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Invoice currencies, import prices, and inflation

Masanori Ono*

Abstract

This paper uses the structural VAR approach to examine the interactive responses between import prices and domestic prices in Japan before and after the 1990s. First, the estimation reveals that the Japanese domestic prices have become a little more vulnerable to foreign inflationary pressure through a rise in contract import prices. Second, Japan after the 1990s can pass along its domestic inflationary pressure to foreign countries with an increase in the pricing of its domestic products. Third, the results confirm that Japan's exchange rate pass-through effect on its domestic prices has decreased, as suggested by other literature.

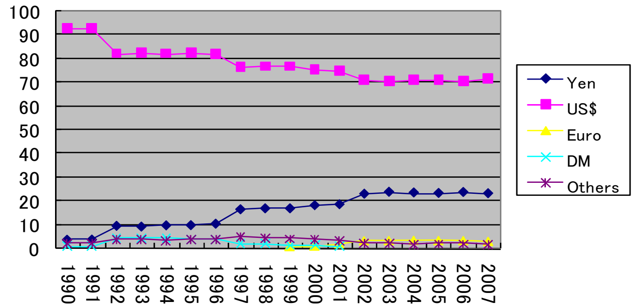
Keywords: Structural VAR; globalization; Japanese economy

JEL classification: E31; F41

1. Introduction

Since the 1990s, global competition in the manufacturing industries has intensified—to the point that some argue that an increase in China and India's low-priced exports is a *deflationary* factor in industrialized countries.[1] On the other hand, it is also important to focus on *inflationary* pressure from various factors, including the surging prices of imported agricultural and petroleum products.[2] In addition, Japan's economy experienced a structural change in the 1990s. Regarding the effectiveness of monetary policy on the macroeconomy, Miyao (2006) identifies this structural change as occurring around the middle of the 1990s. Moreover, Otani et al. (2003) report evidence that Japan's yen-denominated import prices became less responsive to foreign exchange rates' fluctuations in the 1990s than they had been in the 1980s. In fact, invoice currency percentages in Japan's imports have changed over the years. Figure 1 illustrates the changes from 1990 through 2007. The U.S. dollar percentage of contract currencies decreased from 90 percent to 70 percent, whereas that of the Japanese yen increased from below 5 percent to over 20 percent.[3]

Figure 1. Percentages of Contract Currencies in the IPI
(Source: Bank of Japan)



Ball (2006) argues that inflation is the aggregate change in nominal prices, whereas prices affected by trade are relative prices. He then emphasizes that there is no "natural and "obvious" connection between inflation and relative prices. Hence, this paper uses the VAR (Vector Autoregression) approach to estimate the aggregate changes in nominal prices.

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[1] See *The Economist* (2005) for a discussion. In Japan, for example, the share of imports from Asia in total imports was 28.8 percent in 1990 and 44.4 percent in 2005. See the website of the Ministry of Economy, Trade and Industry (www.meti.go.jp).

[2] See Tonouchi (2008) for a discussion of worldwide inflationary fears.

[3] Data before 1990 has not been made available by the Bank of Japan.

2. Data

This paper focuses on two time periods. The first is the decade leading up to December 1990, two months after which the bubble economy ended.[4] The second time period is that from January 2000 to March 2008; two years before this period, the Japanese economy was caught in the credit crunch typified by failures of financial institutions such as Yamaichi Securities or the Hokkaido Takushoku Bank.

Here, I apply the VAR model to three variables: the import price index on a contract (that is, invoiced) currency basis (IPC_t), the import price index on a yen denominated basis (IPY_t), and the price index for domestic (that is, domestically produced) consumer goods (CPD_t). The bank of Japan (www.boj.or.jp) compiles these variables as some of Corporate Goods Prices Indexes. It should be noted that the bank has already removed consumption tax rates from CPD_t, which is one of indexes classified by Stage of Demand and Use. The Statistics Bureau's consumer price index (CPI) includes prices of services and imported products. I choose CPD_t rather than CPI in order to examine how import prices influence the price of *domestic* products for consumers. One channel is a cost-push effect, in which an increase in the price of imported materials forces domestic producers to raise their selling prices. The other channel is a competitive effect in which the recent globalized competition puts pressure on domestic manufacturers to lower the prices of their products. If imported products are increasingly substitutable for domestically produced products, the link between import prices and domestic product prices will be reinforced.

In addition, the VAR model includes the exchange rate pass-though effect into yen-denominated prices. One is to go directly into IPY_t and the other one is to go indirectly into CPD_t. For the U.S. and other OECD countries, Blanchard and Gali (2007) employ the VAR approach to compare between the 1970s and 2000s in the macroeconomic effects of oil shocks. However, their model does not take into account exchange rate pass through into domestic prices. In fact, their estimation does not well capture Japan's business fluctuations whereas it does fit pretty well the U.S. economy, of which currency is overwhelmingly invoiced in international trade (see pp.19–20 in their paper). This may suggest that exchange rates pass-through effects play a nonnegligible role in determining domestic prices in Japan.

3. The Structural VAR model

To aid in determining whether a variable has an I(0) or I(1) process, Table 1 reports the Augmented Dickey-Fuller (ADF) statistic and the Phillips-Perron (PP) statistic.[5] The logarithms of variables reveal unit roots in many cases, except when the PP test with no trend rejects the null hypothesis of unit root at the

Table 1. Unit Root Tests

	ADF[a]			ADF[a]			PP[c]			PP[d]		
	No trend	lags		Trend	lags		No trend	lags		Trend	lags	
1981m1–1990m12												
ln(IPCt)	−1.7795	3		−1.3807	3		−1.5314	6		−0.7340	5	
ln(IPYt)	−1.0778	1		−1.6381	1		−0.9683	7		−1.4231	7	
ln(CPDt)	−0.8183	3		−1.6896	3		−0.6625	6		−1.8226	6	
Δln(IPCt)	−4.3060	2	***	−4.4508	2	***	−4.8226	4	***	−4.8692	4	***
Δ ln(IPYt)	−5.3486	0	***	−5.3347	0	***	−5.2516	3	***	−5.2380	3	***
Δ ln(CPDt)	−4.6766	2	***	−4.6452	2	***	−11.3718	6	***	−11.3758	6	***
2000m1–2008m3												
ln(IPCt)	2.1219	1		−0.5327	1		2.3604	4		−0.4241	4	
ln(IPYt)	0.5198	0		−1.1650	0		0.6619	10		−1.0520	9	
ln(CPDt)	−2.4108	1		0.6470	1		−2.6222	1	*	0.9661	1	
Δln(IPCt)	−3.6217	2	***	−7.3654	0	***	−6.4914	3	***	−7.3287	1	***
Δ ln(IPYt)	−9.7614	0	***	−7.1043	2	***	−9.7726	8	***	−9.9055	12	***
Δ ln(CPDt)	−6.7462	0	***	−7.5210	0	***	−6.8139	3	***	−7.5319	1	***

[a] All the lag lengths are chosen with AIC.
[b] All the lag lengths are chosen with the Newely-West method using the Bretlett kernel.
*** Statistically significant at the 1% level.
** Statistically significant at the 5% level.
* Statistically significant at the 10% level.

[4] The Working Group of Indexes of Business Conditions in Japan has determined that the peak in the business cycle occurred in February 1991. See their website (www.esri.cao.go.jp) for details.

[5] I employed the U.S. Census Bureau's X-12 methods to remove seasonal fluctuations from the logarithms of variables.

10% level for $\ln CPD_t$ during the period from 2000m1 to 2008m3. On the other hand, the first-differenced logarithms have a stationary process in all cases. Hence, I conclude that these three variables have an I(1) process. For the VAR model, I use $\Delta\ln IPC_t$, $\Delta\ln IPY_t$, and $\Delta\ln CPD_t$ to form a vector of three variables; namely, $x_t = (\Delta\ln IPC_t, \Delta\ln IPY_t, \Delta\ln CPD_t)'$. To capture contemporaneous relations between shocks, I use the structural VAR model. I impose restrictions on the relationships between the reduced-form VAR residuals (e_t) and the structural disturbances (u_t) as follows:

$$\begin{pmatrix} 1 & 0 & -a_{13} \\ -a_{21} & 1 & 0 \\ 0 & -a_{32} & 1 \end{pmatrix} \begin{pmatrix} e_t^{IPC} \\ e_t^{IPY} \\ e_t^{CPD} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 \\ 0 & b_{22} & 0 \\ 0 & 0 & b_{33} \end{pmatrix} \begin{pmatrix} u_t^{IPC} \\ u_t^{IPY} \\ u_t^{CPD} \end{pmatrix}. \quad (1)$$

The matrix A has three one-restrictions and three zero-restrictions. The matrix B has six zero-restrictions. Then, the structural model is just identified, due to k(3k-1)/2 restrictions in total where k denotes the number of endogenous variables. The purpose of this paper is to focus on the interaction between price changes, not on identifying supply and demand shocks. Therefore, the diagonal element (b_{11}, b_{22}, or b_{33},) indicate its own shock to itself, which originates from either a demand or a supply shock in its market.

Residual e^{IPC}_t includes a shock from domestic prices (e^{CPD}_t). The value of $-a_{13}$ indicates the extent to which contract import prices react to import demand, driven by a change in domestic prices. Residual e^{IPY}_t embodies $a_{21}e^{IPC}_t$ in it, because the yen-based import price index comprises contract-currency based prices and the exchange rates of the yen against the invoiced foreign currencies. In this regard, $b_{22}u^{IPY}_t$ captures something like the yen's effective exchange rates weighted by invoicing currencies' shares in *imports*, which are not usually available from statistics bureaus.[6] Finally, e^{CPD}_t includes $a_{32}e^{IPY}_t$, which represents the effect of IPY_t on CPD_t.

4. The Results

First, I estimate the VAR model using a vector of the three variables. I used the Akaike Information Criteria (AIC) to determine the lag length. According to this measure, the model for the first period has two lags and that for the second period has one lag. Second, I use the maximum likelihood methods to estimate the orthogonal factorization matrices A and B in (1) for impulse response analysis.

Figures 2 and 3 illustrate the accumulated impulse responses to one-standard-deviation structural shocks, for the first time period and for the second time period, respectively. First, let me introduce how to interpret these figures. Here, recall equation (1). For both figures, a response of IPC_t to u^{CPD}_t represents a reaction to a demand shock driven by a change in the price of domestically produced consumer products. Accordingly, a response of IPY_t to u^{CPD}_t indicates the above reaction that emerges into the yen based import prices. Similarly, IPY_t's response to u^{IPC}_t represents IPC_t's response to u^{IPC}_t that appears as a reaction of the yen based import prices. IPC_t's response to u^{IPC}_t is its own shock to itself, which originates from either a demand or a supply shock in international trade markets. Because IPY_t comprises of IPC_t and the yen's exchange rate, IPY_t's response to u^{IPY}_t is a change in the exchange rate of the yen against the contract currencies. Hence, IPC_t's response to u^{IPY}_t captures an adjustment in contract prices for changes in the yen's exchange rates. On the other hand, CPD_t's response to u^{IPY}_t reveals an

[6] For example, the Bank of Japan calculates the effective exchange rates based on export destinations. International Monetary Funds and the Bank of Settlements report them on exports and imports combined.

indirect pass through from exchange rates into CPD_t because a change in exchange rates from yen-based import prices has an effect on domestic consumer prices *excluding* imported products. CPD_t's response to u^{IPC}_t captures the effect of foreign prices on domestic prices. Finally, CPD_t's response to u^{CPD}_t represents its own shock to itself, which originates from either a demand or a supply shock in markets for domestically produced consumer products.

Figure 2. Response to Structural One S.D. Innovations ± 2 S.E. (first time-period: 1981m1-1990m12)

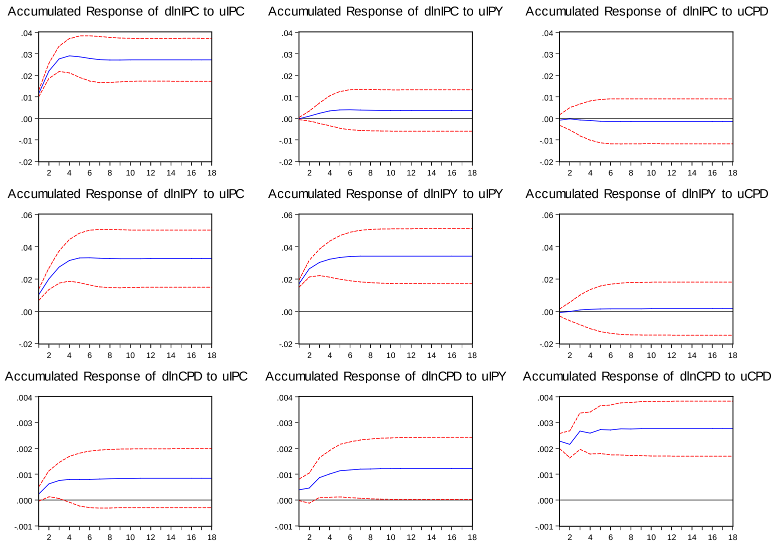
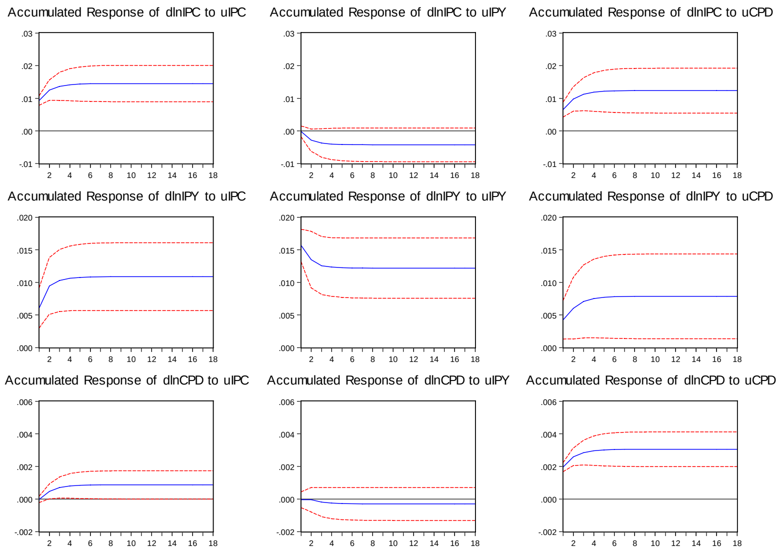


Figure 3. Response to Structural One S.D. Innovations ± 2 S.E. (second time-period: 2000m1-2008m3)



The responding magnitudes in the two periods differ greatly. First, the accumulated levels responding to u^{IPY}_t in the two periods are qualitatively different from each other. CPD_t's accumulated level for the first time period is positive and twice the standard errors, whereas that for the second time period is virtually zero. The difference is caused by the opposite directions in which IPC_t's respond to u^{IPY}_t. IPC_t's accumulated changing rate during the eighteen months was + 0.364 percent in the first time period model, whereas it was –0.427 percent for the second time period model. The second time period's negative reaction to u^{IPY}_t indicates foreign exporters' pricing-to-market (PTM) behavior toward Japanese imports.[7] When the yen devaluates against invoicing foreign currencies, the exporters lower the invoiced contract prices (IPC_t) to lessen an increase in yen-denominated import prices (IPY_t). Otherwise, IPY_t would increase at the same rate as that of the yen's devaluation.

Compared to the first time period, the PTM behavior seems to have grown more common with more imports of differentiated products. In fact, a ratio of machinery imports to the total

[7] See Krugman (1987) for an early discussion of PTM behavior.

imports was 17.4 percent in 1990 and 29.5 percent in 2005.[8] Eventually, IPY_t's contemporaneous response to u^{IPY}_t for the second period overshoots, and then the accumulated change settles at a level lower than the first response but higher than the initial level. CPD_t's accumulated levels responding to u^{IPY}_t are also smaller for the second time period than for the first time period. The insensitive reaction of CPD_t to u^{IPY}_t demonstrates that the *indirect* pass-through into domestic prices has been reduced.[9]

As stated earlier, CPD_t's response to u^{IPC}_t represents the combined effects of cost-push reactions and competitive pressure. The accumulated level, after eighteen months, responding to u^{IPC}_t for the second time period (+0.087 percent) is a little larger than that for the first time period (+0.084 percent). This evidence does not strongly support a hypothesis that the impact of contract-currency based import prices on domestically produced products has magnified recently.[10]

Finally, IPC_t's response to u^{CPD}_t for the second time period becomes positive and larger than twice the standard errors whereas that for the first time period appears at zero. Thus, the second period's model has a more inflationary structure, in which contract import prices undergo a demand shock from domestic prices. Thus, the inflationary pressure from domestic factors to import prices should receive more attention in the discussion of globalized competitions in the manufacturing industry.

5. Concluding Remarks

The behavior of pricing-to-market has recently emerged strongly enough to stabilize domestic price fluctuations caused by devaluation or appreciation in the yen. Second, globalization has not greatly made Japan's manufacturing prices more vulnerable to foreign inflationary pressure through a rise in contract import prices. On the other hand, Japan has passed along its domestic inflationary pressure to foreign countries with an increase in the pricing of its domestic products. For future research, it is worth to expand the VAR model by including other price indexes or real business indicators. However, we should also be more careful of making restrictions that identify structural shocks in a larger VAR model.

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[8] See the website of the Ministry of Economy, Trade and Industry (www.meti.go.jp).

[9] This evidence supports a view that Japan's pass-through rates have decreased. See Otani et al. (2003).

[10] For the U.S. economy, Ball (2006) rejects the hypothesis that globalization has brought about substantial negative shocks in the inflationary process.