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ABSTRACT

This research investigates the role non-macroeconomic factors have played in subduing inflationary pressures in Japan. We investigate the hypothesis that the under-recognized presence of goods with high foreign produced content (FPC) in the consumer market basket has coincided with reduced price-level increases over the time period 1991-2004. An empirical examination and descriptive comparison of CPI market basket items and import data categories suggest the negative relationship between FPC and the CPI inflation rate over this time period is significant. Our conclusions suggest the extent to which measures of inflation are considered to be an accurate gauge of macroeconomic conditions or monetary policy effectiveness is overstated.

INTRODUCTION

Questions surrounding the determinants of global disinflation have received much attention in academic and policy debates regarding possible explanations for and causes of the recent global recession. Some economists and pundits have argued the on-going troubles in the global economy are ultimately the result of the collective non-reaction of central banks to seemingly non-threatening low levels of inflation. Overly loose monetary policy and low interest rates, their reasoning suggests, created asset bubbles (since popped) in housing, equity prices and other financial investments.[1]

On the other hand, some researchers and policy makers have attributed the so-called Great Moderation, or the 'taming of the business cycle' (i.e., low inflation and steady positive GDP growth), directly to the decisions of central bankers.[2] Others have attributed moderating levels of inflation to improved inventory management, more flexible employment contracts or other changes in business practices,[3] and still others have suggested some form of 'globalization' may be the cause.[4] In any case, there appears to be no apparent consensus concerning the role exogenous, non-macroeconomic factors might play in explaining global disinflation.[5]

An investigation into the determinants of price disinflation in Japan may shed some light on this controversy. Low interest rates in Japan in the mid-1980's helped fuel an asset bubble that burst in 1989, and despite various attempt to stimulate, the economy remained mired in a long period of slow-growth recession (Krugman, 1998; Katz, 2003; Ito & Mishkin, 2004). One notable feature of Japan's lengthy economic downturn has been the decline in consumer prices. A previous paper (Blakley, Takahashi, Hijazi, 2008) laid the theoretical framework for questioning the belief that deflation in Japan is merely a symptom of decreased aggregate demand. If some portion of the disinflationary trends in Japan can be explained by 'natural' causes—i.e., not related to macroeconomic conditions – it can be argued the Bank of Japan should not have kept interest rates so low and for so long. To the extent inflation targeting is used by policy makers, it may be necessary to factor in some degree of natural deflationary pressure, or risk creating asset bubbles.

Blakley et al (2008) develops a line of reasoning and a conceptual argument which suggests price increases during this time period were kept in check in part because of an increase in the foreign produced content (FPC) of the Japanese consumer market basket. FPC is a concept intended to measure the extent to which any direct or indirect foreign inputs are associated with a good in the consumer market basket. FPC, it is alleged, increased due to decisions

made by Japanese managers in response to changes in their competitive and operational environment. These changes include advances in information technology, the emergence of China as a trading partner, trade liberalization and changes in the domestic regulation of retail markets. The authors' conclude the collective influence of these non-macroeconomic factors has likely been lower prices for consumers due to the (heretofore unacknowledged) increase in the FPC of the Japanese consumer market basket.

The primary objective of the research presented below is to provide some empirical evidence in support of this argument. The alleged increase in FPC in the consumer market basket has occurred both directly, through imports of finished goods, and indirectly, through the increased use of subcomponents and intermediated goods/parts that have been produced or assembled offshore. This research project, however, focuses exclusively on the former potential source of FPC increases (i.e., imports of final goods) in explaining price disinflation.[6]

By analyzing changes in the Japanese market basket and corresponding import data for the years 1991-2004, we empirically demonstrate prices of CPI market basket items that have likely experienced growth in imports have increased less (decreased more) than prices of those items with an absence of import activity.

EXPERIMENTAL DESIGN

To test the hypothesis that FPC plays a role in moderating price increases, we analyze descriptive information on items within the official CPI market basket from the Japanese Bureau of Statistics over the time period 1991-2004. This annual CPI information includes prices and weights of each market basket item used in the CPI inflation rate calculations, as well as descriptions of the items themselves.[7]

Likewise, annual information from The Ministry of Trade is used to ascertain details of Japanese import items[8]. However, unlike the U.S. data, where CPI market basket and import data have consistent and comparable SIC product codes, the Japanese government data does not use comparable product identification codes for CPI market basket and import data.[9] Consequently, in order to investigate possible correlations between the CPI price movements and import activity, it is necessary to conduct a thorough item-by-item assessment of both CPI and import databases. Independently, descriptions of CPI items are scrutinized for a possible item match in the import database and vice versa.[10]

For our analysis, we define three categories of products within the core CPI market basket. In Category A, we place CPI market basket items with an obvious and unequivocal match to items in the import database. In Category C we place CPI items that clearly have no FPC. In Category B we placed items that have no clear domestic or import provenance, or CPI items with likely import content but that could not be matched directly to the import database. To summarize, the core CPI market basket (void of energy and housing) is segmented into 3 categories:

A—CPI market basket items that can be identically matched with corresponding items in the import database.

B—CPI market basket items that have questionable degrees of FPC but have no definitive corresponding match, (e.g. tires).

C—CPI items that clearly have no match and are therefore assumed to have no FPC, (e.g. domestic rice, educational fees).

To validate our hypothesis it is necessary to demonstrate the aggregate weight adjusted average price increase of items in Category A is statistically lower than that of Category C, or equivalently, prices of CPI market basket items that have potential for FPC (imports) have increased less (or decreased more) than the prices of those items with an absence of possible import activity. Or, more formally

H_0: $^{A}\mu = {}^{C}\mu$

H_1: $^{A}\mu < {}^{C}\mu$

Using the segmented core market baskets A and C, it is possible to calculate the annual price increase of each item within each market basket for each year, as well as the weighted average price increase in each market basket each year (between 1991 and 2004). Letting $^{\alpha}\pi_i^t$ represent the price of item *i* (1-*n*) in the α market basket (A, B or C) at time *t* (1-14) and $^{\alpha}\omega_i^t$ the normalized weight of item *i* in the α market basket at time *t* (1 to 14), where $\sum_{i=1}^{n} {}^{\alpha}\omega_i^t = 1$, we can write the normalized weighted price of item *i* in the α market basket at time *t* as $^{\alpha}X_i^t = {}^{\alpha}\pi_i^t . \omega_i^t$, and the rate of change in the price of item *i* in α market basket at time *t* (1 to 13), as

$$ {}^{\alpha}\rho_i^t = \frac{{}^{\alpha}X_i^{t+1} - {}^{\alpha}X_i^t}{{}^{\alpha}X_i^t} $$

Given this, we can define the average rate of change in the entire α market basket at time *t* (1 to 13), as[11]

$$ {}^{\alpha}\mu^t = \frac{\sum_{i=1}^{n} {}^{\alpha}X_i^{t+1} - \sum_{i=1}^{n} {}^{\alpha}X_i^t}{\sum_{i=1}^{n} {}^{\alpha}X_i^t} $$

The fundamental contention tested below is that the aggregate weight-adjusted average price increase of items in market basket A in a given year is statistically lower than market basket C. This conclusion is expected, a priori, because of the potential presence of increased FPC in Category A but not Category C. Further, we can support our hypothesis by taking the entire 1991-2004 time period under consideration and showing with statistical significance category A item prices have decreased more or increased less than category C items.

EMPIRICAL RESULTS

Sign Test: Comparing Cumulative (1991-2004) Differences Between A and C

A one-tailed, two group Sign Test was selected to examine if the differences between price change in the CPI *across the collective 13-period time series* of Category A and C were statistically significant or merely due to random error. The use of this nonparametric test relaxes the requirement of normally distributed populations for small sample testing (n=13) and views the two categories as paired because they are "matched" across common time slices.[12]

The logic of the Sign Test assumes that if there were no real difference between CPI price, then one category would be larger or smaller than the other for half of the 13 time periods or 6.5 periods. However, our results display that Category A has a CPI price difference larger than category C in only 2 out of the 13 periods examined between 1991 and 2004 (Figure 1). The chance of achieving this outcome yields a statistically significant result with a p-value of 0.011 and compelling evidence that the difference in CPI values of Basket C are reliably larger than Basket A.[13]

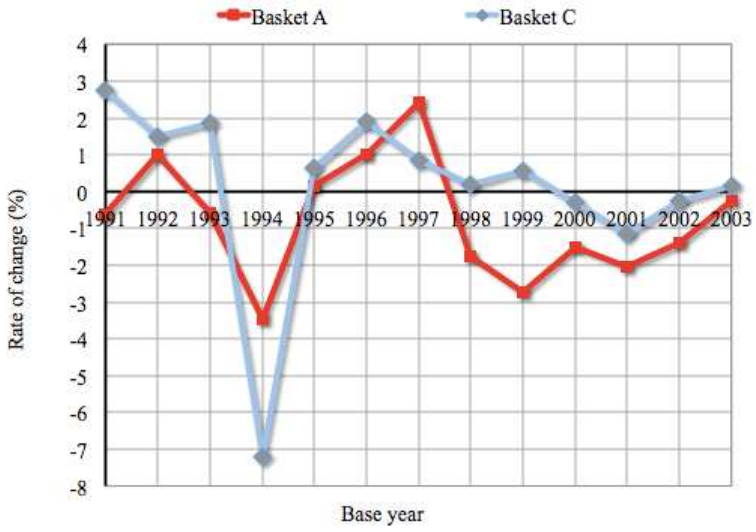

Figure 1: Weighted rate of price change of segmented categories A and C across thirteen time periods.

Two-Group, Unmatched Z-Test: Comparing Year-By-Year Differences Between A and C

A one-tailed, two group, unmatched, large sample Z-test is used to study possible differences between the mean CPI price change of basket A and C *for each* of the 13 time periods of the study.[14] The results discovered statistically significant findings for 7 of the 13 periods (*p*-value < .05) and are shown as bolded values in Table 1.

DISCUSSION AND CAVEATS

The results in Table 1 demonstrate a robust difference between the aggregate weight-adjusted price increase in market basket A (product items subject to potential increases in FPC) and market basket C (product items not subject to FPC increases). In 11 of the 13 years under consideration, price increases in market basket C exceed market basket A, as hypothesized. Of those 11 years, 6 provide statistically significant p-values less than 0.05. Of the 2 years that show a price increase in market basket A exceeding that of C (1994-95 and 1997-98), only 1997-98 had statistical significance. Further, comparing the rates of price change over the entire period 1991-2004, there is a statistically significant difference that shows price increases in category C items exceeding category A with a p-value equal to 0.011.

The overall statistical results, subject to the caveats discussed below, generously support the contention that the potential increased presence of FPC in the Japanese market basket is coincident with price increases (decreases) being lower (greater) than what otherwise would have been the case.

It should be noted other conventional macroeconomic factors have influenced the degree of Japanese price disinflation during the time period 1991-2004. A non-exhaustive list of these factors include fluctuating foreign exchange values of the Yen, changes in the VAT rate, expansionary and contractionary monetary and fiscal policies and, of course, decreases/increases in GDP growth and unemployment rates. Undoubtedly, during this time period, these influences have impacted (pro and con) the strength of the purported statistical relationship shown above, dependent on the specific year under consideration.[15] The primary objective of this research is to nominate FPC growth as a likely determinant of changes in the CPI inflation rate in Japan, albeit one of many, and to statistically demonstrate increases in the growth of FPC coincides with suppressed rates of inflation.

Table 1: Testing for differences between changes in the CPI for categories A and C for each time period, 1991-2004.

	Basket A			Basket C			
Year	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**	**N**	**p-value***
1991-1992	-0.62%	9.04%	174	2.75%	4.37%	170	**0.000005***
1992-1993	1.00%	9.66%	174	1.51%	6.54%	170	0.2810
1993-1994	-0.59%	7.86%	174	1.87%	5.04%	170	**0.00027***
1994-1995	-3.48%	24.68%	174	-7.20%	33.03%	170	0.1190
1995-1996	0.16%	6.46%	174	0.64%	2.76%	170	0.1840
1996-1997	1.01%	5.94%	174	1.88%	1.94%	170	**0.034***
1997-1998	2.43%	9.17%	174	0.86%	2.44%	170	**0.0143***
1998-1999	-1.75%	6.76%	174	0.18%	1.87%	170	**0.0014***
1999-2000	-2.75%	50.74%	174	0.58%	82.15%	170	0.3260
2000-2001	-1.50%	6.41%	174	-0.31%	1.85%	170	**0.0096***
2001-2002	-2.04%	6.19%	174	-1.17%	7.94%	170	0.1290
2002-2003	-1.41%	7.16%	174	-0.26%	2.04%	170	**0.0212***
2003-2004	-0.26%	7.05%	174	0.14%	2.28%	170	0.2390

Note: Ę(Basket A-Basket C) for 2-group unmatched Z-test;
*=statistically significant results

EXTENSIONS AND CONCLUSION

This research has not attempted to measure the numerical extent to which CPI prices have been decreased by the presence of FPC in the market basket, but only that the relationship between increased levels of FPC and lower CPI prices is statistically significant. In order to approximate the numerical influence of FPC on inflation, it would be necessary to track for a given time period the relationship between price changes and the magnitude of FPC growth. Regression analysis, for example, may allow for an estimation of how prices would have changed in the absence of FPC growth, and the difference between this rate and the actual rate would allow an approximation of the numerical amount of exogenously induced deflation.

Also, it remains to be shown to what extent the observed increase in FPC in the Japanese market basket can be empirically linked to China's emergence, trade liberalization, deregulation of domestic retail markets and/or advances in information technology. Lastly, further diagnosis of import data would likely reveal more FPC penetration of the CPI market basket through intermediate goods and, presumably, result in a larger degree of price suppression. These extensions will be the subject of future research.

The investigation into the determinants of price disinflation in Japan presented in this research supports the contention that non-macroeconomic factors play a significant role in the suppression of the CPI inflation rate. To the extent this exogenous pressure impacts price level movements, it is important that Central Bankers be cognizant of this effect in the conduct of monetary policy. For example, the target rate of inflation below which expansionary policy would normally be implemented has, in effect, been lowered, and failure to factor this into policy making decisions risks creating potentially destructive asset bubbles. In other words, policy makers should, our results suggest, consider lowering inflation targets and keep interest rates higher than previously considered appropriate at any given point in the business cycle.

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NOTES

[*] Datasets, compilations and calculations are available upon request. Please contact takahaship@usfca.edu

[1] See, for e.g., Filardo (2004) for a thorough discussion of various definitions/types of asset bubbles, the frequency of asset bubbles and the role of monetary policy.

[2] Romer, Christina, Chair of Council of Economic Advisors, in a speech at LBJ Library in Austin Texas, September 2007: "… better policy, particularly on the part of the Federal Reserve, is directly responsible for the low inflation and the virtual disappearance of the business cycle in the past 25 years."

[3] Davis, Steven J. and Kahn, James A. (2008) identify more flexible labor contracts and improved inventory management as possible explanations for the Great Moderation.

[4] McConnell, Margret and Gabriel Perez-Quiros (2000) suggested the Great Moderation emerged from new business practices that occurred for competitive reasons, not macroeconomic policy goals.

[5] See Kumar, Manmohan S. (2003) for technical discussion of the various supply-side and demand-driven shocks that can result in deflation.

[6] The primary unit of analysis in this research is the CPI market basket which, by definition, is a final product.

[7] The CPI data breaks up the consumer market basket into 10 general groupings. Information on each item includes a description and the price/weighting factors over time. The assigned item weighting factors used in the official aggregate CPI are updated periodically to match changing consumption patterns. Ministry of Internal Affairs and Communications. *Bureau of Statistics*

[8] The import data is broken into over 200 broad groupings with item descriptions and quantity of imports (numerical count, weight or volume) over time. Ministry of Finance. Trade Statistics of Japan.

[9] The complexities of reconciling coding systems for Japanese CPI and import data provides a likely explanation for the paucity of research in this area.

[10] The authors wish to acknowledge the efforts of Rie Shigeta in helping to corroborate the matching of CPI items to comparable import items as well as her overall efforts in this extensive research endeavor. Because of her native language proficiency and that of the authors, we have significant confidence in our market basket categorizations.

[11] Note, by definition, $^{\alpha}\mu_7^t$ is also equal to $(\sum_{i=1}^{n} {}^{\alpha}p_i^t)/n$.

[12] See Newold, Carlson & Thorne, pp. 587-594.

[13] Cumulative binomial probability tables are used in conjunction with the Sign Test to establish the level of statistical significance delivered.

[14] See McClave, Benson & Sincich, p. 407.

[15] For example, a likely reason for the large increase in import prices in1997-98 (the only year category A price increases were statistically higher than C) was the Asian financial crisis that began in the summer of 1997. In response to Japan's economic slowdown, the value of Japan's yen had been gradually depreciating throughout the mid-1990's; however the Asian currency crisis quickly spread to Japan in 1998 resulting in the yen's lowest value since the late 1980s. As a result of this significant drop in the yen's value, foreign exports into Japan increased in price. (World Trade Organization, 1998)