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Price Pass-Through, Household Expenditure, and Industrial Structure
The Case of Taiwan

Biing-Shen Kuo and Su-Ling Peng

7.1 Introduction

The pass-through caused by global commodity prices has substantial impacts on the Taiwan economy and has resulted in shifts in household expenditure patterns and the industrial structure. Globalization links the world through a network of increasingly close relationships, and causes each economy to be intertwined with the world market. The pass-through caused by global commodity prices is also evidence of this situation. Taiwan is a unique small open economy that is lacking in natural resources.[1] Since Taiwan behaves as a price-taker in international markets, the price pass-through effect caused by changes in global commodity prices has a substantial impact on the domestic economy.

Price pass-through can convulse an economy. Not only may it give rise to incentives to innovation and investment in technology as well as reflect market efficiency, but it may also inevitably worsen the income distribution, and fuel speculation.

The degrees of price pass-through in food and energy appear to differ in the levels of economic development.[2] Taiwan's economy has taken off since

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See online appendix for this chapter at: http://www.nber.org/data-appendix/ito_09-1/EASE20ch7appendix.pdf.

1. Taiwan has to import about 99.9 percent of its crude oil. The value of imports of crude oil far exceeded Taiwan's trade surplus (25.2 billion in U.S. dollars) in 2007.

2. According to the IMF (2008), the estimated coefficients for twenty-five advanced economies and twenty-one emerging economies show that food-related price pass-through in advanced economies was found to be higher than in developing economies, whereas energy-related price

Table 7.1 The economic performance of Taiwan during the price fluctuations

Period (average)	Per capita GNP (US$)	Household expenditure on food-related items (%)	Household expenditure on energy-related items (%)	2nd ind. GDP/GDP (%)	Oil price (WTI)[a]
1972–1974	722	49.2	19.9	40.9	19.6
1979–1981	2,360	40.9	23.1	43.2	109.0
1989–1991	8,451	28.9	30.4	38.7	72.3
1999–2001	13,935	24.1	29.7	28.9	82.9
2004–2007	16,275	24.0	29.2	27.4	194.8
2008	17,524	24.0	28.0	25.0	328.5

Source: Own calculations based on DGBAS and AREMOS data sets.

Note: The GDP in Taiwan has increased fourfold since 1972 and the industrial structure has been upgraded.

[a]Oil price is denoted by the Texas Spot price index, which is obtained from the IFS.

the 1970s. Taiwan's per capita gross national product (GNP) was about $393 in 1970, and reached $17,524 in 2008 while her household expenditure patterns and industrial structure have been radically transformed, as shown in table 7.1. Household expenditure patterns have been changing in Taiwan with the proportion of expenditure on food dropping from 50 percent in 1970 to about 24 percent in 2008. The expenditures on food-related goods and energy-related items[3] are accorded a weight of 52 percent over the disposable income of the lowest 20 percent of households.[4] The higher the price pass-through effect, the more adverse is its effect on low-income households.[5]

The ratio of the secondary industry gross domestic product (GDP) to total GDP was around 36 percent in 1970, and reached 46 percent in 1980. Yet, the ratio of the secondary industry GDP to total GDP gradually fell to about 25.0 percent in 2008, being caused by Taiwan's expansion plans in the service sector in the past twenty years as well as low production costs in China, which has attracted many of Taiwan's manufacturing businesses. It needs to be asked if pass-through effects will result in distinct impacts as an economy is transformed and its household expenditure patterns and industrial structure are transformed as in Taiwan?

pass-through was found to be lower in developing economies. The sample was obtained from the IMF (2008).

3. The food-related goods include food, beverages, and tobacco. The energy-related goods and services comprise rent, water, electricity, gas, and other fuels.

4. The expenditures on food, rent, water, electricity, gas, and other fuels account for less than 40 percent of disposable income for the highest 20 percent of households, according to the "Survey on Household Income and Expenditure in Taiwan," published in 2007.

5. According to the Organization for Economic Cooperation and Development (OECD) and the Food and Agriculture Organization (FAO 2008), the weights of the food-related prices relative to the consumer price index are around 39.3 percent in developing economies and 16.2 percent in the developed economies, respectively.

As for the factors that might affect the extent of price pass-through, some studies have focused on institutional factors such as Imbs (2006) and Balakrishnan et al. (2009), who placed emphasis on financial integration, while some have focused on the relationship between monetary policy and exchange rate orientation with pass-through, such as Engel (2009), Ito and Sato (2008), the International Monetary Fund (IMF 2008), Monacelli (2005), and so on. According to the IMF (2008), more than 80 percent of emerging and developing economies around the world still maintain heavily-managed exchange rate regimes in order to anchor inflationary expectations more easily, but this also restricts the ability of monetary policy to respond.[6]

Taiwan is an export-oriented economy. The central bank of Taiwan has also carefully managed the exchange rate regime and thereby facilitated merchandise exports even though Taiwan has adopted a managed independently floating exchange rate policy since the mid-1980s. The influence of the monetary side on price pass-through has been restricted. Besides, the household expenditure patterns and transformation of the industrial structure have been more important than inflation to Taiwan's economy since the 1990s, owing to Taiwan's businesses having moved to China, which has evidently speeded up the transformation of the industrial structure.

Moreover, due to the constraints on data availability, both the United Nations and the IMF have omitted Taiwan's statistics; there are also no empirical results for Taiwan in studies such as De Gregorio, Landerretche, and Neilson (2007); IMF (2008); and Jongwanich and Park (2008). We thus focus on Taiwan as a case study both to make up for this omission and to serve as a source of reference for other economies.

We focus our analysis more on the inner structural and distribution effects in Taiwan. Based on the data availability and the features of the Taiwan economy, we look at this issue by placing emphasis on the relationship between a commodity's price pass-through with distribution effects on the real side and focus on consumers and producers.

As a result, while the price pass-through coefficients for food follow global trends, the coefficients for energy-related prices are higher in terms of domestic prices to core Consumer Price Index (CPI), which may result from the industrial structure factors in energy-related industries and government policies. However, shifts in the energy-related products that help make up the household expenditures are only slight because the supply of energy-related services is inelastic, and they are heavily subsidized. The impacts of commodity price shocks on the industrial structure are also reduced, resulting from the technology innovations in food processes, energy-saving improvements, and a reduction in energy-dependency.

We start with a fundamental analysis of Taiwan's price transmission

6. See the IMF (2008, 105–06).

channel and engage in empirical estimation to calculate the degree of price pass-through. Then we use the results to analyze the characteristics of the Taiwan economy and compare them with global trends. Then by adopting various scenarios we go further down to the demand side and the supply side in order to consider the economic outlook for Taiwan to see how the global commodity price fluctuations impact both consumers and producers.

7.2 The Commodity Price Pass-Through in Taiwan

7.2.1 The Transmission Mechanisms and Empirical Procedures for Price Pass-Through

The fluctuations in global commodity prices have impacts on the business cycles of small economies. As for Taiwan, the annual growth rates of the CPI were higher during the oil crisis in 1973 and the energy crisis in 1979. Nevertheless, the fluctuations in the prices of food-related items that were used in the calculation of the CPI were relatively moderate compared with the fluctuations in the prices of oil-related items that were used in the calculation of the CPI from the 1980s onward. This kind of situation was similar to the global trend.

Figure 7.1 depicts the transmission channels and empirical procedures for the fluctuations in global commodity prices transmitted to Taiwan's domestic prices and their impacts on Taiwan's economy. The fluctuations in the global commodity prices affect the domestic prices by means of the trade sectors and domestically-produced processes, and result in changes in relative prices. They may influence consumers' choices and reflect shifting household expenditure patterns. Thus, the various kinds of goods and services should be adjusted over time and thus the degrees of variation might be diversified. However, the changes in relative prices are not adjusted immediately and completely for there is usually a time lag. The degrees of global price pass-through are related to the industrial structures and consumers' expenditure patterns. Hence, the fluctuations in global commodity prices will result in changes in consumer behaviors, the costs of production, and the impacts on different goods and services.

In order to calculate the pass-through effect from international commodity prices to domestic prices in Taiwan, and evaluate the impact on household expenditure patterns and the industrial structure, we have conducted an empirical study with a focus on Taiwan.

The empirical procedures involve first calculating the degree of price pass-through by means of the vector autoregression (VAR) model, then utilizing AIDS (almost ideal demand system), a consumption conversion matrix, and input-output tables to distribute the impacts of price pass-through effects to consumers and producers. To transmit the price pass-through effects to consumers and producers, we need bridges to access the linkages. The bridges

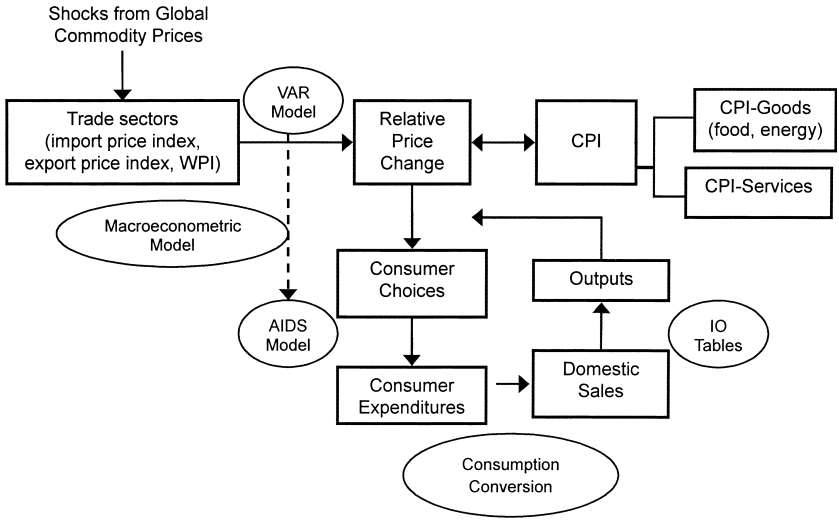


Fig. 7.1 The price transmission and empirical procedures flow chart

Note: The fluctuations in global commodity prices transmitted to Taiwan's domestic prices and their impacts on Taiwan's economy.

must capture the characteristics of the Taiwan economy and depict the interactions and transmissions of the price indexes. A macroeconometric model is an excellent solution.[7] The details of the empirical procedures are referred to in the appendices and the technical details are referred to on the web.

7.2.2 Estimating Commodity Price Pass-Through

There are two steps involved in assessing the potential impacts of the changes in the global commodity price pass-through on the core CPI in Taiwan. The first step is to link the changes in the domestic prices with the changes in global commodity prices. The second step is to link the core CPI inflation with the changes in the fuel and food prices in terms of domestic prices by controlling the changes in the Phillips curve output gap, respectively.[8]

7. Although a macroeconometric model is criticized for the nonstationarity of time-series data and suffers from the problems of spurious regression, a macroeconometric model can capture the characteristics of the Taiwan economy and depict the interactions and transmissions of price indexes. Besides, according to Park and Philips (1988, 1989), the traditional estimated methodology and asymptotic normality *t* test are still available if the residuals are I(0) and even if the model is a mix of I(1) and I(0). Furthermore, Hsiao (1997) also demonstrates that, despite variables that are integrated, the fundamental issues regarding structural equation modeling raised by the Cowles Commission remain valid and standard estimation and testing procedures can still be applied.

8. The equations used for the estimation are in a simple VAR form. The technical details are listed in the appendices, which are available in the web version.

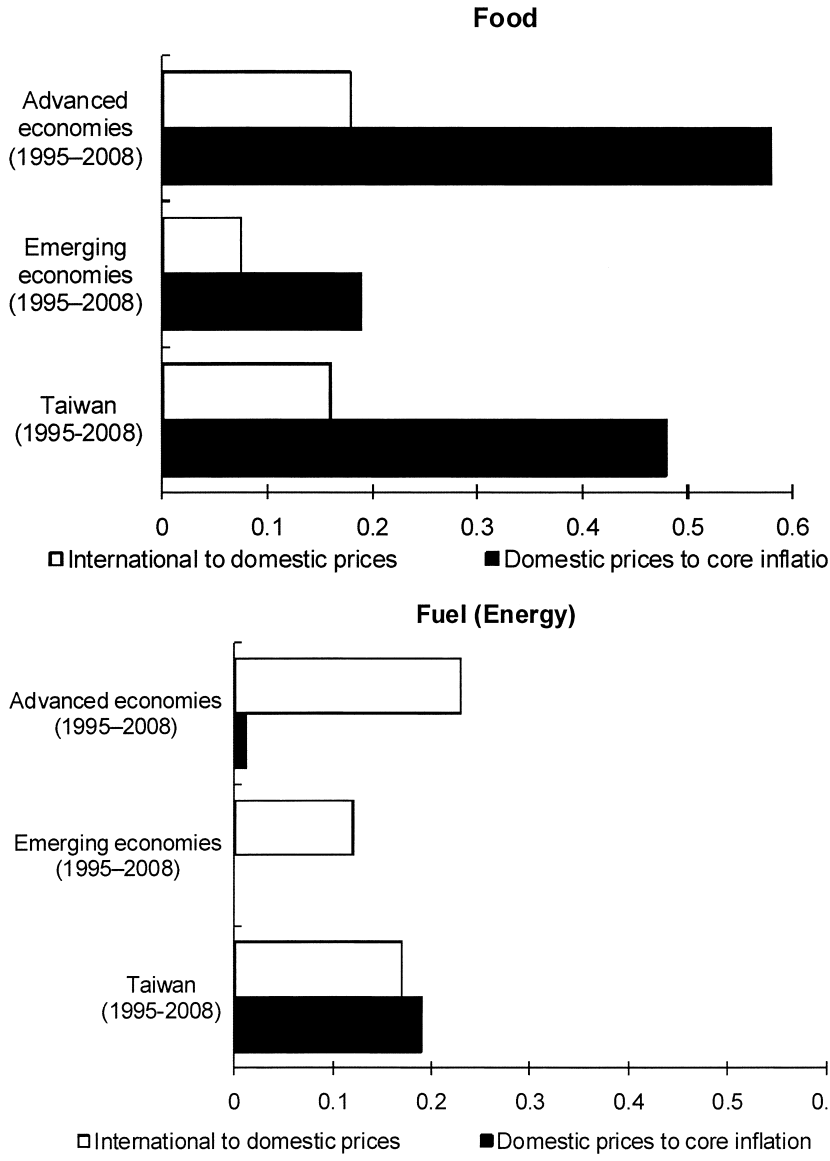


Fig. 7.2 The price pass-through estimation

Sources: Calculation based on IMF (2008). Own calculations based on estimation results.

The estimated results of the price pass-through in Taiwan are illustrated in figure 7.2 and displayed in table 7.2. The coefficient of price pass-through for food-related items in Taiwan, from global commodity prices to domestic prices, is 0.1346 and from domestic prices to core CPI is 0.1894. The IMF (2008) has stated that the estimated coefficients of price pass-through from

Table 7.2 The price pass-through for core CPI in Taiwan

Dependent variable		Independent variables	Sample period: 1995Q1–2008Q3
Step 1			
Domestic price (CPI_FOOD)		(a) Global commodity price—Food	0.1346
Domestic price (CPI_ENERGY)		(b) Global commodity price—Energy[a]	0.1733
Step 2			
Core CPI		(c) Domestic price (CPI_FOOD)	0.1894
		(d) Domestic price (CPI_ENERGY)	0.1921
Total price	Food	(e) = (a)*(c)	0.0255
Pass-though	Energy	(f) = (b)*(d)	0.0333

Source: Own calculations based on estimation results.

[a]In the IFS database, the world price index for energy starts from 1992Q2.

global commodity prices to domestic prices for advanced economies and developing economies are about 0.09 and 0.15, respectively, while Taiwan's lies somewhere in the middle. In addition, the estimated coefficients of price pass-through from domestic prices to core CPI in advanced economies and developing economies are about 0.18 and 0.48, respectively, while Taiwan's still lies in between.

On the other hand, the coefficient of price pass-though for energy-related items from global commodity prices to domestic prices is 0.1733, and from domestic prices to core CPI is 0.1921 for Taiwan. The IMF (2008) reported the estimated coefficients of global commodity prices to domestic prices in advanced economies and developing economies as being 0.23 and 0.12, respectively. Taiwan's is again still in between these two groups. Nevertheless, the estimated coefficients of price pass-through from domestic prices to core CPI in advanced economies and developing economies are 0.01 and almost 0, respectively. Here, Taiwan's is, however, higher than both that for advanced economies and that for developing economies, but is similar to the advanced economies (0.21) over the 1970 to 1995 period.

As figure 7.2 illustrates, the two price pass-through estimated coefficients, from international prices to domestic prices and domestic prices to core inflation in food-related items, is higher in emerging economies than in advanced economies during the period from 1995 to 2008, which indicates the influence that food-related goods price changes have on other goods (except fuel-related goods) is more price-sensitive in emerging economies.

The pass-through from international to domestic prices and from domestic prices to core inflation for fuel-related items is substantially lower in emerging economies than it is in advanced economies. We can explain that this may result from declining energy intensity, price controls in emerg-

ing economies, and energy-saving incentives, as well as high fuel taxes in advanced economies.

We define the total pass-through effects as the product of the two stages of the estimated coefficients, with the total price pass-through effects being equal to the pass-through from the global price index to the domestic price index multiplied by the pass-through from the domestic price to core CPI. The total food-related price pass-through for Taiwan lies between that for advanced economies and for developing economies, but the total energy-related price pass-through for Taiwan is found to be significantly higher than for advanced economies and developing economies during the 1995 to 2008 period. In addition, Taiwan's energy pass-through is slightly higher than the food price pass-through.

Notwithstanding that Taiwan is lacking in natural resources—such as oil, soybeans, or wheat, depending on foreign supplies—the estimated coefficients of price pass-through in Taiwan approximately follow the global trends. The exception is the price pass-through from domestic prices to core CPI for energy-related price items. The price pass-through for energy-related items is found to be slightly higher than for food-related items. We explain that this is because energy-related industries are almost public utility services and characterized by inelastic supply, and the industrial structures are either monopolies or oligopolies. Taiwan's government mostly adopts subsidy-related treatments[9] when fluctuations in energy-related prices become excessively large. Furthermore, energy shortages and a low degree of substitution in energy as well as guaranteed profits for certain companies all result in the higher price pass-through in Taiwan.

As we wondered whether the price pass-through may be different for domestic prices with export prices in the export-oriented economies such as Taiwan, we examined the price pass-through effects of global prices to import prices and export prices. We extended the work of the IMF (2008) to estimate price pass-through in the MPI (import price index) and XPI[10] (export price index). The estimated results are shown in table 7.3. The global price pass-through for the XPI was lower than it was for the MPI for both food and energy prices. We suggest that these results are attributed to Taiwan's entrepreneurial strength. The lower the XPI, the higher the world competitiveness. To benefit from international competition, Taiwan may mostly pass through the fluctuations in global commodity prices to the domestic market, but keeps the XPI more stable than it would otherwise have been.

Since there is no PPI (Produce Price Index) in Taiwan, we use the WPI (Wholesale Price Index) instead of PPI, which is composed of XPI, MPI,

9. The price control may cut down the price pass-through effects, but the subsidy may have positive effects to encourage the pass-through effects.

10. The XPI and MPI, which are denoted as price indexes, are expressed in terms of U.S. dollars, while the others are expressed in terms of New Taiwan (NT) dollars. We have added the exchange rate index to remove the effect of the exchange rate. However, the results are similar regardless of whether there is an exchange rate index or not.

Table 7.3 The Price pass-through for other prices in Taiwan

Dependent variable	Independent variables	Sample period: 1995Q1–2008Q3
Import Price Index (MPI)		
Food	Global commodity price—Food	0.4233
Energy	Global commodity price—Energy[a]	0.1904
Export Price Index (XPI)[b]		
Food	Global commodity price—Food	0.2252
Energy	Global commodity price—Energy[a]	0.0961
Domestic Sales Excluding Imports Price Index (DSPI)		
Food	Global commodity price—Food	0.2588
Energy	Global commodity price—Energy[a]	0.0713
WPI[c]		
Food	Global commodity price—Food	0.3004
Energy	Global commodity price—Energy[a]	0.1193

Source: Own calculations based on estimation results.

[a]In the IFS database, the world price index for energy starts from 1992Q2.

[b]There is no energy-related index in the XPI (export price index), so we cannot calculate the price pass-through for energy goods in the XPI.

[c]The WPI is composed of MPI (weighted 32.7 percent), XPI (weighted 36.5 percent), and DSPI (weighted 30.8 percent).

and DSPI (the domestic sales excluding imports price index). We compare our estimated results with core CPI and the WPI, and find the pass-through from the global commodity prices to the WPI is higher than it is to core CPI. These findings are similar to the 2008 study by Jongwanich and Park (in which Taiwan is somehow omitted), which states that the pass-through coefficients tend to be lower for consumer prices than producer prices, implying that the gap between these two price indices depends on the ability of firms to pass higher costs on to consumers. In the face of intense market competition, as the global commodity prices increase dramatically, the private producers may cut their marginal profits instead of immediately charging higher prices to consumers to keep their market shares. In addition, Taiwan's government policies such as price controls, energy-saving incentives, and other regulations might be implemented to reduce or delay the pass-through to CPI.

7.3 The Impacts of Price Pass-Through

The price pass-through might have distinct distribution impacts on the content of household expenditures and the industrial structure.[11] To evalu-

11. Hamilton (2009) stated that, regardless of whether oil price shocks are primarily caused by physical disruptions in supply or caused by strong demand, the consequences for the economy appear to have been very similar.

ate the distribution effects of the pass-through via the macro-econometric model of Taiwan's economy, we quantify the results from price pass-through to household expenditure patterns and the industrial structure—the impact on household expenditure patterns is treated as the demand side, while the impact on the industrial structure is represented as the supply side. To observe whether the impacts change as time passes, there are two scenarios:

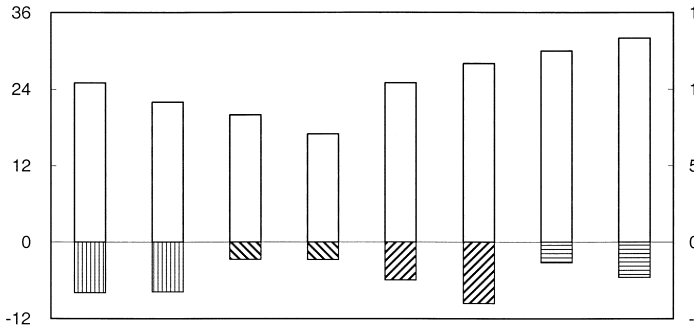
1. Scenario 1: Assume the food-related price shock and energy-related price shock both occurred in 1993.[12] That is, we consider how much of an impact these had on the Taiwan economy in the 1990s as the food-related price index and energy-related price index both rose sharply in 1993.
2. Scenario 2: Assume that the food-related price shock and energy-related price shock both occurred in 2004. That is, we consider how much of an impact these had on the Taiwan economy in the twenty-first century as the food-related price index and energy-related price index both rose sharply in 2004.

7.3.1 Price Pass-Through Distribution Effects upon Consumers

When we evaluate the household expenditure patterns, we reclassify the categories of household expenditure patterns from twelve classifications to four classifications, which are referred to as "food-related expenditures" (which includes different kinds of food, beverages, and tobacco); "energy-related expenditures" (which is composed of fuel, gas, light, rent, and water charges); "entertainment-related expenditures" (which is made up of recreation, entertainment, education, and cultural services); and "other goods and services expenditures" (which includes various kinds of clothing, transport, communications, and so on).

Figure 7.3 indicates that the impacts on energy-related expenditures are smaller as shocks occur. It is known that the energy-related items are inelastic demand and the Taiwan government mostly adopts subsidy-related treatments, as the fluctuations in energy-related prices are noticeably large. As for food-related expenditures, they are for living necessities, and the elasticity of price is generally low. However, as diversities of food selections increase and the beverages, which are included in food-related items and whose ratio was around 10 percent in 2008, are more price-flexible, we think those might be the reasons why the food-related impacts are greater than the energy-related impacts. In addition, the impact on entertainment-related expenditures is the most severe—due to their being luxuries—and their income elasticity is also higher.

12. The energy index in International Financial Statistics (IFS) starts with the year 1992 and this results in the historical data covering fewer years than for the food index, which starts from the 1960s. When we set the scenario, we refer to the food index rather than the energy index. We assume that the annual growth rate of the commodity price shocks, as measured by both the food and energy indexes, rose by 80 percent of the growth rate of the food price index in 1973.



	Food-Related (1996)	Food-Related (2007)	Energy-Related (1996)	Energy-Related (2007)	Entertainment related (1996)	Entertainment related (2007)	Other (1996)	Other (2007)
Share of Expenditure (%)	25.0	22.0	20.0	17.0	25.0	28.0	30.0	32.0
Percentage Change(%)	-3.3	-3.3	-1.1	-1.1	-2.5	-4.0	-1.3	-2.3

Fig. 7.3 Price pass-through and household expenditure patterns

Source: Based on estimated results.

Notes: The upper parts are the share of each kind of expenditure over total expenditures. The lower parts are the percentage changes as commodity price shocks occur, which are based on scenario 1 and scenario 2.

7.3.2 Price Pass-Through Distribution Effects upon Producers

We employ the consumption conversion matrix to project the twelve categories of goods and services into 161 industries. The consumption conversion matrix and the input-output tables are based in the years 1996 and 2007,[13] respectively.

In general, the input-output model is excellent at describing the industrial structure,[14] and it may be the best tool that we can use to analyze the impacts of industrial shocks, which result in final demand such as household expenditures, and export-oriented and promotional policies. We apply the input-output tables to analyze and describe the price pass-through from household expenditure patterns to industrial structure that is caused by the global food and energy price shocks.

Although the input-output tables for 1996 and 2007 classify industries into 161 industries,[15] based on considerations of keeping the analysis concise, we

13. The 2007 input-output table is also extended, using 2004 as the base by means of the biproportional adjustment technique which is provided by Professor Hao-Yen Yang.

14. The frequency for the input-output tables in Taiwan is every five years. Owing to the data availability, we can only link the tables in different eras to capture the trends. If more data were available, we could have expressed them in terms of a dynamic process, but this is not possible here.

15. Although the shocks lasted for a period of more than one year, they have ceased to be felt as time passes. The variation in the real sector is close to zero in the fourth year after the shocks occurred, and the price deflators respond more quickly than the real sector. Due to the

have reclassified them into nine industries and renamed them as "agriculture and minerals"; "manufacturing—traditional industries"; "manufacturing—chemical and petroleum-related industries"; "manufacturing—heavy industries"; "construction"; "electricity, gas, and water"; "transportation, telecommunications, wholesale, and trading"; "finance, insurance, and real estate services"; as well as "other services."

The food-related goods and energy-related goods are the main intermediate inputs for "agriculture and minerals," and manufacturing industries. The manufacturing industries are described in more detail because of the differences in technology level, energy intensity, and energy efficiency. They are separated into "traditional industries," which include processed foods, beverages, tobacco, textile mill products, wearing apparel and accessories, leather and leather products, wood and wood products, paper and paper products and printed matter, and so on. "Chemical and petroleum-related industries" comprise chemicals, artificial fibers, plastic, plastic and rubber products, miscellaneous chemical manufactures, and petroleum-refining products; "heavy industries" might be treated as hi-tech industries and include iron and steel products, metallic products, machinery, electronic products, information products, communications equipment, electronic components and parts, electrical machinery, and so forth.

In table 7.4, we calculate the industrial linkage effect by means of forward linkages and backward linkages for the global commodity price shocks. In scenario 1, based on final demand, the top three industries ranked by percentage changes are "agriculture and minerals"; "electricity, gas, and water"; and "manufacturing-traditional industries", whose percentage changes are all over –2.5 percent. In scenario 2, the ranks are similar to those in scenario 1 except that the "manufacturing—traditional industries," is replaced by "electricity, gas, and water,"

"Agriculture and minerals" include food-related goods and crude oil, which suffer seriously due to the direct effects caused by the commodity price shocks. The "electricity, gas, and water" are regarded as intermediate inputs for almost all industries and their energy intensity is also higher. Therefore, the impacts are as sharp as if the shocks had occurred. "Manufacturing—traditional industries" are lower in terms of energy technology investment, and include processed food industries that are using food-related goods as intermediate inputs; therefore, the final demand is also likely to be affected.

Among the manufacturing industries, the higher the technology level, the smaller the impacts. The impacts on the "manufacturing—traditional industries," are the most critical, followed by those on "manufacturing—chemical and petroleum-related industries." Although "manufacturing—heavy industries," are relatively energy-intensive, they are also higher in

national incomes and input-output tables being compiled annually, we calculate their impacts by using weighted averages, and take the base years as 1996 and 2007.

Table 7.4 Simulation results in input-output tables

No. industries	1996 Base (millions)	(a) Scenario 1 (1996)	2007 Base (millions)	(b) Scenario 2 (2007)	(c) = (b) – (a)
	Final demand (percentage change [%])				
1 Agriculture and minerals	263,012	–4.952	412,417	–4.037	0.915
2 Manufacturing—traditional industries	1,213,545	–2.534	1,412,253	–2.746	–0.212
3 Manufacturing—chemical and petroleum-related industries	583,044	–0.600	1,701,082	–0.532	0.068
4 Manufacturing—heavy industries	3,232,880	–0.130	7,564,001	–0.194	–0.065
5 Construction	861,800	0.000	1,081,775	0.000	0.000
6 Electricity, gas, and water	87,044	–2.911	155,599	–2.254	0.658
7 Transport, telecom, and trading	1,483,245	0.038	2,925,416	–0.069	–0.106
8 Finance, insur., and real estate services	1,317,928	–1.576	2,745,917	–1.477	0.099
9 Other services	1,928,251	–0.792	2,975,259	–1.346	–0.554
Total	10,970,749	–0.816	20,973,719	–0.788	0.028
	Output (percentage change [%])				
1 Agriculture and minerals	488,894	–7.753	687,090	–7.331	0.422
2 Manufacturing—traditional industries	1,690,809	–2.917	1,893,071	–3.463	–0.546
3 Manufacturing—chemical and petroleum-related industries	1,662,753	–1.508	3,931,377	–1.253	0.254
4 Manufacturing—heavy industries	4,060,134	–0.439	8,596,517	–0.541	–0.101
5 Construction	1,013,445	–0.121	1,251,176	–0.152	–0.032
6 Electricity, gas, and water	366,281	–1.731	623,621	–1.652	0.079
7 Transport, telecom, and trading	2,894,714	–0.329	4,288,290	–0.458	–0.129
8 Finance, Insur., and real estate services	1,523,656	–2.092	4,175,374	–1.512	0.580
9 Other services	2,549,009	–1.092	4,496,904	–1.451	–0.359
Total	16,249,695	–1.273	29,943,420	–1.242	0.031
	Value added (percentage change [%])				
1 Agriculture and minerals	180,714	–10.893	335,824	–8.070	2.823
2 Manufacturing—traditional industries	455,928	–2.637	456,809	–3.562	–0.925
3 Manufacturing—chemical and petroleum-related industries	492,224	–1.206	883,516	–1.325	–0.119
4 Manufacturing—heavy industries	1,083,427	–0.337	1,928,870	–0.511	–0.174
5 Construction	350,008	–0.097	289,792	–0.181	–0.084
6 Electricity, gas, and water	174,621	–1.371	251,572	–1.554	–0.183
7 Transport, telecom, and trading	2,053,243	–0.307	2,611,210	–0.475	–0.167
8 Finance, Insur., and real estate services	1,051,525	–2.100	3,042,128	–1.391	0.708
9 Other services	1,714,111	–0.975	2,836,047	–1.431	–0.455
Total	7,555,801	–1.180	12,635,768	–1.303	–0.123

Source: Own calculations based on simulation results.

terms of energy efficiency and in terms of being energy-saving. Therefore, the impacts could be smaller than in the case of the traditional industries and petroleum-related industries. The services industries are also affected as commodity shocks occur by means of the industrial linkage effect. However, the impact is smaller than that of the "agriculture and minerals industries," and manufacturing industries.

By comparing the results from scenario 1 (based on 1996) with those from scenario 2 (based on 2007), in terms of final demand, the gaps that take differences in terms of percentage changes between 1996 and 2007 are extremely small. Those industries such as "agriculture and minerals"; "manufacturing—chemical and petroleum-related industries"; "electricity, gas, and water"; as well as "finance, insurance, and real estate services," for which the negative effects of price shocks have become smaller in 2007 than in 1996, almost all use food-related or energy-related items as intermediate inputs. The first three industries are all highly correlated with global commodity shocks. The reduced impacts may result from technology innovations in food processes, energy-saving improvements, and reductions in energy-dependency. The impacts on "finance, insurance, and real estate services" are also reduced; these might be correlated with the deregulation and globalization in the financial sector since the mid-1990s.

The gaps are amplified in "other services"; "manufacturing—traditional industries"; "transportation, telecommunications, wholesale, and trading"; and "manufacturing—heavy industries." The "other services," which include information services, education services, medical services, broadcasting, recreational and cultural services, and so on, and "transportation, telecommunications, wholesale, and trading," are highly related to reductions in expenditure on entertainment. The entertainment-related industries saw a bigger reduction in 2007 than in 1996.

The "manufacturing—traditional industries" and "manufacturing—heavy industries" are also deepened because their technology related to energy efficiency and energy-saving has been upgraded more slowly than the improvement in energy intensity. In addition, the traditional industries have been hollowed out to mainland China since the mid-1990s.

The impacts on the industrial structure in terms of output and value added are similar with final demand. While the results have been analyzed, the impacts on output and value added appear to be superfluous; we do not reproduce them here.

7.4 Conclusion

In order to calculate the price pass-through effect from international commodity prices to domestic prices and evaluate the impacts on household expenditure patterns and the industrial structure, we have conducted an empirical study that focuses on Taiwan.

Being a small, open, export-oriented, price-taker economy and lacking

natural resources, the price pass-through effect caused by global commodity prices has a substantial impact on Taiwan's economy. In particular, Taiwan's household expenditure patterns and industrial structure have gradually been transformed and upgraded since its economy took off in 1972.

The commodity price shocks will affect the Taiwan economy by means of the price pass-through effect. How significant are the impacts? This will depend on the degree of pass-through, household expenditure patterns, and industrial structures. We apply a case study to calculate the extent to which global commodity prices are passed through to domestic prices for a small, open, price-taker, and developing economy like Taiwan in order to evaluate their impact on distribution effects such as household expenditure patterns and the industrial structure.

The price pass-through also results in distinct impacts on household expenditure patterns and industrial output by means of distribution effects. The effects of cuts in household expenditures on fuel and power and transportation and communications are slightly less pronounced than in the food-related industries, although the global price pass-through effects on domestic prices included in core CPI are similar. These findings reflect diversification in food purchases for households and the government's subsidy treatments for energy-related items.

Regarding the impacts of commodity shocks on the industrial structure, the food-related goods and energy-related goods mostly belong to the "agriculture and minerals" sectors and will be affected directly, so the impact will be most serious regardless of whether it is accounted for in final demand, output or value added. The impacts are evident in the primary industries and in secondary industries, which treat foods and energy as the main intermediate inputs. Nevertheless, the lessening of the impacts on food-related industries and energy-related industries results from technology innovations in food processes, energy-saving improvements, and the reduction in energy-dependency.

For the empirical procedures, we employ a VAR model to estimate the coefficients of price pass-through. Since the specifications of the VAR model take the possible control variables into account by means of the log-dependent variables, it may not be necessary to add more control variables if there are no specific issues of concern.

We do not emphasize the response of the pass-through to monetary policy, but have looked closely at the relationship between the pass-through and distribution effects in terms of household behavior following the shocks. In particular, the household expenditure patterns and transformation of the industrial structure have been more important than inflation to Taiwan's economy since the 1990s, resulting from Taiwan's firms moving to China, which has resulted in a rapid transformation of the industrial structure.

In taking the labor market into account, we have considered generalized Phillips curve equations in the price pass-through equations, which are treated as the supply-side effect. Furthermore, the labor market in Taiwan is

characterized by almost full employment. The unemployment rate is almost always under 4.5 percent except during the bursting of the dot-com bubble in 2002 and 2003.

We focus on the relationship between structural transformation such as household expenditure patterns and the industrial structure with price pass-through effects. Since we consider the pass-through in terms of the overall effect, the estimation results for the price pass-through obtained from the VAR model should be regarded as a total effect based on the changing tax policy, exchange rate, and so on. Much more complicated modeling would be involved and more detailed data would need to be collected for the purpose of isolating each individual effect. These items may be regarded as limitations in this study.

Appendix

The Empirical Procedures for Price Pass-Through, Household Expenditure, and the Industrial Structure: The Case of Taiwan

In order to clarify the pass-through effect from global commodity prices to domestic prices, we evaluate the distribution effects of the pass-through on household expenditure patterns, which is treated as the demand side, and on the industrial structure, which is represented as the supply side.

The empirical procedures can be divided into two parts. In the first part, we follow the IMF (2008) to employ simple VAR models to estimate the coefficients of price pass-through, which are described as just mentioned. In the second part, we utilize AIDS, a consumption conversion matrix, and input-output tables to distribute the impacts of the price pass-through effects.

The VAR Model for Commodity Price Pass-Through

We modified De Gregorio, Landerretche, and Neilson (2007) and IMF (2008) to calculate the price pass-through coefficients for Taiwan. There are two steps involved. The first step traces the changes in domestic prices to the changes in global commodity prices. The first step employs simple regressions of the following form:

$$\text{(A1)} \qquad \pi_t^{\text{domestic}} = \alpha + \sum_{i=1}^{4} \beta_i \pi_{t-i}^{\text{domestic}} + \sum_{i=0}^{4} \delta_i \pi_{t-1}^{\text{world}} + \varepsilon_t.$$

Here, π is denoted as the annualized quarter-over-quarter log difference (in percent) in food or fuel prices (we also include seasonal dummies). The reported pass-through coefficients are calculated as:

$$\text{(A2)} \qquad \text{price pass-through} = \frac{\sum_{i=0}^{4} \delta_i}{1 - \sum_{i=1}^{4} \beta_i}.$$

The second step for pass-through from domestic (food and fuel) prices to core CPI is estimated using the following generalized Phillips curve equations:

$$\text{(A3)} \quad \pi_t = \alpha + \sum_{i=1}^{4} \beta_i \pi_{t-i} + \sum_{i=0}^{4} \gamma_i (y_{t-i} - y^*_{t-i}) + \sum_{i=0}^{4} \phi_i \pi^{\text{food}}_{t-i} + \sum_{i=0}^{4} \varphi_i \pi^{\text{fuel}}_{t-i} + \varepsilon_t.$$

The price pass-through can be defined as:

$$\text{(A4)} \qquad \text{food price pass-through} = \frac{\sum_{i=0}^{4} \phi_i}{1 - \sum_{i=1}^{4} \beta_i}$$

$$\text{(A5)} \qquad \text{fuel price pass-through} = \frac{\sum_{i=0}^{4} \varphi_i}{1 - \sum_{i=1}^{4} \beta_i}.$$

Here π stands for the annualized quarter-over-quarter log difference (in percent) in core, food, and fuel prices, while y and y^* denote the annualized quarter-over-quarter log difference (in percent) in, respectively, real and potential output[16] (the equations also include seasonal dummies). To eliminate contamination of the estimates by endogenous factors, the price pass-through from domestic commodity prices to core inflation is estimated using predicted values from the first step.[17]

The Macroeconometric Model of Taiwan's Economy

To feed the parameters for evaluating the distribution effects of the pass-through on household expenditure patterns, we employ a macroeconometric model for reference purposes. The macroeconometric model can be treated as a conduit to transfer the price pass-through effect to consumers and producers.

The features of such a macroeconometric model of the Taiwan economy are listed as follows.

16. We follow the IMF (2008) by employing the Hodrick-Prescott filtered trend to estimate potential GDP.

17. In this way, domestic food and fuel prices reflect only the variation that is due to changes in international prices and the lagged effects of domestic price developments, rather than movements in labor, transportation, and retailing costs that may have common origins with overall inflation.

First, the model provides detailed descriptions of the GDP deflator, WPI, MPI, XPI, CPI, and the private consumption deflator. For the settings of the price functions, we consider the transmission mechanism and comovement between price indices. Second, the model is demand driven.[18] Third, as for the composition of GDP on the expenditure side, each of its components has its own behavioral equations except for the government sector, which we treat as exogenous. Fourth, the household expenditures are classified into twelve categories based on the characteristics of the goods and services, which can be described in more detail.[19] Based on the transmission processes, feedback effects, and related theories, we specify and capture the variables' interactions.

Based on the transmission processes and feedback effects, we capture the variables' interactions. In the processes of selecting the behavioral functions, the independent variables are specified and recognized as their related theories. Moreover, each equation must satisfy the statistical diagnosis. The technical details are available on the web (http://www.nber.org/confer//2009/ease09/program.html).

We find that the global commodity price shocks will pass away as time passes. The changes in real GDP will be close to zero in the fifth year. The paths for the changes in the price indexes, such as the CPI, XPI, and MPI, will respond more quickly than the real sectors. They will tail off as time passes by. That is, by comparing the change and trend from real GDP (or the real sectors) with the CPI (or the price index), we learn that the price indexes respond more quickly. The price index almost responds perfectly within a period of two years. Then the negative effect tails off.

If we compare the simulation results for only the food-related price shock with only the energy-related price shock, we find that the food-related shock has a heavier impact even though the pass-through effect is higher. Owing to the energy-related price fluctuating more frequently, the government mostly adopts subsidy-related treatments. Besides, there is a gearing effect related to the domestic food-related prices. That is, it is easier for the food-related prices in the domestic market to rise than it is for them to fall. Therefore, the food-related price shock has a more serious impact on the Taiwan economy.

18. Due to the labor market being stable in Taiwan, for example, the unemployment rate is almost under 4.5 percent except in 2002 and 2003, the rigidities in the labor market are not so serious, and we have added a term representing the gap between actual output and potential output. This is denoted as $(y - y^*)$ in the price pass-through equations, which are denoted as the generalized Phillips curve equations, and is also treated as a proxy for the supply-side effect. In view of this, we model the labor market as simply as possible.

19. We have adopted the suggestions proposed by the referee to reestimate the macroeconometric model and the AIDS model using the sample periods from 1992Q2 to 2008Q3, and so the estimated equations' sample period could coincide with the simulation results. We also conducted structural break tests, such as the Chow test, and only little evidence was found for the structural break.

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Comment

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Introduction

I would like to thank the National Bureau of Economic Research and the Hongkong University of Science and Technology for inviting me to this conference. I found this chapter quite enjoyable and informative, and I would like to commend the authors for writing a chapter with important policy implications for Taiwan and with probable applicability of the same

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