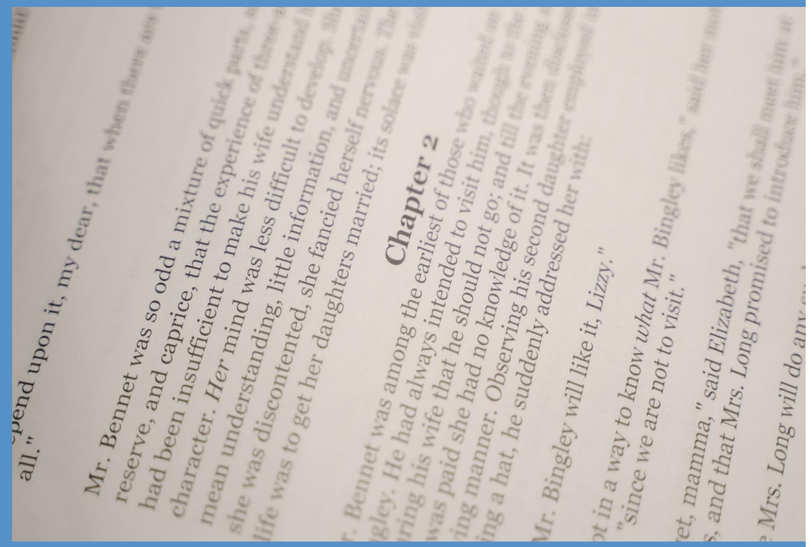
Presented by Group 7

Content



Introduction

- Ahmadi-Esfahani, Stanmore (1997)
- Fruit is the highest in the annual agricultural products consumption (115.21 kg) per capita in 2022
- Banana, pineapple, belt fruit and guava are common in the consumption market, such as self-usage, present, worshipping



LITERATURE REVIEW

01

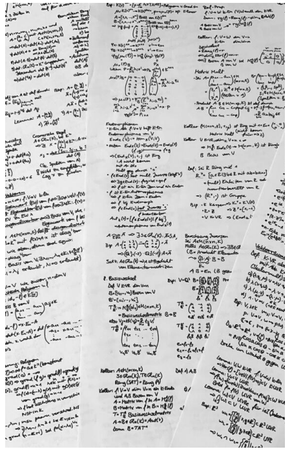
LITERATURE 1

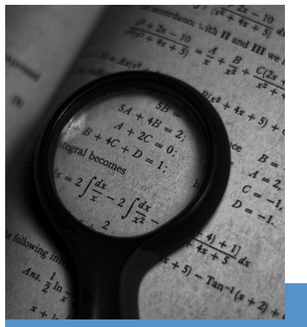
Zheng, Henneberry, Zhao, Gao (2019) find that as per capita incomes continue to grow, the shares of spending on foods at home are expected to decline, while both urbanization and population aging continue their upward trends, at-home food budget shares of foods with animal origins and fruits would be on the rise.

LITERATURE REVIEW

02 LITERATURE 2：魯真、葉敬軒(2000)

- Analysis target: pineapples, papayas, belt fruits, grapes, and pears.
- Variables: Population of Taiwan (expect Lienchiang County and Kinmen County) (Demographic Variables), Nominal Retail Price. Used wholesale market transaction volume, fruits production, and fresh fruits import volume to generate the fruits consumption share per household.
- The Interesting Findings: pineapples and grapes are substitute while grapes and pears were complementary.





DATA

- Prices
- Expenditure Share
- Demographic Variables (D.V.)
- 資料期間：2017 - 2021

  樣本層級：縣市

county	縣市
yr	年
bana_p	香蕉批發市場價格
belt_p	蓮霧批發市場價格
guva_p	芭樂批發市場價格
pine_p	鳳梨批發市場價格
bana_w	香蕉支出份額
belt_w	蓮霧支出份額
guva_w	芭樂支出份額
pine_w	鳳梨支出份額
houses	縣市總家戶數
h_people_1	1人家戶占比
h_people_2	2人家戶占比
h_people_3	3人家戶占比
h_people_4	4人家戶占比
h_people_5	5人以上家戶占比
household_inco	家戶平均可支配所得
h_child_ratio	扶幼比
h_old_ratio	扶老比
urbanisation	都市化程度

DATA Prices

- 產品:香蕉、蓮霧、鳳梨、芭樂(番石榴)
- 資料來源:農產品交易批發市場
- 批發市場價格
- 單位:新台幣元／公斤

DATA Prices

Variable	Obs	Mean	Std. dev.	Min	Max
bana_p	65	25.15749	5.553938	11.96	41.84
belt_p	65	54.61741	14.8396	28.78	96.97
guva_p	65	28.93635	5.536976	19.04	40.86
pine_p	65	20.51127	3.81075	12.51	28.9

DATA Expenditure Share

- 計算步驟:
  1. 各縣市各品項水果的交易總價值
     該年度各項水果總產值
  2. 各縣市平均每戶的各品項水果之支出金額

$$= \frac{\text{各品項水果交易總價值}}{\text{該縣市家戶總數}}$$

  3. 各水果支出份額

$$= \frac{\text{各品項水果平均每戶之支出金額}}{\text{四項水果平均每戶之支出金額}}$$

DATA Expenditure Share

Variable	Obs	Mean	Std. dev.	Min	Max
bana_w	65	.2678888	.0611039	.1198342	.4160408
belt_w	65	.1935439	.0673681	.0432835	.3422748
guva_w	65	.2716958	.100488	.0682526	.4891333
pine_w	65	.2668715	.0864731	.1145856	.4596021

DATA D. V. - Households

- 支出資料:

  資料來源:行政院家庭收支調查

  家戶平均食品及非酒精飲料科支出

- 人口特徵:

  資料來源:內政部人口統計資料、行政院家庭收支調查

  1. 各家戶人數比例
  2. 家戶平均可支配所得
  3. 年齡結構(扶幼比、扶老比)
  4. 都市化程度

DATA D. V. - Households

- 扶幼比 $= \frac{\text{各縣市老年人口}}{\text{各縣市青壯年人口}} \times 100$

- 扶老比 $= \frac{\text{各縣市幼年人口}}{\text{各縣市青壯年人口}} \times 100$

DATA D. V. - Urbanisation

- 都市化地區 - 行政院主計總處
    1. 一個具有二萬人以上之聚居地，其人口密度達每平方公里三百人以上者。
    2. 不同市、鎮、鄉之二個以上毗鄰聚居地，其人口數合計達二萬人以上，且平均人口密度達每平方公里三百人以上者。
- 鄒克萬、黃書偉(2003)

    地方空間自我相關分析(LISA)

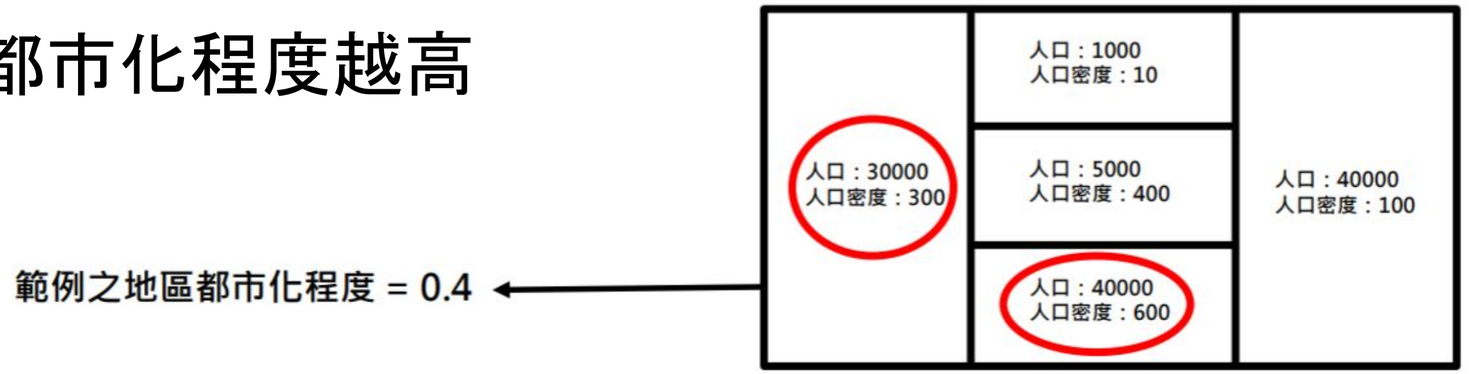
DATA D. V. - Urbanisation

- 「人口數 > 20000 且人口密度達 300人／平方公里」

  定義該地區為 1、反之為 0

- 都市化程度 $= \frac{\text{各縣市為 1 之鄉政市區數}}{\text{各縣市總鄉政市區數}}$

- 越接近 1 表示該縣市都市化程度越高



鄒克萬、黃書偉（2003）。台灣地區所得空間公平性變遷之研究。規劃學報，(30)，47-57。
https://doi.org/10.6404/JP.200312.0047

DATA D. V.

Variable	Obs	Mean	Std. dev.	Min	Max
houses	65	584133.3	475550.3	82869	1620906
h_people_1	65	.3332308	.0333123	.25	.39
h_people_2	65	.2035385	.0105224	.18	.22
h_people_3	65	.1798462	.0096002	.16	.19
h_people_4	65	.1452308	.0150112	.11	.17
h_people_5	65	.1373846	.0337397	.09	.25
household_~e	65	1007556	183316.7	746774.9	1430572
h_child_ra~o	65	18.21631	2.534352	14.39	24.45
h_old_ratio	65	25.25	6.905353	15.5	43.17
urbanisation	65	.6909846	.3031832	.059	1

Endogenous TEST

aidsills bana_w belt_w guva_w pine_w, prices(bana_p belt_p guva_p pine_p) expenditure(exp) ivexpenditure(ln_house_income) intercept(h_people_1 h_people_2 h_people_3 h_people_4 h_people_5 h_child_ratio h_old_ratio urbanisation) symmetry

	Coefficient	Std. err.	z	P>|z|	[95% conf.	Interval]
bana_w						
gamma_lnbana_p	-.1088314	.0471385	-2.31	0.021	-.2012055	-.0164572
gamma_lnbelt_p	.0257088	.032394	0.79	0.427	-.0377822	.0891998
gamma_lnguva_p	.088657	.0557083	0.16	0.877	-.1005293	.1178433
gamma_lnpine_p	.0744655	.0615291	1.21	0.226	-.0461293	.1950604
beta_lnx	.0258683	.010782	2.40	0.016	.004736	.0470007
rho_vexp	-.0306715	.0123259	-2.49	0.013	-.0548298	-.0065132
belt_w						
gamma_lnbana_p	.0257088	.0443832	0.58	0.562	-.0612808	.1126984
gamma_lnbelt_p	.1033877	.0319812	3.23	0.001	.0407058	.1660697
gamma_lnguva_p	.0352779	.0548498	0.64	0.520	-.0722257	.1427816
gamma_lnpine_p	-.1643745	.0609736	-2.70	0.007	-.2838806	-.0448684
beta_lnx	-.002853	.0107165	-0.27	0.790	-.023857	.018151
rho_vexp	-.0047486	.0128244	-0.37	0.712	-.029876	.0203947
guva_w						
gamma_lnbana_p	.088657	.0573951	0.15	0.880	-.1038352	.1211493
gamma_lnbelt_p	.0352779	.0414471	0.85	0.395	-.045957	.1165128
gamma_lnguva_p	.044972	.0718858	0.63	0.527	-.0943535	.1842976
gamma_lnpine_p	-.088907	.0791314	-1.12	0.261	-.2440018	.0661878
beta_lnx	.0025343	.0138805	0.18	0.855	-.024671	.0297396
rho_vexp	-.0007644	.01663	-0.05	0.963	-.0333585	.0318297
pine_w						
gamma_lnbana_p	.0744655	.0496745	1.50	0.134	-.0228948	.1718259
gamma_lnbelt_p	-.1643745	.0352788	-4.66	0.000	-.2335197	-.0952293
gamma_lnguva_p	-.088907	.0596955	-1.49	0.136	-.205908	.028094
gamma_lnpine_p	.178816	.0678472	2.64	0.008	.0458379	.311794
beta_lnx	-.0255496	.0116809	-2.19	0.029	-.0484437	-.0026555
rho_vexp	.0361765	.0132571	2.73	0.006	.0101931	.06216

test rho_vexp

```
( 1)  [bana_w]rho_vexp = 0
( 2)  [belt_w]rho_vexp = 0
( 3)  [guva_w]rho_vexp = 0
( 4)  [pine_w]rho_vexp = 0
      Constraint 4 dropped

          chi2(  3) =   11.22
        Prob > chi2 =    0.0106
```

Reject hypothesis of endogeneity

Homogeneity TEST

aidsills bana_w belt_w guva_w pine_w, prices(bana_p belt_p guva_p pine_p) expenditure(exp) ivexpenditure(ln_house_income) intercept(h_people_1 h_people_2 h_people_3 h_people_4 h_people_5 h_child_ratio h_old_ratio urbanisation) iteration(0)

INSTRUMENTAL REGRESSION(S)

Source	SS	df	MS		
				Number of obs	65
				F(13, 51)	12.09
Model	133.779866	13	10.2906974	Prob > F	0.0000
Residual	43.413527	51	.851245628	R-squared	0.7550
				Adj R-squared	0.6925
Total	177.192593	64	2.76863426	Root MSE	.92263

lnexp	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
lnbana_p	3.815546	.7611747	5.01	0.000	2.323671	5.307421
lnbelt_p	1.052736	.6528178	1.61	0.107	-.226763	2.332236
lnguva_p	-.4539867	1.072516	-0.42	0.672	-2.555999	1.648185
lnpine_p	.1151952	1.251979	0.09	0.927	-2.338638	2.569029
ln_house_income	1.954756	1.984702	0.98	0.325	-1.935188	5.844699
h_people_1	-9.94598	19.48348	-0.51	0.610	-48.13291	28.24095
h_people_2	2.378363	27.27529	0.09	0.931	-51.08823	55.83695
h_people_3	-38.69877	33.7752	-1.15	0.252	-104.8969	27.4994
h_people_4	55.47287	29.08884	1.91	0.056	-1.524525	112.4703
h_people_5	-28.99288	17.27914	-1.68	0.093	-62.85936	4.873604
h_child_ratio	-.1076562	.0535315	-2.01	0.044	-.212576	-.0027364
h_old_ratio	-.0230604	.0195052	-1.18	0.237	-.0612899	.0151691
urbanisation	.9601666	1.14869	0.84	0.403	-1.291224	3.211557
_cons	-15.60193	30.15415	-0.52	0.605	-74.70297	43.49911

AIDS - LINEARIZED WITH STONE PRICE INDEX
UNCONSTRAINED ESTIMATES

Equation	Obs	Parms	RMSE	"R-sq"	F(14, 50)	Prob > F
bana_w	65	14	.0443122	0.5891	5.12	0.0000
belt_w	65	14	.0502525	0.5653	4.64	0.0000
guva_w	65	14	.0625084	0.6977	8.24	0.0000
pine_w	65	14	.0462608	0.7764	12.40	0.0000

HOMOGENEITY TEST: Chi2(3) = 1.35 Prob > chi2 = 0.7182

The result shows the rejection of the hypothesis of homogeneity, meaning 4 fruits are not homogenous.

Symmetry TEST

aidsills bana_w belt_w guva_w pine_w, prices(bana_p belt_p guva_p pine_p) expenditure(exp) ivexpenditure(ln_house_income) intercept(h_people_1 h_people_2 h_people_3 h_people_4 h_people_5 h_child_ratio h_old_ratio urbanisation) homogeneity

```
AIDS - PROPER ESTIMATION WITH FIXED ALPHA_0 = 0
HOMOGENEITY CONSTRAINED ESTIMATES
```

Equation	Obs	Parms	RMSE	"R-sq"	F(14, 50)	Prob > F
bana_w	65	14	.0443552	0.5801	5.42	0.0000
belt_w	65	14	.0517946	0.5290	4.41	0.0000
guva_w	65	14	.0676546	0.6388	6.94	0.0000
pine_w	65	14	.0496023	0.7378	11.04	0.0000

```
SYMMETRY TEST:      Chi2(  3) =     3.07    Prob > chi2 =   0.3804
```

```
// another test of symmetry :
quietly test [bana_w]gamma_lnbelt_p = [ belt_w ] gamma_lnbana_p, notest
quietly test [ bana_w]gamma_lnguva_p = [ guva_w ] gamma_lnbelt_p , notest accumulate
test[belt_w]gamma_lnguva_p=[guva_w]gamma_lnbelt_p,accumulate
```

```
( 1)  [bana_w]gamma_lnbelt_p - [belt_w]gamma_lnbana_p = 0
( 2)  [bana_w]gamma_lnguva_p - [guva_w]gamma_lnbelt_p = 0
( 3)  [belt_w]gamma_lnguva_p - [guva_w]gamma_lnbelt_p = 0

          chi2(  3) =    3.31
        Prob > chi2 =    0.3459

. // Do NOT Reject, Probably Symmetry
```

The result shows DO NOT rejection of the hypothesis of symmetry, meaning the estimation of pi on wj is equal to the estimation of pj on wi.

FINDINGS

```
aidsills bana_w belt_w guva_w pine_w, prices(bana_p
belt_p guva_p pine_p) expenditure(exp)
ivexpenditure(ln_house_income) intercept(h_people_1
h_people_2 h_people_3 h_people_4 h_people_5
h_child_ratio h_old_ratio urbanisation) symmetry
```

Presented by Group 7

INSTRUMENTAL REGRESSION(S)

Source	SS	df	MS		
Model	133.779066	13	10.2906974	Number of obs	65
Residual	43.413527	51	.851245628	F(13, 51)	12.09
				Prob > F	0.0000
				R-squared	0.7550
				Adj R-squared	0.6925
Total	177.192593	64	2.76863426	Root MSE	.92263

lnexp	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
lnbana_p	3.815546	.7611747	5.01	0.000	2.323671	5.307421
lnbelt_p	1.052736	.6528178	1.61	0.107	-.226763	2.332236
lnguva_p	-.4539067	1.072516	-0.42	0.672	-2.555999	1.648185
lnpine_p	.1151952	1.251979	0.09	0.927	-2.338638	2.569029
ln_house_income	1.954756	1.984702	0.98	0.325	-1.935188	5.844699
h_people_1	-9.94598	19.48348	-0.51	0.610	-48.13291	28.24095
h_people_2	2.378363	27.27529	0.09	0.931	-51.08823	55.83695
h_people_3	-38.69877	33.7752	-1.15	0.252	-104.8969	27.4994
h_people_4	55.47287	29.08884	1.91	0.056	-1.524525	112.4703
h_people_5	-28.99288	17.27914	-1.68	0.093	-62.85936	4.873604
h_child_ratio	-.1076562	.0535315	-2.01	0.044	-.212576	-.0027364
h_old_ratio	-.0238604	.0195052	-1.18	0.237	-.0612899	.0151691
urbanisation	.9601666	1.14869	0.84	0.403	-1.291224	3.211557
_cons	-15.60193	30.15415	-0.52	0.605	-74.78297	43.49911

```
Iteration - 1       Criterion - .12779966
Iteration - 2       Criterion - .00071488
Iteration - 3       Criterion - 4.596e-06
```

AIDS - PROPER ESTIMATION WITH FIXED ALPHA_0 - 0
HOMOGENEITY AND SYMMETRY CONSTRAINED ESTIMATES

Equation	Obs	Parms	RMSE	"R-sq"	F(14,	50)	Prob > F
bana_w	65	14	.0443552	0.5801		5.42	0.0000
belt_w	65	14	.0517946	0.5290		4.41	0.0000
guva_w	65	14	.0676546	0.6388		6.94	0.0000
pine_w	65	14	.0496023	0.7378		11.04	0.0000

	Coefficient	Std. err.	z	P>|z|
bana_w				
gamma_lnbana_p	-.1088314	.0471385	-2.31	0.021
gamma_lnbelt_p	.0257088	.032394	0.79	0.427
gamma_lnguva_p	.008657	.0557083	0.16	0.877
gamma_lnpine_p	.0744655	.0615291	1.21	0.226
beta_lnx	.0258683	.010782	2.40	0.016
rho_vexp	-.0386715	.0123259	-2.49	0.013
alpha_h_people_1	.2740641	.9586729	0.29	0.775
alpha_h_people_2	-.1475795	1.340922	-0.11	0.912
alpha_h_people_3	2.514329	1.804249	1.39	0.163
alpha_h_people_4	.6859347	1.516665	0.45	0.651
alpha_h_people_5	.7919049	.8842701	0.90	0.370
alpha_h_child_ratio	.003152	.0029083	1.08	0.278
alpha_h_old_ratio	.0004024	.0009186	0.44	0.661
alpha_urbanisation	-.2679579	.049951	-5.36	0.000
alpha_cons	-.7483736	.8662471	-0.86	0.388
belt_w				
gamma_lnbana_p	.0257088	.0443832	0.58	0.562
gamma_lnbelt_p	.1033877	.0319812	3.23	0.001
gamma_lnguva_p	.0352779	.0548498	0.64	0.520
gamma_lnpine_p	-.1643745	.0609736	-2.70	0.007
beta_lnx	-.002853	.0107165	-0.27	0.790
rho_vexp	-.0047486	.0128244	-0.37	0.712
alpha_h_people_1	-.1601857	.956956	-0.17	0.867
alpha_h_people_2	-2.763656	1.339303	-2.06	0.039
alpha_h_people_3	-1.013961	1.800711	-0.56	0.573
alpha_h_people_4	-3.622655	1.514622	-2.39	0.017
alpha_h_people_5	-.0144338	.8822386	-0.02	0.987
alpha_h_child_ratio	.0034872	.0029018	1.20	0.229
alpha_h_old_ratio	-.000061	.0009157	-0.07	0.947
alpha_urbanisation	.1588586	.0498024	3.03	0.002
alpha_cons	1.281738	.8644195	1.48	0.138

	Coefficient	Std. err.	z	P>|z|
guva_w				
gamma_lnbana_p	.008657	.0573951	0.15	0.880
gamma_lnbelt_p	.0352779	.0414471	0.85	0.395
gamma_lnguva_p	.044972	.0710858	0.63	0.527
gamma_lnpine_p	-.088907	.0791314	-1.12	0.261
beta_lnx	.0025343	.0138885	0.18	0.855
rho_vexp	-.0007644	.01663	-0.05	0.963
alpha_h_people_1	3.266991	1.242314	2.63	0.009
alpha_h_people_2	-4.35644	1.738619	-2.51	0.012
alpha_h_people_3	-.1620086	2.337485	-0.07	0.945
alpha_h_people_4	4.989293	1.966308	2.54	0.011
alpha_h_people_5	-1.320262	1.145267	-1.15	0.249
alpha_h_child_ratio	.0038496	.0037663	1.02	0.307
alpha_h_old_ratio	.000776	.0011883	0.65	0.514
alpha_urbanisation	-.0664653	.0646429	-1.03	0.304
alpha_cons	-.5789671	1.122139	-0.52	0.606
pine_w				
gamma_lnbana_p	.0744655	.0496745	1.50	0.134
gamma_lnbelt_p	-.1643745	.0352788	-4.66	0.000
gamma_lnguva_p	-.088907	.0596955	-1.49	0.136
gamma_lnpine_p	.178816	.0678472	2.64	0.008
beta_lnx	-.0255496	.0116889	-2.19	0.029
rho_vexp	.0361765	.0132571	2.73	0.006
alpha_h_people_1	-3.388869	1.055815	-3.20	0.001
alpha_h_people_2	7.267675	1.477558	4.92	0.000
alpha_h_people_3	-1.33836	1.987515	-0.67	0.501
alpha_h_people_4	-2.052573	1.671914	-1.23	0.220
alpha_h_people_5	.5427988	.9738489	0.56	0.577
alpha_h_child_ratio	-.0104888	.0032003	-3.28	0.001
alpha_h_old_ratio	-.0011174	.0010095	-1.11	0.268
alpha_urbanisation	.1835646	.0549489	3.34	0.001
alpha_cons	1.045603	.9535672	1.10	0.273

Elasticity - Price & Budget

PREDICTED SHARES, BUDGET AND (UN)COMPENSATED OWN-PRICE ELASTICI

	shares b/se	budget b/se	u_price b/se	c_price b/se
bana_w	0.271***	1.096***	-1.389***	-1.093***
	(0.005)	(0.040)	(0.160)	(0.154)
belt_w	0.193***	0.985***	-0.461***	-0.271
	(0.006)	(0.056)	(0.167)	(0.166)
guva_w	0.272***	1.009***	-0.837***	-0.562**
	(0.008)	(0.051)	(0.259)	(0.263)
pine_w	0.264***	0.983***	-0.259	-0.020
	(0.006)	(0.045)	(0.247)	(0.248)

* p<0.1, ** p<0.05, *** p<0.01

Budget:

- **All of fruits** consumption are significantly influenced by household budget.
  - When the budget increase 1%, all of fruits consumption will increase almost 1%.

Uncompensated Price:

- Consumers who buy **banana, belt fruit, and guava** are significantly negative sensitive with the prices, where banana consumption would decrease 1.39%, belt fruit will decrease 0.46%, and guava will decrease 0.837% when the price increase 1%.

Compensated Price:

- Consumers who buy **banana and guava** are significantly negative sensitive with the prices, where banana consumption would decrease 1.09%, and guava will decrease 0.562% when the price increase 1%.

Elasticity - Cross Price

UNCOMPENSATED CROSS-PRICE ELASTICITIES

	bana_p b/se	belt_p b/se	guva_p b/se	pine_p b/se
bana_w	-1.389***	0.872	0.010	0.211
	(0.160)	(0.119)	(0.202)	(0.221)
belt_w	0.131	-0.461***	0.186	-0.841***
	(0.225)	(0.167)	(0.281)	(0.311)
guva_w	0.033	0.127	-0.837***	-0.333
	(0.207)	(0.153)	(0.259)	(0.285)
pine_w	0.269	-0.599***	-0.314	-0.259
	(0.180)	(0.133)	(0.225)	(0.247)

COMPENSATED CROSS-PRICE ELASTICITIES

	bana_p b/se	belt_p b/se	guva_p b/se	pine_p b/se
bana_w	-1.093***	0.284**	0.308	0.501**
	(0.154)	(0.119)	(0.204)	(0.223)
belt_w	0.398*	-0.271	0.454	-0.580*
	(0.217)	(0.166)	(0.285)	(0.313)
guva_w	0.306	0.323**	-0.562**	-0.066
	(0.199)	(0.153)	(0.263)	(0.287)
pine_w	0.513***	-0.425***	-0.068	-0.020
	(0.173)	(0.133)	(0.227)	(0.248)

* p<0.1, ** p<0.05, *** p<0.01

Uncompensated:

- **Belt fruit and pineapple are complementary**, which the consumption share of pineapple would decrease 0.6% when belt fruits price increase 1%, and when the pineapple price increase 1%, the belt fruit consumption share would decrease 0.84%.

Compensated:

- **Belt fruit and pineapple are still complementary.**
- **Banana and pineapple are substitute**, which the pineapple consumption share would increase around 0.5% when banana price increase 1%, vice versa.
- **Banana and belt fruit are weakly significant complementary**, which banana consumption share would increase 0.294% when the belt fruit price increase 1% at 5% significance level, and when the banana price increase 1%, the belt fruit consumption share would increase 0.398% at 10% significance level.

Conclusion

- Belt fruit and pineapple are complementary due to the most production are in different season, and consumers are not sensitive to the price.
- Banana and pineapple are substitute, since both of them have the most production during summer.
- Banana and belt fruit are weakly significant complementary, while banana production is high in summer, and belt fruit is in winter.

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