



The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Convergence in Food Consumption in Rural China: Evidence from Household Survey Data

Guang Hua Wan

Department of Agricultural Economics
The University of Sydney
NSW 2006

Abstract: Convergence in food consumption not only reflects homogenisation of preferences but may also imply nationalisation or integration of markets. This paper will (a) propose an econometric model for studying consumption convergence; (b) apply the model to a set of panel data from China; and (c) discuss various implications of modelling results.

Keywords: convergence, China, food consumption

Contact details: Guang Hua Wan
Department of Agricultural Economics
The University of Sydney A04
NSW 2006, Australia

Tel: (61-2) 9351 6931
Fax: (61-2) 9351 4953
Email: g.wan@agec.usyd.edu.au

Paper to be presented at the 46th Annual Conference of the Australian Agricultural and Resource Economists Society, Canberra, February 12-15, 2002.

Convergence in Food Consumption in Rural China: Evidence from Household Survey Data

1. Introduction

There is a growing interest in studies of convergence in food consumption (Blandford 1984, Wohlken and Filip 1988, Connor 1994, Gil, et al. 1995, Herrmann and Roder 1995). Consumption convergence, if occurred or occurring, would have important ramifications for policy makers, food producers, processors, traders and distributors. In the presence of convergence, government and non-government agencies must be prepared to alter infrastructure and production development plans, adjust international or regional trade policies and reconsider existing marketing strategies including location of agents and use of media. Confirmation of convergence has ramifications for demand modelling as it implies a need to take preference into modelling consideration.

From an international perspective, rural China is potentially the largest food market. China's accession to the WTO implies that this previously closed market is now within reach of foreign producers. Consequently, food consumption pattern in rural China and its convergence are becoming important issues for American and European countries, especially in their assessment of specific market segments and evaluation of long term prospects.

It is a well-known fact that food consumption pattern differs substantially for the northern and southern residents in China. Such a difference may be originated from tradition, cultural inheritance or fragmented markets. A consequence of this difference is that non-discriminating policies would yield different impacts in different parts of China. For example, R&D funding in wheat production will benefit northern residents more than others. Similarly, increases in government assistance to meat industries will improve the welfare of consumers as well as producers in Xizhang (Tibet) and Inner Mongolia more than others. To some extent, consumption divergence has contributed to the localised production pattern in China, although the contrary may be true. Nevertheless, it is questionable whether consumption convergence would help de-localise food production. In any case, policies without due consideration to the convergence issue may well aggravate regional inequality.

Recent opening up of China coupled with its rapid economic growth have brought about significant changes in life style and consumption habit. These changes are likely to lead to convergence in food consumption. Major contributors to consumption convergence include market development and improved infrastructure which imply better accessibility and availability of domestic even imported goods in non-producing locations. On the other hand, a large volume of internal migration and a growing tourism naturally promote homogenisation of consumption pattern. Penetration of multinationals such as Macdonald, Lipton, KFC and Pizza Hut serve as another stimulus of

consumption convergence. Finally, advances in technologies (particularly media and cooking techniques) are expected to help close the consumption gaps across regions.

This paper represents a first attempt to address the issue of convergence in food consumption in China. Although there exist a few studies on China's food consumption, most of them focus on demand modelling or elasticity estimations (Fan, et al. 1995; Wan 1996). In measuring inequality of grain output in China, Lyons (1991) might be the only one who just touched on the status of food consumption divergence in China. Needless to say, studying food demand is different from studying consumption convergence, just as estimating production functions is different from studying catch up and convergence in growth.

2. Analytical Techniques

Following earlier studies, consumption convergence will be analysed using the frameworks developed in the literature of catch-up and economic growth. See, for example, Barro (1996) and Gil, et al. (1995). The frameworks assume a homogeneous rates of time preference and identical production functions across regions. Under these assumptions, neo-classical theory implies eventual convergence to a common equilibrium value of income level. By the same token, convergence in consumption would be inevitable provided that consumers utility functions are identical.

Alternative measures of convergence exist. In a path-breaking paper, Barro and Sala i Martin (1992) define Sigma convergence and Beta convergence. The former says that the cross-section standard deviation of income or consumption levels decreases over time. The latter says that low income or consumption regions grow faster than high income or consumption counterparts. Clearly, Beta-convergence is a necessary condition for Sigma-convergence. It is not sufficient because the level of income or consumption also changes over time and standard deviation is not a unit-free measure. If one defines Gamma convergence as the reduction in the coefficient of variation of income or consumption over time, Beta convergence will be both necessary and sufficient for Gamma convergence.

The above concepts of Beta convergence is unconditional. That is, the growth rates of income or consumption depend on the initial income or consumption levels only and they are inversely related. In the context of consumption studies, convergence is likely to be conditional on the income variable. This is because convergence stimulus (market development, information flow and internal migration and so on) may provide the possibility of convergence but actual convergence can not take place unless means for such convergence is provided. For instance, the poor cannot catch up in luxury goods consumption unless their income levels improve. As long as income growth determines consumption growth, convergence, if found, is said to be conditional. When consumption growth is only related to initial consumption level (the income variable plays no significant role), convergence is said to be unconditional.

So far, both growth convergence and convergence in consumption are being discussed together. This is acceptable as they are mirror images in many aspects. In fact, the modelling framework to be used in this paper is basically taken

from the literature of economic growth. However, distinctions must be made between these two closely related concepts. In particular, catch up in growth causes convergence in consumption under conditional convergence. And the contrary may not be true. Also, distinguishing these two concepts helps to avoid any confusions in exposition. Therefore, discussions hereafter will be referred to consumption convergence only.

In the context of consumption studies, it seems reasonable to propose that conditional convergence means co-existence of consumption movement along an existing demand function and consumption movement due to shifts in the underlying demand function. Unconditional convergence only signals (not necessarily parallel) shifts of demand functions. Under this proposition, convergence could be income driven (or conditional) or preference driven (unconditional). Since income and preference are functions of different determinants, such a proposition might be valuable when deriving policy recommendations from convergence studies.

To analyse consumption convergence, the focal point is to specify an econometric model to explain the average rate of growth in consumption (denoted as r). From the growth literature, unconditional convergence defines r as a function of initial level of consumption only:

$$r = \alpha - (1 - e^{-\beta T})/T \ln C_0 \quad (1)$$

where $r = \ln (C_T/C_0)(1/T)$, T indexes time, C represents consumption, β indicates speed of convergence. Model (1) can be linearised according to Uhlig (2001). That is, $(1 - e^{-\beta T}) \approx \beta T$. Thus, we have

$$\ln (C_T/C_0)(1/T) = \alpha + \beta^* \ln C_0 + v \quad (1')$$

where $\beta^* = -\beta$ and v denotes approximation errors caused by the linearisation.

Following the arguments in Dowrick and Nguyen (1989), the above model only captures inter-regional difference in growth rate of consumption or catch-up effects in the context of economic growth. Changes in growth rate over time for a given region is not fully accounted for by the above model. Such intra-regional variation in growth rate of consumption is commonly observed. In the absence of panel data, such variations are impossible to be examined. When panel data are available, as in this paper, it is useful and necessary to account for variations in the growth rate within regions.

In considering intra-regional variation in the consumption growth rate, it is important to point out that any analysis of convergence exclusively focuses on the long-run perspective. Short-run factors are excluded from consideration. In the long run, consumption is predominantly driven by income. Further, it is accepted that the higher the income the smaller the marginal propensity to consume or income elasticity. Consequently, an ad hoc long run consumption function can be written as

$$\ln C_{it} = \alpha_0 + \alpha_1 \ln I_{it} + \alpha_2 (\ln I_{it})^2 \quad (2)$$

$$\text{Thus } \ln C_{it} - \ln C_{i0} = \alpha_1 \ln (I_{it}/I_{i0}) + \alpha_2 [(\ln I_{it})^2 - (\ln I_{i0})^2]$$

Dividing both sides by T, we obtain

$$1/T [\ln C_{it} - \ln C_{i0}] = \alpha_1 1/T [\ln (I_{it}/I_{i0})] + \alpha_2 1/T [(\ln I_{it})^2 - (\ln I_{i0})^2] \quad (3)$$

Based on the above model, average growth rate in consumption within a region is a function of average growth rate in income. While poor regions catch up with richer regions according to (1'), individual regions may converge to a stable value according to (3). As argued earlier, the first convergence is unconditional, primarily driven by non-economic factors (Gil, et al. 1995), including changes in life-style, demographic or nutritional factors. The second convergence is conditional and clearly driven by income.

It is natural to combine the two models and then test for both forms of convergence. The combined model is

$$1/T [\ln C_{it} - \ln C_{i0}] = \alpha + \beta^* \ln C_{i0} + \alpha_1 1/T [\ln (I_{it}/I_{i0})] + \alpha_2 1/T [(\ln I_{it} - \ln I_{i0})^2] \quad (4)$$

It is expected that $\alpha_1 > 0$ for normal goods and $\alpha_1 < 0$ is usually associated with inferior goods. When $\alpha_1 > 0$, α_2 should be negative so that income elasticity declines as income rises. When $\alpha_1 < 0$, however, α_2 should be positive so that the negative income elasticity would become smaller in absolute terms as income rises. While it is possible for both α s to be positive, it is unreasonable for both of them to be negative.

Based on (4), unconditional convergence occurs if $\alpha_1 = \alpha_2 = 0$ and $\beta^* < 0$. This can be tested in a two-step procedure. First, $H_0: \alpha_1 = \alpha_2 = 0$ is tested by an F-test. Acceptance of H_0 indicates absence of conditional convergence. Subsequently, one can estimate (1') and test for possible existence of unconditional convergence by applying a simple t-test with $H_1: \beta^* < 0$. When H_0 is rejected, conditional convergence may exist and can be tested by applying the simple t-test just mentioned but based on estimation of (4). Rejection of H_0 does not necessarily mean non-existence of unconditional convergence, though testing its existence seems difficult under this circumstance.

The implications of these two forms of convergence are different. If convergence is conditional or income driven, income distribution policies and poverty alleviation will accelerate convergence. If convergence is purely preference-driven or unconditional, education and health concerns even advertising could lead to convergence.

3. Data and Preliminary Analysis of Convergence

Original data on disposable income and food consumption are compiled from various issues of Rural Household Survey Statistics, a publication of the State Statistical Bureau of China (SSB). They are aggregated to the provincial or regional level and are available on a per capita basis. The SSB publication goes back at least to 1970s. However, data prior to 1982 are too incomplete to be usable. Since the consumption variables are measured in kilograms per head, it is necessary only to deflate the income observations. Although different price indices exist, the Cost-of-Living Index or Consumer Price Index (CPI) for Farmers seems most appropriate. This index is published in various issues of China Statistical Yearbook and the name has been changed to Rural CPI as from 1994. The published regional CPIs take the preceding year as the base and they are all converted so to make 1981 as the common base.

Since the CPIs for Xizhang (Tibet) do not exist, Xizhang is excluded from the following analysis. Hainan was part of Guangdong province prior to 1988 and Chongqing was part of Sichuan province prior to 1997. Thus, Hainan is merged with Guangdong and Chongqing is merged with Sichuan throughout. In short, for each of the remaining 28 regions in China, 17 yearly observations (1982 - 98) on per capita disposable income and various consumption items, rural population and rural CPI are collected and will be used in this study.

Table A1 in the appendix tabulates the summary statistics of cross-region observations of the consumption and income variables. Consumption items examined in this study include total grain, fine grain, coarse grain, fresh vegetables, edible oil, vegetable oil, animal fat, meats, red meats, poultry products, eggs, aquatic products, sugar and alcohol.

Looking at the mean values, it is clear that (a) There is a general declining trend in total grain consumption, mainly driven by reductions in the coarse grain category. Fine grains (rice and wheat) exhibit an increasing trend; (b) Rural residents in China consume less and less fresh vegetables over time. This phenomenon may be explained by two factors: substitution by meats and aquatic products and less use of family garden as vegetable plots; (c) Animal fat and sugar share a similar time profile: increasing initially then declining. It is believed that health concerns are the major determinants of this trend; and (d) All other consumption items are on the rise.

Focusing on standard deviations in Table A1, it can be concluded that Sigma convergence is only present in the consumption of grains, vegetables and sugar. For all other food items, standard deviations had increased over the sample period of 1982-98. Changes in standard deviations seem to be positively related to changes in the mean consumption levels with fine grain as the only exception. These findings highlight the deficiency of standard deviation as a measure of convergence.

To analyse Gamma convergence, coefficients of variation need to be computed. Calculation results in Table A1 indicate that the food items can be classified into three groups. The first group consists of all grains, vegetable oil, poultry, aquatic products, sugar and alcohol and they show convergence. The second group displays a stable CV over time and this group includes fresh vegetables and edible oil. The last group (meats, red meats, animal fat, and eggs) possess an increasing trend in their coefficients of variation. Given the finding of increasing income inequality in rural

China (Wan 2001), Gamma convergence found in most food items implies emergence of unconditional convergence in food consumption, an inference which may or may not be confirmed by modelling results in the next section.

It is useful to note that the minimum of coarse grain consumption had increased over time although its mean value had dropped. The increase largely occurred in relatively rich regions as consumers there become more concerned about fibre intakes. Similarly, minimum animal fat had increased, largely in poor regions although consumers in rich regions used less and less animal fat. Also, quality of data for meat and red meats is found to be unsatisfactory, possibly due to frequent changes in the definition of survey variables regarding meat consumption. All of these will have bearings on the modelling work below.

4. Model Estimation and Discussions

To study Beta convergence or conditional convergence, it is necessary to employ econometric models discussed in Section 2 of this paper. Models (1') and (4) are readily subject to econometric estimation, once a stochastic disturbance term is added. If the added disturbance term is a white noise or well-behaved, as is commonly assumed, the simple technique of ordinary least squares or OLS can be applied. Recall that most, if not all, of convergence models are estimated using cross-sectional data, the conventional practice of specifying the disturbance to be a white noise is considered to be inappropriate.

An effective yet simple framework to take advantage of the features associated with cross-sectional data is developed by Kmenta (1986), in which variances of the disturbance term in the models are allowed to differ. Autocorrelation can be incorporated into the models as well. An iterative generalised least squares procedure can be utilised to estimate these models, which produces maximum likelihood estimates. See Kmenta (1986) and Wan (1996) for more details.

The estimation was accomplished using Shazam 8.0. Results from estimating (4) are presented in Table 1. Buse R^2 is a goodness of fit measure accommodating presence of heteroscedasticity and use of cross-sectional data (Buse 1973). The values of Buse R^2 in the table are comparable to those reported in Gil, et al. (1995) and in other studies using cross-sectional data. The t-ratios indicate that most of the coefficients are significantly different from 0 at the 1% or 5% level. Conventional F-statistics are not reported but they range from 5.067 to 137.991, indicating a maximum p-value of 0.002 or 0.2%. A disappointing result is the insignificance of individual parameters in the meat and red meat equations.

[Table 1 here]

Looking at the signs of the estimates, 11 out of the 14 β estimates are negative and are significant except that for the fresh vegetables equation. The β estimates for the meat and red meat equations are positive but insignificant. As

anticipated, 10 out of the 14 α_1 estimates are positive and their corresponding α_2 estimates are negative except the equation for aquatic products where the α_2 estimate is positive but insignificant. For the other equations with negative α_1 estimates, the α_2 estimates are positive.

It can thus be said that the estimation results are satisfactory though not ideal. In particular, the F-ratios presented in the last column indicate that the income variable is relevant in determining consumption changes in all the equations thus any convergence, if detected, cannot be exclusively unconditional. This finding also implies that unconditional measures such as Sigma or Gamma convergence, if applied alone to China, would produce misleading results.

Focusing on the β estimates, it is clear that convergence appears in the consumption of all food items except animal fat, meats, and red meats. Animal fat consumption shows divergence which is quite consistent with the fact that it is an inferior commodity. Poor regions used to consume relatively high amount of animal fat and still increase the consumption as income grows. Meanwhile, for rich regions, relatively less animal fat was consumed and even less are demanded as income rises. Put it differently, animal fat is an inferior good for rich consumers but remain a necessity or even luxury for the poor. Although it is an inferior good at the aggregate level as far as its relationship with income is concerned, the divergence associated with initial consumption levels seems to be present.

Coarse grain is another example of inferior good, as confirmed by its negative estimate of α_1 . However, initial level of coarse grain for rich regions was low and recently consuming more coarse grain is gaining popularity in affluent regions. On the other hand, poor regions started with high level of coarse grains and have been cutting down its intake. This certainly depicts a convergence picture which will be confirmed by the modelling results.

Non-convergence in meat and red meat is consistent with what revealed by Sigma divergence. However, modelling results do not show divergence as the β parameter is insignificant in either of these equations. This could be realistic because high income regions continue to increase meat consumption while poor regions, although increasing meat consumption as well, are unable to close the gap, a phenomenon not inconsistent with reality in China.

In terms of speed of convergence, they range from 0.6% for fresh vegetables and poultry meat and 2.7% for total grain. The relatively high speed of convergence for grain is another indication of the reasonable quality of our modelling work. At this rate, it requires 26 years to close half of the 1982 gap in regional grain consumption and it would take 52 years to eliminate three-quarters of the 1982 gap. The estimated speeds of convergence indicate that it would take between 26 and 116 years to close half of the 1982 gaps in various food consumption. It is important to point out that these assertions or predictions are conditional on the current income distribution. If income gaps among the regions grow larger, it will take much longer to close the gaps.

5. Conclusions and Limitations of the Study

This paper proposes an econometric framework for studying convergence in food consumption. When applied to panel data from rural China on 14 different food categories, modelling results imply the following major findings: (a) Conditional convergence is confirmed for all grain items, fresh vegetables, vegetable oil, poultry, eggs, aquatic products, sugar and alcohol; (b) Animal fat exhibits consumption divergence; (c) All meat items displays no convergence nor divergence; (d) It requires 26 - 116 years to close half of the 1982 gap in food consumption with grain lying on the minimum end.

These findings are drawn without reference to unconditional convergence only driven by preference changes. Although the proposed models do not allow separate identification of unconditional convergence, preference changes are inevitable in such a dynamic society as in China. Studies by Fan et al. (1994) and Wan (1998) conclude that habit formation and preference changes are evident in China. As stated earlier, stimulus to unconditional convergence include education development, internal migration and information gathering through television, mobile phone, travel, computers and other media. Also important are the value of convenience placed by consumers coupled with introduction of fast food products and packaging, advances in food processing and cooking technologies (e.g., popularity of microwave oven). Institutional reform such as vertical or horizontal integration of firms, nationalisation of food processing and distribution, particularly the abolishment of household register system will promote unconditional convergence in China as well.

It is no doubt that at present and in the near future, income plays a crucial role in affecting food consumption convergence. However, income becomes a weaker determinant of food expenditure when food becomes a smaller share of total expenditure (Senauer, et al. 1992). Also, consumption smoothing or risk sharing will further weaken the role of income as a determinant of consumption. While not downplaying the importance of conditional convergence, policy makers of various institutions must not neglect the growing role of unconditional convergence.

Our exploration of the meat consumption data points to substantial errors in the records. In early years, only pork consumption was reported with beef and lamb as one category added later. In the 1980s, another category of meat products is added while pork, beef and lamb were merged together. It is our belief that such frequent changes in the definition of variables may have caused confusion in the collection and transmission of the relevant data.

Finally, the ad hoc nature of the analytical framework must be acknowledged. Rural residents play dual roles as consumers and producers of food. In this case, consumption behaviour in terms of income effects and substitution effects may deviate from standard microeconomic theory. It is thus useful to study convergence as part of a complete household model, not simply borrowing the models from the growth literature.

References

Barro, R.J. and Sala-i-Martin, X. (1992). Convergence, *Journal of Political Economy*, 100(2): 223-251.

Blanford, D. (1984). Changes in food consumption patterns in the OECS area, *European Review of Agricultural Economics*, 11(1): 43-65.

Buse, A. (1973). Goodness of fit in generalised least squares estimation, *American Statistician*, 27(1): 106-108.

Connor, J.M. (1994). North America as a precursor of changes in Western European food-purchasing patterns, *European Review of Agricultural Economics*, 21(2): 155-173.

Fan, S.G., Wailes, E.J. and Cramer, G.L. (1994). Food demand in rural China: evidence from rural household survey, *Agricultural Economics*, 11(1): 61-69.

Fan, S.G., Wailes, E.J. and Cramer, G.L. (1995). Household demand in rural China: a two-stage LES-AIDS model, *American Journal of Agricultural Economics*, 77(1): 54-62.

Gil, J.M., Gracia, A. and Perez y Perez, L. (1995). Food consumption and economic development in the European Union, *European Review of Agricultural Economics*, 22(3): 385-399.

Herrmann, R. and Roder, C. (1995). Does food consumption converge internationally? Measurement, empirical tests and determinants, *European Review of Agricultural Economics*, 22(3): 400-414.

Kmenta, J. (1986). *Elements of Econometrics*, 2nd Ed., Macmillan, New York, NY.

Lyons, T.P. (1991). Interprovincial disparities in China: output and consumption, 1952 - 1987, *Economic Development and Cultural Change*, 39 (3): 471-506.

Dowrick, S. and Nguyen, D.T. (1989). OECD comparative economic growth 1950-85: catch-up and convergence, *American Economic Review* 79: 1010-1030.

Senauer, B., Asp, E. and Kinsey, J. (1993). *Food Trends and the Changing Consumer*, St. Paul, MN: Eagan Press.

Uhlig, H. (2001). A toolkit for Analysing Nonlinear Dynamic Stochastic Models Easily, Unpublished manuscript.

Wan, G.H. (1998). Nonparametric measurement of preference changes: the case of food demand in Rural China, *Applied Economics Letters* 5(7): 433-436.

Wan, G.H. (1996). Income elasticities of household demand in rural China: estimates from cross-sectional survey data, *Journal of Economic Studies*. 23(3): 18-34.

Wan, G.H. (2001). Changes in regional inequality in rural China: decomposing the Gini index by income sources, *Australian Journal of Agricultural and Resource Economics* 45(3): 361-82.

Wohlken, E. and Filip, J. (1988). Strukturwandel im Nahrungsmittelverbrauch ausgewählter OECD-lander. *Berichte über Landwirtschaft*, 66: 458-476.

Table 1: Estimation Results of Model (4), by Food Items							
Food items		β^*	α_1	α_2	α	Buse R^2	F-ratio*
Total	Estimate	-0.027	0.940	-0.075	0.151		
Grain	t-ratio	-10.340	7.507	-7.196	10.270	0.33	54.42
	p-value	0	0	0	0		
Fine	Estimate	-0.016	2.672	-0.209	0.086		
Grain	t-ratio	-6.265	11.540	-10.750	6.083	0.37	39.63
	p-value	0	0	0	0		
Coarse	Estimate	-0.009	-10.171	0.854	0.015		
Grain	t-ratio	-2.623	-10.000	9.594	0.962	0.27	37.72
	p-value	0.009	0	0	0.336		
Fresh	Estimate	-0.006	1.252	-0.100	0.019		
Vegetables	t-ratio	-1.410	2.609	-2.453	0.916	0.03	46.45
	p-value	0.159	0.009	0.015	0.36		
Edible	Estimate	-0.014	1.051	-0.056	0.039		
Oil	t-ratio	-2.553	1.793	-1.131	5.703	0.22	37.68
	p-value	0.011	0.074	0.259	0		
Vegetable	Estimate	-0.015	0.444	-0.004	0.045		
Oil	t-ratio	-2.488	0.590	-0.067	7.858	0.15	34.89
	p-value	0.013	0.556	0.946	0		
Animal	Estimate	0.014	-4.770	0.411	-0.001		
Oil	t-ratio	2.728	-4.210	4.252	-0.309	0.05	48.32
	p-value	0.007	0	0	0.757		
Meats	Estimate	0.000	-0.764	0.091	0.010		
	t-ratio	0.028	-1.410	2.004	1.137	0.22	42.53
	p-value	0.977	0.159	0.046	0.256		
Red	Estimate	0.005	0.326	-0.001	-0.011		
Meats	t-ratio	1.129	0.579	-0.014	-1.105	0.18	41.85
	p-value	0.259	0.563	0.989	0.27		
Poultry	Estimate	-0.006	3.305	-0.222	0.028		
Meat	t-ratio	-3.498	3.101	-2.413	11.590	0.31	56.45
	p-value	0.001	0.002	0.016	0		
Eggs	Estimate	-0.021	-0.465	0.083	0.038		
	t-ratio	-4.175	-0.457	0.940	10.570	0.19	41.31
	p-value	0	0.648	0.348	0		
Aquatic	Estimate	-0.018	0.245	0.018	0.033		
Products	t-ratio	-10.360	0.258	0.220	9.530	0.24	41.20
	p-value	0	0.797	0.826	0		
Sugar	Estimate	-0.026	4.314	-0.342	0.014		
	t-ratio	-12.570	5.877	-5.417	5.996	0.47	36.82
	p-value	0	0	0	0		
Alcohol	Estimate	-0.012	1.674	-0.100	0.042		
	t-ratio	-2.211	1.840	-1.275	6.647	0.24	38.58
	p-value	0.027	0.066	0.203	0		

* F-ratios are for testing the hypothesis: $\alpha_1 = \alpha_2 = 0$. Critical values are 4.6 and 2.9 at 1% and 5% significance levels.

Table A1: Summary Statistics of Variables

Mean	St. Dev.	Min	Max.	C.V.	Year
Total Grain					
257.66	33.02	206.36	319.92	0.13	1982
257.05	34.55	205.28	329.34	0.13	1983
264.90	36.57	216.97	334.56	0.14	1984
255.61	32.25	213.70	326.06	0.13	1985
254.66	32.29	209.93	325.95	0.13	1986
256.91	30.87	216.34	330.96	0.12	1987
258.12	33.21	219.61	335.58	0.13	1988
260.58	30.61	220.62	335.08	0.12	1989
259.57	29.75	213.32	340.85	0.11	1990
255.69	30.95	191.79	331.08	0.12	1991
251.17	30.76	203.67	327.24	0.12	1992
266.56	33.83	198.38	343.36	0.13	1993
260.70	34.89	187.76	339.19	0.13	1994
259.55	33.88	192.79	325.39	0.13	1995
256.19	29.85	167.75	317.55	0.12	1996
249.48	26.49	169.47	302.57	0.11	1997
247.61	26.54	173.42	301.40	0.11	1998
Fine Grain					
180.01	79.97	53.88	312.42	0.44	1982
187.54	76.19	57.44	319.36	0.41	1983
200.61	73.65	68.33	329.07	0.37	1984
202.38	63.05	85.12	320.53	0.31	1985
204.85	60.50	87.01	319.22	0.30	1986
204.73	59.00	91.38	323.89	0.29	1987
205.28	57.92	98.85	323.09	0.28	1988
208.37	54.45	96.64	313.87	0.26	1989
208.75	54.04	107.19	323.29	0.26	1990
210.35	51.94	121.71	318.27	0.25	1991
208.83	48.70	121.31	319.14	0.23	1992
217.93	50.02	124.74	329.73	0.23	1993
209.47	48.17	129.54	315.02	0.23	1994
208.09	43.96	133.25	302.45	0.21	1995
208.01	47.25	122.84	303.04	0.23	1996
205.39	43.84	126.00	290.91	0.21	1997
205.21	43.71	131.80	294.62	0.21	1998
Coarse Grain					
77.65	58.22	7.49	223.76	0.75	1982
69.51	55.92	9.98	225.40	0.80	1983
64.30	60.30	5.49	255.10	0.94	1984
52.99	48.51	5.53	181.10	0.92	1985
49.81	45.92	6.33	174.36	0.92	1986
52.17	45.39	7.04	175.97	0.87	1987
52.84	46.03	3.92	177.85	0.87	1988
52.21	45.20	3.36	179.94	0.87	1989
50.82	45.17	4.07	180.52	0.89	1990

45.31	42.10	2.65	159.15	0.93	1991
42.23	39.06	2.40	147.33	0.93	1992
48.63	43.56	4.76	163.07	0.90	1993
51.23	44.44	4.37	173.71	0.87	1994
51.47	42.19	1.44	163.24	0.82	1995
48.19	39.32	1.67	142.71	0.82	1996
43.96	34.39	2.44	124.26	0.78	1997
42.30	32.22	1.55	124.27	0.76	1998

Fresh Vegetables

131.22	46.00	35.28	240.11	0.35	1982
129.26	47.45	39.96	220.53	0.37	1983
139.79	54.70	52.93	303.16	0.39	1984
129.15	44.70	40.48	220.90	0.35	1985
130.60	44.66	44.84	219.65	0.34	1986
129.74	46.76	43.31	237.15	0.36	1987
130.94	47.86	43.89	263.52	0.37	1988
133.23	47.51	47.40	260.15	0.36	1989
133.36	48.04	43.74	285.32	0.36	1990
125.53	45.96	34.49	241.08	0.37	1991
128.58	48.40	40.09	243.04	0.38	1992
104.43	39.96	29.36	187.97	0.38	1993
105.36	44.31	32.04	202.55	0.42	1994
102.68	38.94	32.04	193.52	0.38	1995
104.17	38.09	29.82	205.82	0.37	1996
103.40	37.08	25.33	212.00	0.36	1997
104.69	37.57	35.51	204.26	0.36	1998

Edible Oil

3.42	0.96	1.96	5.47	0.28	1982
3.63	1.17	1.92	7.05	0.32	1983
4.06	1.11	2.37	6.44	0.27	1984
4.21	1.15	2.19	6.24	0.27	1985
4.35	1.12	2.35	6.21	0.26	1986
4.95	1.36	2.91	8.40	0.27	1987
5.19	1.58	2.85	8.51	0.30	1988
5.13	1.36	3.04	7.33	0.26	1989
5.54	1.48	3.17	8.14	0.27	1990
5.93	1.47	3.55	9.07	0.25	1991
6.16	1.72	3.52	9.66	0.28	1992
5.88	1.70	3.40	9.20	0.29	1993
5.89	1.55	3.35	9.30	0.26	1994
6.08	1.77	3.31	9.52	0.29	1995
6.27	1.59	4.34	10.08	0.25	1996
6.30	1.75	2.79	10.09	0.28	1997
6.40	1.83	3.34	10.50	0.29	1998

Vegetable Oil

2.12	1.01	0.52	4.14	0.48	1982
2.29	1.20	0.43	5.72	0.52	1983
2.58	1.15	0.49	4.51	0.45	1984
2.82	1.22	0.49	4.90	0.43	1985
2.85	1.27	0.44	5.41	0.45	1986
3.41	1.62	0.66	7.91	0.48	1987

3.75	1.90	0.74	8.35	0.51	1988
3.64	1.67	0.68	7.19	0.46	1989
3.96	1.83	0.78	7.76	0.46	1990
4.22	1.84	0.85	7.40	0.44	1991
4.47	2.07	0.92	8.45	0.46	1992
4.43	1.95	1.12	8.30	0.44	1993
4.50	1.91	0.87	8.55	0.42	1994
4.66	2.01	0.92	8.20	0.43	1995
4.83	1.83	1.10	8.13	0.38	1996
5.08	1.96	1.04	8.46	0.39	1997
5.05	2.02	1.17	9.45	0.40	1998
Animal Fat					
1.35	0.67	0.49	2.83	0.50	1982
1.28	0.65	0.30	2.79	0.50	1983
1.49	0.81	0.17	3.33	0.54	1984
1.41	0.89	0.21	3.52	0.63	1985
1.50	0.97	0.22	3.64	0.64	1986
1.55	0.97	0.20	3.71	0.63	1987
1.44	0.91	0.16	3.09	0.64	1988
1.49	0.96	0.14	3.54	0.64	1989
1.57	0.98	0.16	3.25	0.63	1990
1.71	1.14	0.19	4.42	0.67	1991
1.69	1.16	0.17	4.34	0.69	1992
1.45	0.97	0.12	3.87	0.67	1993
1.40	1.01	0.11	3.76	0.72	1994
1.42	1.05	0.09	4.06	0.74	1995
1.44	1.12	0.08	4.69	0.78	1996
1.22	1.06	0.06	4.50	0.87	1997
1.35	1.15	0.07	5.30	0.86	1998
Meats					
9.23	3.28	4.11	16.83	0.36	1982
9.99	3.52	3.98	17.91	0.35	1983
10.57	3.93	3.99	19.18	0.37	1984
10.83	4.17	4.26	17.60	0.38	1985
11.51	4.16	4.70	19.19	0.36	1986
11.60	4.17	4.34	18.54	0.36	1987
10.57	4.24	3.40	18.28	0.40	1988
10.79	4.25	3.93	19.65	0.39	1989
11.32	4.15	4.52	19.47	0.37	1990
12.12	4.68	4.41	22.27	0.39	1991
11.81	4.70	4.00	21.28	0.40	1992
13.58	5.97	4.34	25.41	0.44	1993
12.98	5.90	4.60	25.71	0.45	1994
13.61	6.16	4.69	25.79	0.45	1995
15.28	6.45	5.02	27.64	0.42	1996
15.59	6.25	5.24	28.56	0.40	1997
16.07	6.72	5.59	29.45	0.42	1998
Red Meats					
9.23	3.28	4.11	16.83	0.36	1982
10.00	3.53	3.98	17.91	0.35	1983
10.57	3.93	3.99	19.18	0.37	1984

10.84	4.16	4.26	17.60	0.38	1985
11.51	4.16	4.70	19.19	0.36	1986
11.60	4.17	4.34	18.54	0.36	1987
10.57	4.24	3.40	18.28	0.40	1988
10.79	4.25	3.93	19.65	0.39	1989
11.32	4.15	4.51	19.47	0.37	1990
12.13	4.70	4.41	22.27	0.39	1991
11.81	4.70	4.00	21.28	0.40	1992
11.50	4.85	4.05	21.00	0.42	1993
10.86	4.89	4.24	20.76	0.45	1994
11.21	4.86	4.20	21.39	0.43	1995
12.67	5.23	4.60	22.99	0.41	1996
12.48	5.04	4.75	21.77	0.40	1997
11.66	5.52	4.05	22.90	0.47	1998

Poultry Meat

0.70	0.67	0.05	2.65	0.96	1982
0.75	0.74	0.04	3.01	0.98	1983
0.86	0.84	0.06	3.60	0.98	1984
0.94	0.87	0.06	3.41	0.93	1985
1.10	1.07	0.06	4.05	0.97	1986
1.12	1.10	0.06	4.55	0.98	1987
1.28	1.36	0.08	6.43	1.06	1988
1.27	1.17	0.14	4.83	0.93	1989
1.27	1.26	0.08	5.10	0.99	1990
1.33	1.33	0.08	5.20	1.00	1991
1.49	1.45	0.07	5.58	0.98	1992
1.53	1.53	0.02	6.53	1.00	1993
1.58	1.53	0.15	6.54	0.97	1994
1.79	1.72	0.10	7.38	0.96	1995
1.86	1.75	0.15	7.38	0.94	1996
2.28	2.15	0.14	8.75	0.94	1997
2.26	2.16	0.10	8.66	0.95	1998

Eggs

1.53	0.91	0.41	4.18	0.60	1982
1.74	1.15	0.29	4.54	0.66	1983
2.03	1.37	0.53	6.78	0.68	1984
2.30	1.44	0.54	5.64	0.63	1985
2.43	1.54	0.66	6.31	0.63	1986
2.45	1.45	0.55	6.18	0.59	1987
2.63	1.84	0.52	8.44	0.70	1988
2.80	2.01	0.70	9.22	0.72	1989
2.79	1.97	0.66	8.38	0.71	1990
3.12	2.25	0.67	10.82	0.72	1991
3.15	2.01	0.68	8.35	0.64	1992
2.99	1.62	0.59	6.59	0.54	1993
3.17	1.88	0.38	6.76	0.59	1994
3.41	2.12	0.54	7.57	0.62	1995
3.46	2.37	0.27	9.66	0.68	1996
4.25	2.87	0.42	9.92	0.68	1997
4.30	2.75	0.52	10.33	0.64	1998

Aquatic Products

1.48	1.84	0.00	6.16	1.24	1982
1.64	1.98	0.00	7.96	1.21	1983
1.81	2.19	0.00	8.88	1.21	1984
1.64	2.06	0.00	8.44	1.25	1985
1.99	2.53	0.00	9.09	1.27	1986
2.06	2.60	0.01	9.72	1.26	1987
2.02	2.56	0.00	9.15	1.27	1988
2.19	2.72	0.00	9.13	1.24	1989
2.13	2.66	0.00	10.08	1.25	1990
2.30	2.73	0.00	9.75	1.19	1991
2.37	2.84	0.01	10.16	1.20	1992
2.56	2.81	0.05	9.58	1.10	1993
2.80	2.96	0.04	9.93	1.06	1994
3.19	3.23	0.06	11.69	1.01	1995
3.49	3.37	0.08	11.64	0.96	1996
3.45	3.40	0.06	12.16	0.99	1997
3.47	3.36	0.12	12.40	0.97	1998
Sugar					
1.22	0.94	0.18	4.39	0.77	1982
1.34	1.00	0.32	3.98	0.75	1983
1.34	0.98	0.35	4.18	0.73	1984
1.45	0.95	0.34	3.83	0.66	1985
1.58	1.02	0.46	4.13	0.65	1986
1.68	0.96	0.60	4.17	0.57	1987
1.41	0.90	0.45	3.76	0.64	1988
1.54	0.97	0.45	3.89	0.63	1989
1.50	0.90	0.48	3.96	0.60	1990
1.40	0.82	0.47	3.48	0.59	1991
1.55	0.85	0.57	3.73	0.55	1992
1.38	0.76	0.45	3.37	0.55	1993
1.29	0.71	0.48	2.98	0.55	1994
1.24	0.66	0.46	2.87	0.53	1995
1.33	0.70	0.44	3.10	0.53	1996
1.30	0.66	0.38	2.89	0.51	1997
1.38	0.68	0.46	3.02	0.49	1998
Alcohol					
2.76	1.83	0.40	8.26	0.67	1982
3.31	2.52	0.38	12.72	0.76	1983
3.72	3.03	0.42	15.04	0.82	1984
4.21	3.45	0.65	17.08	0.82	1985
4.82	4.29	0.74	21.32	0.89	1986
5.30	4.47	0.82	22.00	0.84	1987
5.49	4.57	0.79	23.06	0.83	1988
5.49	4.30	0.90	21.97	0.78	1989
5.50	4.14	0.83	20.71	0.75	1990
5.81	4.54	0.81	23.41	0.78	1991
5.98	4.62	0.80	22.83	0.77	1992
4.97	2.98	0.80	13.61	0.60	1993
5.42	3.31	0.75	14.84	0.61	1994
6.18	4.09	0.78	16.51	0.66	1995
6.66	4.06	0.91	16.49	0.61	1996

7.76	5.30	1.09	21.80	0.68	1997
7.68	5.30	1.11	22.40	0.69	1998
		Income			
282.99	74.94	174.16	530.07	0.26	1982
330.31	87.71	213.06	562.97	0.27	1983
383.54	122.65	221.05	785.06	0.32	1984
414.85	129.94	255.22	805.92	0.31	1985
452.69	152.76	269.40	936.57	0.34	1986
499.36	181.09	296.14	1059.20	0.36	1987
592.63	224.15	339.88	1301.00	0.38	1988
647.28	253.95	365.89	1379.90	0.39	1989
751.59	308.71	430.98	1907.30	0.41	1990
778.02	341.13	446.05	2003.40	0.44	1991
861.77	386.67	489.47	2225.90	0.45	1992
1011.50	489.51	555.83	2727.00	0.48	1993
1323.30	617.22	723.73	3436.60	0.47	1994
1699.20	795.10	880.34	4245.60	0.47	1995
2060.40	889.48	1100.60	4846.10	0.43	1996
2247.50	940.74	1185.10	5277.00	0.42	1997
2364.40	958.30	1334.50	5406.90	0.41	1998
