



WHAT DRIVES CHINA'S FOOD-PRICE INFLATION AND HOW DOES IT AFFECT THE AGGREGATE INFLATION?

Prepared by Wenlang Zhang and Daniel Law*
Research Department

Abstract

It is typically argued that China's food-price inflation has been mainly driven by supply-side shocks including natural disasters. Our research, however, shows that demand pressures have played a more important role from a medium-term perspective. This suggests surging food prices may call for policy reactions even if non-food-price inflation is tame. Meanwhile, we find food-price inflation has not generated significant second-round effects on non-food-price inflation. In particular, while food-price inflation has pushed up China's inflation expectations, it has not been an important determinant of wage growth. This situation may change as workers gain more bargaining power in wage setting in the medium term.

JEL classification: E31, E32

Keywords: Demand Pressures, Expenditure Elasticity, Food-price Inflation, Supply-side Shocks, Aggregate Inflation

Author's E-Mail Address: wzhang@hkma.gov.hk

The views and analysis expressed in this paper are those of the authors, and do not necessarily represent the views of the Hong Kong Monetary Authority.

* The authors are grateful to Dong He for his guidance and to Ashvin Ahuja, Nathan Porter, and Chang Shu for their thoughtful comments on this paper. Any errors remain the responsibility of the authors.

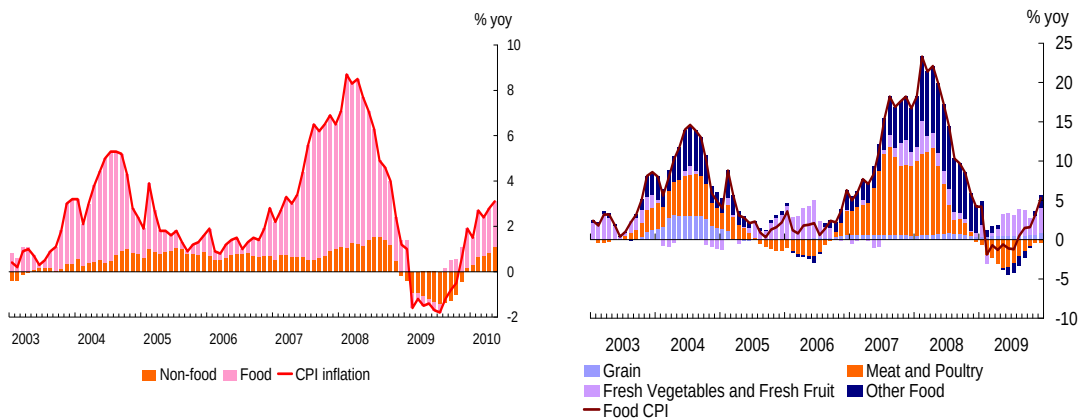
Executive Summary:

- Using both household- and macro-level data, this paper studies the determinants of China's food-price inflation and analyses how it feeds into the aggregate inflation.
- We find that the expenditure elasticities for various foodstuffs in China have been positive, suggesting a rise in total household expenditure would lead to stronger demand for food. In particular, the expenditure elasticity for meat and poultry has been over unity, suggesting that a 1% increase in household expenditure would lead to a more than 1% increase in the demand for these foodstuffs. This partly explains why meat and poultry prices have been a major component of China's aggregate food-price inflation in the past years.
- We study the determinants of food-price inflation from both demand and supply side of the economy. Demand pressures are measured with output gap and excess money, and supply-side factors include natural disasters, food production costs and food yields. Analysis based on macro-level data at both national and provincial levels indicates while supply-side shocks have played a role, demand pressures have been more important in driving up China's food-price inflation from a medium-term perspective.
- Our analysis also provides some useful policy implications. Economic theories suggest that monetary policy should only respond to core inflation as food- and energy-price inflation is usually believed to be triggered by supply-side effects. This may not be true for emerging market economies as hikes in food prices in these economies may also reflect potential demand pressures. This is because upward pressures on food prices are likely to be more intense in emerging market economies than in advanced economies when demand rises.
- Food-price inflation has not generated significant second-round effects on non-food-price inflation. In particular, while food-price inflation affected inflation expectations on the Mainland, it has not been a driving force for China's wage growth. However, this situation may change as workers exert more influences on wage setting in the medium term.

I. INTRODUCTION

Empirical evidence shows that Mainland China's headline CPI inflation has been closely associated with hikes in food prices, and food-price inflation has been largely driven by meat and poultry prices (Figure 1). A natural question is then, what has driven China's food-price inflation, and why has meat- and poultry-price inflation been a major component of China's aggregate food-price inflation? While highlighting the role played by supply-side shocks including natural disasters and global food commodity prices, observers of China's economy appear to have downplayed the importance of demand pressures in determining China's food-price inflation. The World Bank (2007), for example, ascribes the surges in China's food prices in 2007 to global food-price inflation. Ng and Wang (2008) claim that China's soaring inflation of 2007 – 2008 was mainly caused by natural disasters rather than demand-side factors. Zhang and Reed (2008) also consider supply-side factors as the major culprit for the fluctuations in China's pork prices during 2003 – 2008.

Figure 1: Aggregate inflation and food-price inflation in China



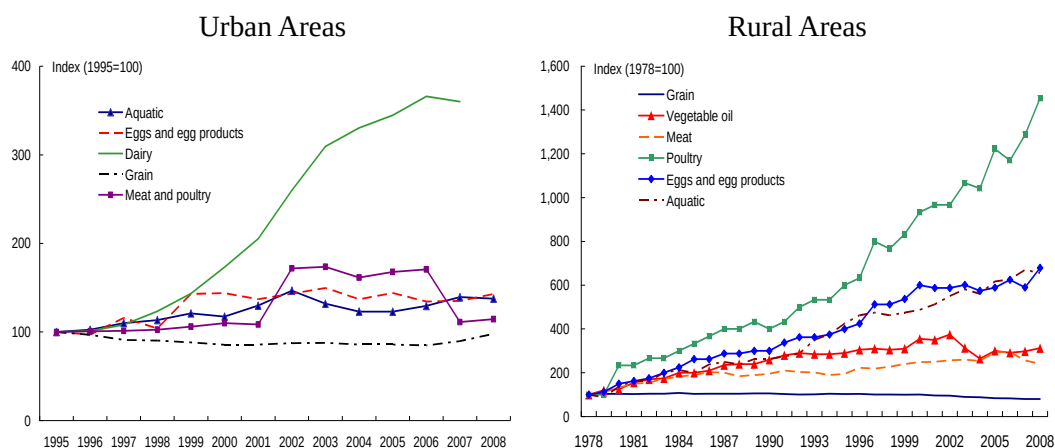
Sources: CEIC and authors' estimates.

In practice it is not easy to distinguish food-price inflation induced by supply-side shocks from that caused by demand pressures. Generally speaking, the impact of adverse supply-side shocks on food-price inflation should be transitory unless they are persistent. Figure 1 shows that food-price inflation remained elevated for almost two full years of 2007 – 2008 before the economic growth slowed. Moreover, the last two episodes of high inflation of 2004 – 2005 and 2007 – 2008 were coincided with high output and money growth on the Mainland. This may suggest the view that China's food-price inflation has been mainly caused by supply-side shocks such as pig blue ear disease and storms does not necessarily hold water. Food prices are usually more flexible and respond to

demand-side shocks faster than non-food prices. This is because the supply of food is more rigid than that of other products, and foodstuffs cannot be stored for a long time. As a result, when demand pressures emerge for food and supply cannot react quickly, upward pressures on food prices will increase.

Meanwhile, findings about food-price inflation in advanced economies may not be true for developing countries because, as shown in the next section, the expenditure elasticity for food is usually higher in developing countries. Moreover, food expenditure accounts for a larger share of total household consumption expenditure in developing countries.¹ In addition, the demand for high-calorie foodstuffs including meat, poultry and dairy products has been steadily growing in emerging market economies. As shown in Figure 2, while per capita consumption of grains in China has been declining steadily, that of other foodstuffs, especially luxury food items, has been trending up. In particular, the consumption of dairy products in urban areas nearly quadrupled between 1995 and 2007, and consumption of poultry products saw a fifteen-fold jump between 1978 and 2008 in rural areas. Against this backdrop, this paper will explain how demand pressures have affected China's food-price inflation in addition to supply-side factors, using both household and macro-level data.

Figure 2: China per capita consumption of major food items in volume



Sources: WIND and authors' estimates.

While food-price inflation has been volatile in China, non-food-price inflation has been much more stable over the same period. A related question is then, how has food-price inflation affected non-food and aggregate inflation on the Mainland? Generally, there are three major channels through which food-price

¹ Food expenditure accounts for over 35% of urban household expenditure and over 45% of rural household expenditure in China in the past few years.

inflation can feed into aggregate price inflation. First of all, as food is a large component of the CPI basket in developing economies, the direct contribution of food price to aggregate inflation can be significant. Secondly, food-price inflation can translate into non-food-price inflation by pushing up inflationary expectations and prompting higher wage demands. The research below will also study how these channels work in China using provincial-level data.

Our research shows that while supply-side factors have played a role, demand pressures appear to have been more important in determining China's food-price inflation. Estimation using household-level data shows that the expenditure elasticities for various foodstuffs have been positive in China, suggesting that a rise in total consumption expenditure will lead to stronger demand for food. In particular, the expenditure elasticity for meat and poultry has been above unity, partly explaining why meat and poultry prices have been a major component of China's aggregate food-price inflation. Analysis based on macro-level data at both national and provincial levels indicates that output gaps and excess money have been major pull factors for various foodstuff-price inflation.

This finding provides some useful policy implications. Economic theories suggest that monetary policy should only respond to core inflation to avoid undue volatility in output as food- and energy-price inflation is usually believed to be caused by supply-side shocks. Our study shows that this rule may not provide useful guidance for policymakers in emerging market economies like China, as hikes in food prices in emerging market economies can also reflect potential demand pressures. This is because upward pressures on food prices are likely to be more intense in emerging market economies than in advanced economies when demand rises. Moreover, as mentioned before, food prices react more quickly to shocks than non-food-price inflation. As a result, hikes in food prices may call for policy reactions even if non-food-price inflation is still tame.

Meanwhile, we find food-price inflation has not generated significant second-round effects on non-food-price inflation. In particular, while food-price inflation has pushed up China's inflationary expectations, it has not been an important determinant of wage growth. This may be partly due to the abundant labour supply in China which have little bargaining power in wage setting. This situation may have changed, however. The recent wage hikes pushed partly by strikes of migrant workers in large cities, coupled with the diminishing demographic dividends and the Government's motive to steer China's growth

pattern towards a more consumption-driven path, suggest that food-price inflation may become a more important push factor for China's wage growth in the medium term.

The rest of this paper proceeds as follows. Section II studies the dynamics of China's food prices using both household and macro-level data. Section III analyses how food-price inflation has fed into aggregate inflation, and the last section concludes.

II. WHAT DRIVES CHINA'S FOOD-PRICE INFLATION?

1. *Estimating expenditure elasticity for various foodstuffs*

This section estimates the expenditure elasticities for various food items with panel household-level data. Our estimation indicates expenditure elasticities for food have been positive, and in particular, the expenditure elasticities for luxury foodstuffs are larger than one. This suggests rising demand will add upward pressures on food prices, especially luxury foodstuff prices.

The model we estimate reads

$$w_i = \alpha_0 + \alpha_i \log x + \sum_j \beta_{ij} \log p_j \quad (1)$$

$$x = \varphi_0 + \varphi_1 \log X + \varphi_2 \log P \quad (2)$$

where w_i is the expenditure share of food i among all food items studied, p_j is the price for food j , and x is the real total expenditure of all food items included in the model. X is the real total expenditure of food and non-food consumer goods and services. P is the Laspeyres price index for the food items studied, which is measured as the weighed average price index for the food items to study in the model.² The expenditure elasticity of food item j then reads $\varphi_1 \left(1 + \frac{\alpha_j}{w_j} \right)$. As

the weight for each food item in total food expenditure changes from period to period, the expenditure elasticity changes over time accordingly.³ We estimate the

² This is the Working-Leser model, see Chern et al. (2003) for details.

³ If total household expenditure is a constant part of household income, the expenditure elasticity is equal to the income elasticity.

expenditure elasticities for eight foodstuffs including aquatic products, milk and its products, eggs, oil and fat, dried and fresh melons and fruits, grains, meat and poultry and their products, and vegetables with provincial data of per capita consumption of 1995 – 2007.

Our research shows that the elasticity for all food items is positive except that the expenditure elasticity for grains in coastal areas in the past few years has been negative, see Figure A-1 in the Appendix for details. This suggests that demand for food will rise with higher household consumption expenditure. In particular, the elasticities for meat and poultry and for milk products have been above unity, suggesting that a 1% increase in real per capita expenditure will lead to a rise in the demand for these products of more than 1%. Our finding appears to be consistent with other researches in this field. Hsu et al. (2002), for example, find that the expenditure elasticity estimated with data of 1993 – 1996 for fish, poultry and pork is 3.41, 3.12 and 1.68 respectively in China's urban areas, compared with 0.11 for grains over the same period. In Table 1 we compare the expenditure elasticity for major foodstuffs across economies. The main message is that expenditure elasticities for foodstuffs, especially luxury food items like meat, and milk and its products, are larger in developing economies than in advanced economies. This suggests that pressures on food-price inflation are likely to be more intense in developing economies than in advanced economies when demand rises.

Table 1: Expenditure elasticity for major foodstuffs across economies

	Bread & cereals	Meat	Fish	Dairy	Fats & oil	Fruit & vegetables
Brazil	0.17	1.01	-	1.05	-	-
Canada	0.15	0.30	0.33	0.32	0.17	0.24
France	0.16	0.35	0.39	0.38	0.19	0.28
Germany	0.15	0.33	0.36	0.35	0.18	0.26
Hong Kong	0.14	0.27	0.30	0.29	0.15	0.21
India	0.17	1.30	-	-	-	-
Indonesia	0.02	2.30	-	0.62	-	-
Japan	0.16	0.31	0.35	0.33	0.18	0.25
Russia	0.11	0.82	-	-	-	-
UK	0.17	0.35	0.39	0.38	0.19	0.28
US	0.05	0.11	0.12	0.12	0.06	0.09
China	0.10	1.15	0.42	1.12	0.30	0.47

Notes: (1) The expenditure elasticity for developed economies is estimated by the US Department of Agriculture (USDA) with 1996 data. The expenditure elasticity for developing economies is adopted from OECD (2010).

(2) For China, we first calculate the average of expenditure elasticities for various foodstuffs of the sample period 1995 – 2007 for coastal and inland areas separately and then take the average of the two areas as the aggregate elasticity. In addition, the expenditure elasticity for bread and cereal is proxied by that for grains, the elasticity for fish is proxied by that for aquatic products, and the elasticity for fruits and vegetables is the average of the elasticity for fruits and that for vegetables.

Sources: USDA, OECD (2010) and authors' estimates.

2. *Determinants of food-price inflation: evidence with quarterly national data*

The above analysis suggests that pressures on food prices, luxury food prices in particular, will intensify when demand pressures emerge, but does not demonstrate to what extent demand pressures have driven up China's food-price inflation. This section studies China's food-price inflation following the framework of Gordon (1985) who uses a "triangle model" to study the determinants of the US inflation between 1954 and 1980. Our research shows that demand pressures have been more important than supply-side shocks in driving China's food-price inflation from a medium-term perspective.

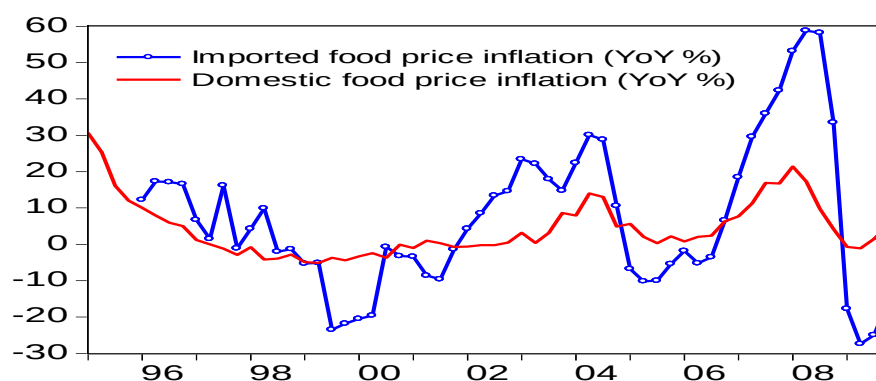
The explanatory variables in the triangle model are inflation inertial, supply-side factors and demand pressures. Using a similar model, Mohanty and Klau (2008) study the determinants of inflation in emerging market economies. Demand-side factors in our analysis include output gap and excess money. In most inflation models for advanced economies, demand pressures are captured by output gap alone and money does not enter as an additional explanatory variable. As mentioned in Mohanty and Klau (2008), this is because the transmission of monetary policy in developed economies mainly works through changes in aggregate demand which is closely linked with interest rate. The story can be somewhat different for developing economies. First of all, money supply is argued to be an important indicator of future demand growth and hence inflationary expectations in developing economies given the relatively undeveloped financial markets and weak relationship between interest rate and inflation.⁴ Secondly, estimates of output gap for emerging economies may not be precise given potential structural changes in these economies, and excess money may help measure demand pressures.

Supply-side factors for food-price inflation include natural disasters, food yields, food production costs and global food commodity prices. Before starting the estimation, we will explore whether global food commodity prices have been a major driver of China's domestic food-price inflation. Figure 3 shows that the trend of China's domestic food-price inflation has been highly correlated with the trend of its imported food-price inflation, particularly in the past few years.

⁴ The impact of money supply on food-price inflation in the view of monetarist school is somewhat different from the story here. According to monetarists, food prices will overshoot their long-run equilibrium levels when a monetary shock occurs as food prices are more flexible than those of other products. See Frankel and Hardouvelis (1985) for more discussions.

Based on this evidence, there are economists arguing that global food prices have been an important determinant of China's domestic food-price inflation (the World Bank, 2007 and 2008).

Figure 3: Domestic and imported food-price inflation



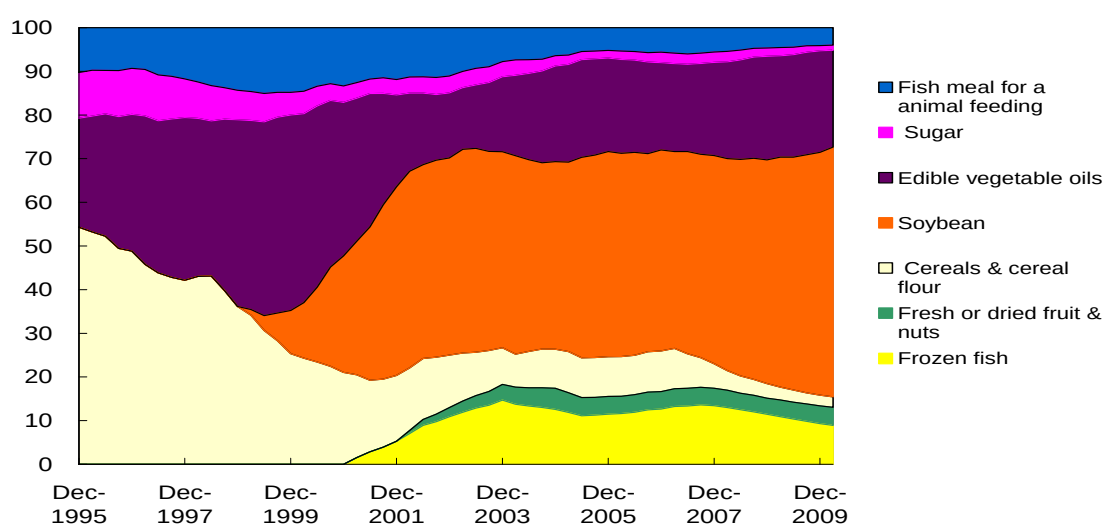
Note: The imported food-price inflation is the weighted average of global inflation of China's major imported foodstuffs including fish meal for animal feeding, sugar, edible vegetable oils, soybeans, cereal and cereal flour, fresh or dried fruits and nuts, and frozen fish.

Sources: CEIC and authors' estimates.

A deeper analysis, however, indicates that global food-price inflation has not been a major driver for China's domestic food-price inflation. Figure 4 presents the shares of the imports of major food items in China's total food imports. While edible oil, and cereal and cereal flour accounted for about 80% of China's total food imports in the late 1990s, the imports of soybeans increased rapidly at the beginning of this century and has accounted for over half of China's total food imports in the past few years. The increasing demand for animal protein has created a large demand for soybean meals, and about 60% of China's total consumption of soybean is dependent on imports. China is now the largest importer of soybeans and soybean oils. According to the estimate of the US Department of Agriculture (USDA), China will import 40.5 million tons of soybeans in the marketing year of 2009/10, about 52% of the total global imports of soybeans. As China is the main driver of global soybean demand, there is no reason to take global soybean-price inflation as an exogenous variable. In other words, the imported food-price inflation shown in Figure 3 is, to a certain extent, determined by China's domestic demand.

Moreover, as shown in Table 2, China is a net exporter of most food items. As a result, there are economists arguing that global markets have had limited impact on China's domestic food-price inflation (Kaaresvirta et al. 2008). In a recent study, Huang et al. (2010) also exclude the inflation of imported goods as a determinant of China's domestic inflation. First of all, they argue that imported inflation can only change relative prices if not accommodated by domestic macro variables. Secondly, international commodity-price inflation is to some extent endogenous rather than exogenous because of China's increasing demand for commodities. Based on the above discussion, we will not take the global food-price inflation as an explanatory variable for China's food-price inflation.

Figure 4: Shares of major food imports in China's total food imports



Sources: CEIC and authors' estimates.

Table 2: China's net exports of major foodstuffs

Foodstuffs	1995 – 2000	2001 – 2005	2008	2010 – 2015*
	(yearly average, units: 1,000 tons)			
Beef and veal	75	43	50	33
Coarse grains	2,828	6,672	-823	-1,429
Eggs	48	55	43	36
Oilseeds	-6,732	-20,616	-34,578	-42,918
Pork	88	206	-282	-50
Rice	1,714	870	850	1,737
Vegetable oils	-2,554	-4,823	-9,138	-8,903
Wheat	-2,475	-880	1,939	2,518

Note: Oil seeds include soybeans.

* refers to forecast values.

Sources: OECD-FAO Agricultural Outlook 2009 – 2018.

Accordingly, we will estimate the following equation with quarterly data of 1996 – 2009 at national level:

$$\pi_{food} = f(\hat{y}, \hat{m}, s) \quad (3)$$

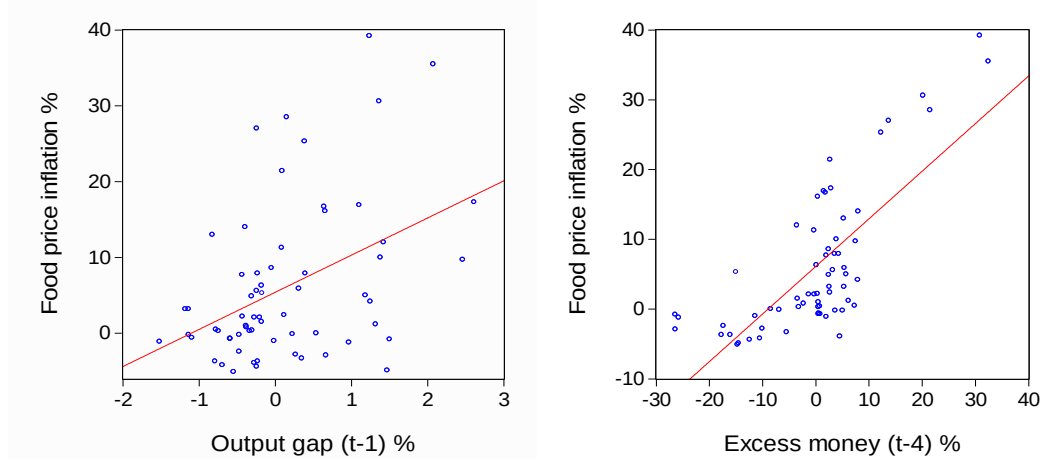
where π_{food} denotes food-price inflation on a year-on-year basis, $\hat{y}$ stands for output gap, $\hat{m}$ denotes excess money, and s stands for supply-side factors. Output gap is estimated with two methodologies: (a) the HP-filter approach, and (b) the growth accounting methodology.⁵ Excess money is measured as the percentage deviation of actual money demand (supply) from its equilibrium value. The long-run money demand equation using data of 1991 Q1 – 2009 Q4 reads

$$m_t = 4.351 + \underset{(3.927)}{0.544} cpi_t + \underset{(21.131)}{1.505} y_t - \underset{(6.281)}{0.068} R_t \quad (4)$$

where m_t is the logarithm of money supply, cpi_t the logarithm of CPI index, y_t is the logarithm of real GDP, and R_t is the one-year benchmark deposit rate (t-statistics in parentheses). The Johansen co-integration test indicates that there exists one co-integration relationship between money supply, CPI index, GDP and deposit rate, justifying our estimate of equilibrium money with the above equation. Figure 5 shows that there exists a significant positive relationship between output gap and food-price inflation and between excess money and food-price inflation, possibly suggesting demand pressures have been important determinants of China's food-price inflation.

⁵ The IMF's Asia Pacific Department has estimated China's output gap using the growth accounting methodology with annual data, and we convert their estimates into quarterly data with the Eviews software.

Figure 5: Output gap, excess money and food-price inflation (1993 Q1 – 2009 Q4)

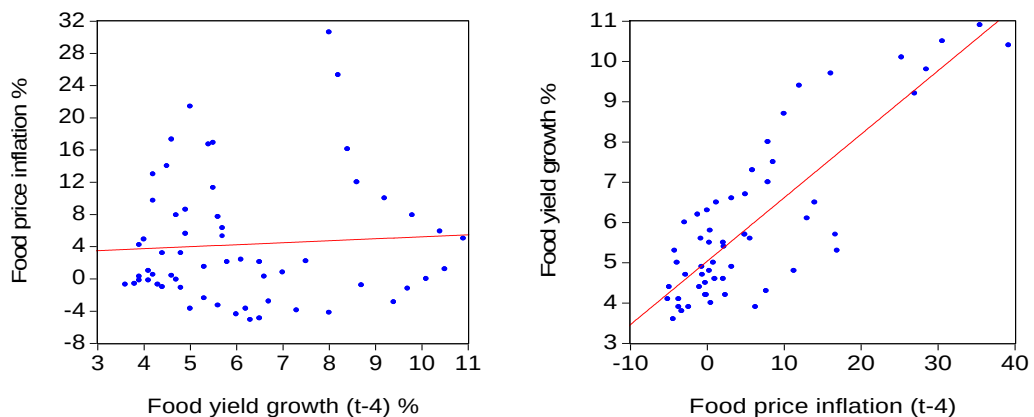


Note: The output gap in this figure is measured as the percentage deviation of real GDP from its HP filter trend.

Sources: CEIC and authors' estimates.

As global food-price inflation is excluded from the regression, supply-side factors will be captured with food production costs and natural disasters or food yields.⁶ Theoretically, the higher the food yield growth, the lower the food-price inflation, but Figure 6 does not demonstrate a significant negative relationship between the four-quarter lag of year-on-year food yield growth and food-price inflation (left-hand panel). This appears to suggest that food yield has not played a notable role in China's food-price inflation. In contrast, there does exist a significant positive relationship between the four-quarter lag of food-price inflation and food yield growth (right-hand panel), suggesting higher food prices would prompt production of food.

Figure 6: Food-price inflation and food yield growth (1994 Q1 – 2008 Q4)



Sources: WIND and authors' estimates.

⁶ As natural disasters exert adverse impact on food yields, we just use one of the two variables in the regressions instead of including both simultaneously.

The estimation results presented in Table 3 indicate that demand pressures have been important determinants of China's food-price inflation.⁷ In contrast, although the coefficients of supply-side factors have correct signs, they are statistically less significant than demand-side variables. Variance decomposition analysis further shows that supply-side effect accounts for a smaller part of China's food-price inflation variation. In estimation A, for example, supply-side effect accounts for 16.8% of food inflation variation, compared with a contribution of 23.7% by demand pressures. In estimation B, the contribution by supply-side effect and demand pressures is 16.5% and 31.9% respectively. This suggests demand pressures have likely been more important in determining China's food-price inflation from a medium-term perspective.

Table 3: Determinants of China's food-price inflation (1996 Q1 – 2009 Q2)

		Estimation A		Estimation B	
Variable		Coefficient	T-statistic	coefficient	T-statistic
Persistence effect		0.101	2.049	0.120	2.583
Demand pressures	Output gap	0.592	1.900	1.966	2.403
	Excess money	0.257	3.037	0.287	3.755
Supply effect	Food yield or natural disasters	-0.891	-1.551	2.340	0.912
	Production costs	0.182	1.467	0.228	1.877
R^2		0.618		0.739	

Notes: (1) In estimation A, output gap is measured with the estimates by the IMF using the growth accounting methodology, and supply effect is measured as the year-on-year food yield growth and food production costs proxied with the year-on-year changes in the aggregate agricultural production price index of inputs. In estimation B, output gap is measured as the percentage deviation of real GDP from its HP-filter trend. Supply effect is measured as the absolute value of the deviation of temperature from its sample mean (a proxy of natural disasters) and food production costs. A higher temperature in absolute terms implies a more severe natural disaster. Therefore, the higher the temperature in absolute terms, the higher the food-price inflation should be.

(2) We try the estimation with up to four-quarter lags of explanatory variables in both estimations and present the results with the most significant t-statistic.

(3) As the correlation coefficient between food-price inflation and output gap is as high as 0.57, it is inappropriate to include the lagged food-price inflation as an explanatory variable. We use the one-period lag of imported food-price inflation as an instrument to capture the impact of the inertia of food-price inflation. While the correlation between the imported food-price inflation and China's domestic food-price inflation is significant, that between the imported food-price inflation and China's output gap is much lower.

Sources: CEIC, China Statistical Yearbook (various issues) and authors' estimates.

⁷ We have also used the difference between broad money (M2) growth and nominal GDP growth to measure excess money. The problem is the excess money measured in this way is highly correlated with output gap, with the correlation coefficient being as high as 0.83 in the past 15 years. As a result, most explanatory variables in the regression have wrong signs.

3. *Determinants of food-price inflation: evidence with panel data of annual frequency at national level*

This section further studies how demand pressures and supply-side factors affect China's food-price inflation with panel data for various food items at national level of 1994 – 2008. Food items to study here include grain, meat, fruit and vegetables. While demand pressures are captured by output gap and excess money, supply-side factors are captured with food production costs, yield growth or natural disasters (the ratio of disaster-affected areas to disaster-covered areas). Estimation results are shown in Table 4. It appears that both demand pressures and supply-side variables are important in determining these foodstuffs' inflation as they are both statistically significant. Variance decomposition analysis, however, shows that supply-side effect accounts for 27.9% of China's food-price inflation variation in estimation A, compared with a contribution of 29.0% by demand pressures. The contribution by supply-side effect and demand pressures to food-price inflation variation in estimation B is 22.3% and 35.0% respectively. This also suggests demand pressures have likely played a more important role from a medium-term perspective.

Table 4: Determinants of China's food-price inflation using national panel data (1994 – 2008)

		Estimation A		Estimation B	
Variable		Coefficient	T-statistic	Coefficient	T-statistic
Demand pressures	Output gap	0.690	1.900	0.692	1.952
	Excess money	0.429	2.100	0.532	2.625
Supply effect	Food yield or natural disasters	-0.612	-2.880	0.490	2.604
	Production costs	0.590	2.886	0.433	2.062
R^2		0.596		0.566	

- Notes:(1) In estimation A, output gap is measured by the estimates of the IMF, and supply effect is measured as the year-on-year food yield growth and the annual growth of food production costs. Food production costs for grain, fruit and vegetables are measured as the weighted sum of the price changes in small farm tools, semi-mechanised farm machinery, mechanised farm machinery, chemical fertilisers, pesticides and pesticidal appliances and oil for farm machinery. The weights of these components are obtained by running a panel regression of inflation of provincial agricultural production price index of inputs on its major components using annual data of 1994 – 2009. Production costs for meat are measured as the year-on-year inflation of forage. In estimation B, output gap is the same as in estimation A, and supply effect is measured as the ratio of disaster-affected areas to disaster-covered areas and the annual growth in food production costs.
- (2) A dummy variable is used to capture the possible impact of the blue ear disease on meat prices in 2007.
- (3) Fixed effect is assumed in the regression.

Sources: CEIC, WIND and authors' estimates.

4. *Determinants of food-price inflation: evidence with annual panel data at provincial level*

This section studies how demand pressures and supply-side shocks affect the inflation of various foodstuffs at provincial levels. Estimation is conducted for each food item (grain, meat, fruit and vegetables) separately with panel data of annual frequency of 1995 – 2008. The main finding is consistent with that of the previous section, that is, demand pressures appear to have outweighed the impact of supply-side shocks from a medium-term perspective.

Demand pressures are still captured with output gap and money supply. Output gaps at provincial levels are estimated using the production function methodology. The production function is assumed to take the following form:

$$Y_t = A_t (V_t K_t)^\rho L_t^{1-\rho} \quad 0 < \rho < 1, \quad (5)$$

where Y denotes output, A is total factor productivity, V denotes the utilisation index of capital stock, K denotes capital stock, and L is employment. In log terms the above equation reads:

$$y_t = a_t + \rho(v_t + k_t) + (1 - \rho)l_t. \quad (6)$$

Following Fuentes et al. (2007), we assume actual capital stock equals potential capital stock and use the deviation of electricity consumption from its HP-filter trend to measure the fluctuations of capital utilisation. Using the deviation of actual employment from its HP-filter trend to measure employment gap, we construct provincial output gaps based on the estimate of ρ in He et al. (2007).

Figure A-2 in the Appendix shows that there exists a significant positive relationship between output gap and food-price inflation in all provinces, possibly suggesting output gap has been an important determinant of food-price inflation. As no data for money supply at provincial level is available, we use the growth in savings deposit as a proxy for money supply. Supply-side effect is captured by food production costs and natural disasters measured as the ratio of disaster-affected areas to disaster-covered areas at provincial level or the yield growth of corresponding food items. Food production costs for grain, fruit and

vegetables at provincial level are measured by the weighted annual price changes in small farm tools, semi-mechanised farm machinery, mechanised farm machinery, chemical fertilisers, pesticides and pesticidal appliances and oil for farm machinery of each province.⁸ The production costs for meat at provincial levels are measured as the annual price changes in forage of each province. Evidence shows a positive relationship between food production costs and food-price inflation. Meanwhile, Figure A-3 in the Appendix demonstrates that there exists a positive relationship between the natural disasters and food-price inflation in 16 of 31 provinces, suggesting natural disasters may have also played a role in determining provincial food-price inflation, as suggested by some economists.

The estimation results presented in Table 5 indicate that both demand pressures and supply-side shocks are important determinants of the inflation of various food items. Nevertheless, variance decomposition analysis shows that supply-side factors account for 9.0% of grain-price inflation variation, compared with a contribution of 13.3% by demand pressures (Table 6). The contribution of supply-side effect to the variation of meat-price inflation, fruit-price inflation and vegetable-price inflation is 5.0%, 8.5% and 6.7% respectively, compared with the contribution by demand pressures of 29.0%, 22.0% and 7.8%. This also suggests demand pressures have been more important in driving food-price inflation in the longer term.

Table 5: Determinants of various foodstuff price inflation

		Grain		Meat		Fruit		Vegetables	
Variable		Coef.	T-st.	Coef.	T-st.	Coef.	T-st.	Coef.	T-st.
Demand pressures	Output gap	0.675	4.247	0.661	4.004	0.690	4.987	0.480	2.866
	Money	0.331	6.201	0.484	8.410	0.230	4.844	0.264	4.428
Supply effect	Food yield or natural disasters	-0.116	-3.201	-0.052	-1.661	0.087	2.560	0.118	2.658
	Production costs	0.548	5.752	0.065	2.670	0.247	2.983	0.367	5.424
R^2		0.578		0.555		0.326		0.317	

Notes: (1) Supply-side factors for grain and meat are measured as the one-year lag of year-on-year yield growth of these two food items and their production costs. Supply-side effect for fruit and vegetables is measured as the ratio of disaster-affected areas to disaster-covered areas and their production costs.

(2) A dummy variable is used to capture the possible impact the blue ear disease on meat prices in 2007.

(3) A dummy variable is used to capture the abrupt jump in grain inflation in 2004.

(4) Fixed effect is assumed in the regression.

Sources: CEIC, WIND and authors' estimates.

⁸ We first regress the aggregate agricultural production price index inflation of inputs on its major components with panel data at provincial level of 1994 - 2009, and then use the estimated weights to construct the food production costs for each province. As the breakdown of agricultural production price index inflation of inputs for Beijing, Chongqing, Shanghai and Tianjin is not available, we use the annual changes in the national agricultural production price index of inputs as the food production costs for these cities.

Table 6: Variance decomposition for foodstuff price inflation (%)

	Grain	Meat	Fruit	Vegetables
Demand pressures	13.3	29.0	22.0	7.8
Supply effect	9.0	5.0	8.5	6.7

Source: authors' estimates.

5. *Policy implications*

The finding that demand pressures have played a major role in determining China's food-price inflation provides some useful policy implications. Economic theories suggest that monetary policy should only respond to core inflation to avoid undue volatility in output as food-price inflation is usually believed to be caused by temporary supply shocks such as natural disasters. Our study shows that this rule may not be appropriate for emerging market economies as food-price inflation in these economies may also reflect potential demand pressures. This is because upward pressures on food-price inflation can be more intense in emerging market economies than in advanced economies when demand rises. As food prices respond faster to rising demand than non-food prices, surging food prices may call for policy reactions to contain potential demand pressures even if non-food-price inflation is still tame.⁹ This can be true for a considerable period of time in China owing to the continued process of urbanisation. Urban residents tend to consume more meat, processed foods, and restaurants than rural residents. Empirical evidence shows that per capita consumption of red meat in China's urban areas was 40% higher than in rural areas in 2000, while per capita consumption of eggs and poultry in urban areas was 2.5 times higher than in rural areas (Hsu et al. 2002).

III. HOW HAS FOOD-PRICE INFLATION AFFECTED CHINA'S AGGREGATE INFLATION?

This section explores how food-price inflation has affected China's non-food and aggregate inflation. As food is a large component of China's CPI basket, its direct contribution to aggregate inflation is significant. In the research below we focus on the other two major channels through which food-price inflation feeds into aggregate inflation. First of all, we would like to see whether

⁹ See Cheung et al. (2008) for a similar argument.

food-price inflation drives up China's wage, and then we analyse whether food-price inflation affects inflationary expectations on the Mainland. Our analysis shows that food-price inflation has translated into China's non-food-price inflation mainly through pushing up inflationary expectations rather than by prompting wage growth.

1. *Has food-price inflation driven up China's wage growth?*

Figure A-4 in the Appendix shows a positive relationship between past food-price inflation and current wage growth in only five of the 31 provinces, probably suggesting limited role played by food-price inflation in pushing up China's wage growth. To get a better understanding of wage growth, it is necessary to estimate the wage determination equation:

$$\Delta W = f(\text{employment rate}, \text{productivity}, \pi_{\text{food}}) \quad (7)$$

where ΔW denotes year-on-year wage growth.¹⁰ The official unemployment rate at provincial level is not a good indicator of the employment situation in China because it records only registered unemployment which has been relatively smooth in the past years. Moreover, it is of annual frequency while we will use quarterly data to estimate the above equation. Therefore, in the research below we use the ratio of the number of employed per household to the number of persons per household as a proxy for labour market conditions. Following Ha et al. (2003), we measure labour productivity with the ratio of real GDP to employment. The regression is conducted using 2003 – 2009 quarterly panel data at provincial level. The Generalised Method of Moments is used to estimate the parameters of the dynamic panel model, with the instruments including the 2 – 5 lags of wage growth, productivity, employment ratio and food-price inflation. Estimation results are shown in Table 7.

¹⁰ Such a model can be found in Ha et al. (2003).

Table 7: Determinants of wage growth

Variable	Coefficient	T-statistic
Persistence effect	0.045	6.173
Employment ratio	0.273	0.860
Productivity	0.213	2.494
Food-price inflation	0.001	0.050
J-statistic	27.450	

Notes:(1) Persistence effect is captured with the one-period lag of wage growth, and instrument variables include the lags of employment ratio, productivity, food-price inflation and wage growth of up to five periods.

(2) Statistic tests indicate that over-identifying conditions are satisfied in our estimation.

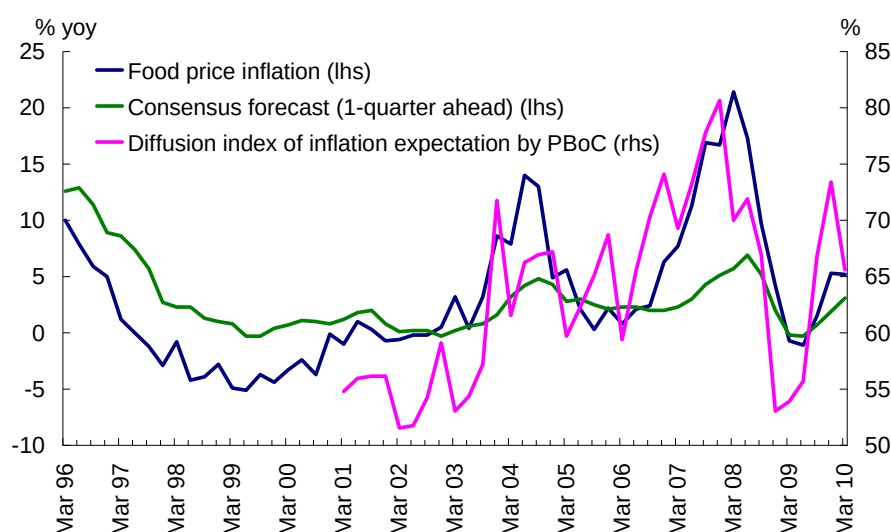
Sources: CEIC, WIND and authors' estimates.

The estimation results indicate neither labour market conditions nor food-price inflation has been a major determinant of China's wage. Instead, productivity has been the driver for China's wage growth. This suggests wage setting is not a major channel through which food-price inflation feeds into aggregate inflation, probably owing to the abundant labour supply in China which exert little influence on wage setting. However, this situation may change down the road. Empirical evidence indicates that the share of young people (15 – 29 years old) in China's population will shrink by about seven percentage points in the next ten years. The recent hikes in the wages of some big firms partly driven by strikes of migrant workers may presage a wave of wage adjustments in the manufacturing industry. In addition, the Central Government has shown strong determination to narrow the income disparity between high and low income groups and to steer China's growth pattern towards a more consumption-driven path. All these factors point to the strengthening of workers' power in wage setting .

2. *Has food-price inflation affected China's inflationary expectations?*

We use the mean of the consensus forecast for inflation to measure inflationary expectations in China, and Figure 7 appears to suggest that food-price inflation leads inflationary expectations. To have a better understanding of the relationship between the two variables, we undertake a Granger-causality test for food-price inflation and inflationary expectations. The results of test with quarterly data of 1995 Q1 – 2010 Q1 shown in Table 8 demonstrate the hypothesis that food-price inflation does not Granger-cause inflationary expectations should be rejected, suggesting food-price inflation has prompted inflationary expectations.

Figure 7: Food-price inflation and inflationary expectations



Note: The diffusion index of inflationary expectation is not an index of expected inflation rate. A higher number of this index suggests that more people believe inflation will rise, and a decline in the index suggests that fewer people expect inflation to rise.

Sources: Consensus forecast (various issues), CEIC and the PBoC.

Table 8: Granger-causality tests for food-price inflation and inflationary expectations

Null hypothesis	F-statistic	Remark
Food-price inflation does not Granger-cause (GC) expected inflation of $t+1$	10.248	Reject*
Food-price inflation does not GC expected inflation of $t+2$	7.697	Reject*
Food-price inflation does not GC expected inflation of $t+3$	6.458	Reject**
Food-price inflation does not GC expected inflation of $t+4$	9.795	Reject*

Notes: (1)* denotes rejection of the null hypothesis at 1% level of significance, and ** denotes rejection of the null hypothesis at 5% level of significance.

(2) The hypothesis that expected inflation does not GC food-price inflation should be accepted at 1% level of significance. Test results are not presented here.

Sources: CEIC and authors' estimates.

3. *Is headline CPI inflation reverting to non-food inflation or vice versa?*

This section follows Cecchetti and Moessner (2008) in studying whether headline CPI inflation reverts to non-food inflation and vice versa. If headline inflation has been reverting to non-food inflation, increases in food inflation have been temporary and have not led to persistently rising headline inflation that could arise from persistent upside shocks to food-price inflation or from second-round effects due to higher inflationary expectations and wage growth. On the other hand, if non-food-price inflation is reverting to headline inflation,

there would be significant spillovers from food-price inflation to non-food-price inflation. Our findings are: (a) headline inflation is partially reverting to non-food-price inflation, and (b) non-food-price inflation has not been closely catching up with headline inflation. These suggest that food-price inflation has not generated significant second-round effects on non-food-price inflation.

To explore whether headline inflation reverts to non-food-price inflation, we use the following equation:

$$\pi_t^{head} - \pi_{t-12}^{head} = \alpha + \beta(\pi_{t-12}^{head} - \pi_{t-12}^{non-food}) \quad (8)$$

where π_t^{head} denotes headline CPI inflation on a year-on-year basis, while $\pi_t^{non-food}$ denotes year-on-year non-food-price inflation. If headline inflation is reverting to non-food-price inflation within one year, the estimate of β should be negative. In an extreme case, if α equals 0 and β equals -1, headline inflation would be fully reverting to non-food-price inflation. The estimate of β based on monthly data of January 1997 – March 2010 is -0.668 with the t-statistic being -4.64 ($R^2 = 0.121$). The hypothesis that α equals 0 and β equals -1 should be rejected at the significance level of 1%, indicating headline inflation is only partially reverting to non-food-price inflation. This is because, first of all, food-price inflation has been somewhat persistent, and secondly, it has generated some second-round effects through driving up China's inflationary expectations.

Meanwhile, the following equation is estimated to see whether non-food-price inflation is reverting to headline inflation:

$$\pi_t^{non-food} - \pi_{t-12}^{non-food} = \varphi + \delta(\pi_{t-12}^{non-food} - \pi_{t-12}^{head}) \quad (9)$$

If δ is negative, non-food-price inflation is to some extent catching up with headline inflation within one year, suggesting that food-price inflation has generated some second-round effects on non-food-price inflation. If δ is zero, non-food-price inflation is not catching up with aggregate inflation at all, suggesting that food-price inflation has generated little second-round effect. The estimate of δ using monthly data of January 1997 – March 2010 is -0.171, with the t-statistic being -1.916 ($R^2 = 0.023$). The hypothesis that δ is zero can be accepted at 5% level of significance, suggesting that non-food-price inflation is only marginally reverting to headline inflation.

IV. CONCLUDING REMARKS

It is typically argued that past episodes of food-price inflation on the Mainland have been mainly driven by supply-side shocks. Using both household and macro-level data, this paper studies the determinants of China's food-price inflation and analyses how it has fed into the aggregate inflation. Main findings are summarised as follows.

- The expenditure elasticities for various food items in China have been positive, suggesting that a rise in household consumption expenditure would lead to stronger demand for food. In particular, the expenditure elasticity for meat and poultry has been over unity, suggesting that a 1% increase in household expenditure would lead to a more than 1% increase in the demand for these foodstuffs. This may partly explain why meat and poultry prices have been a major component of China's aggregate food-price inflation.
- Analysis using macro-level data at both national and provincial levels indicates that while supply-side shocks have played a role in determining China's food-price inflation, demand pressures have been more important from a medium-term perspective. This finding also provides some useful policy implications. As rising food prices may reflect the impact of rising demand in addition to supply-side shocks, surging food-price inflation may call for policy reactions to contain potential demand pressures even if non-food-price inflation is still tame.
- Food-price inflation has not generated significant second-round effects on non-food-price inflation. In particular, while food-price inflation affected inflationary expectations on the Mainland, it has not been a driving force for China's wage growth. This situation may change down the road as workers exert more influences on wage setting in the medium term.

REFERENCES

- Cecchetti, S. G., and R. Moessner (2008), “Commodity prices and inflation dynamics”, *BIS Quarterly Review*, December 2008.
- Cheung, L., J. Szeto, C. Tam and S. Chan (2008), “Rising food prices in Asia and implications for monetary policy”, *Hong Kong Monetary Authority Quarterly Bulletin*, September 2008.
- Frankel, J. A. and G. A. Hardouvelis (1985), “Commodity prices, money surprises and Fed credibility”, *Journal of Money, credit and Banking*, 17 (4), 425 – 438.
- Fuentes, R., F. Gredig and M. Larrain (2007), “Estimating the output gap for Chile”, Central Bank of Chile, Working Papers 455.
- Ha, J., K. Fan and C. Shu (2003), “The causes of inflation and deflation in Mainland China”, *Hong Kong Monetary Authority Quarterly Bulletin*, September 2003.
- He, D., W. Zhang and J. Shek (2007), “How efficient has been China’s investment? Empirical evidence from national and provincial data”, *Pacific Economic Review*, 12(5), 597 – 617.
- Hsu, H. H., W. S. Chern and F. Gale (2002), “How will rising income affect the structure of food demand?” in *China’s Food and Agriculture: Issues for the 21st Century*, US Department of Agriculture, Agriculture Information Bulletin No. 775.
- Huang, Y., X. Wang and X. Hua (2010), “What determines China’s inflation?” CCER Working Paper 2010 – 2, Peking University.
- Kaaresvirta, J., T. Koivu and A. Mehrotra (2008), “China and food price developments”, Bank of Finland, Focus/Opinion, 3/2008.
- Ng, G. and Q. Wang (2008), “China: inflation to ease again after temporary storms pass”, Economic Research Note, JPMorgan Chase Bank, 31 January 2008.

OECD (2010), “Demand growth in developing countries”, Trade and agriculture Directorate Committee for Agriculture, manuscript.

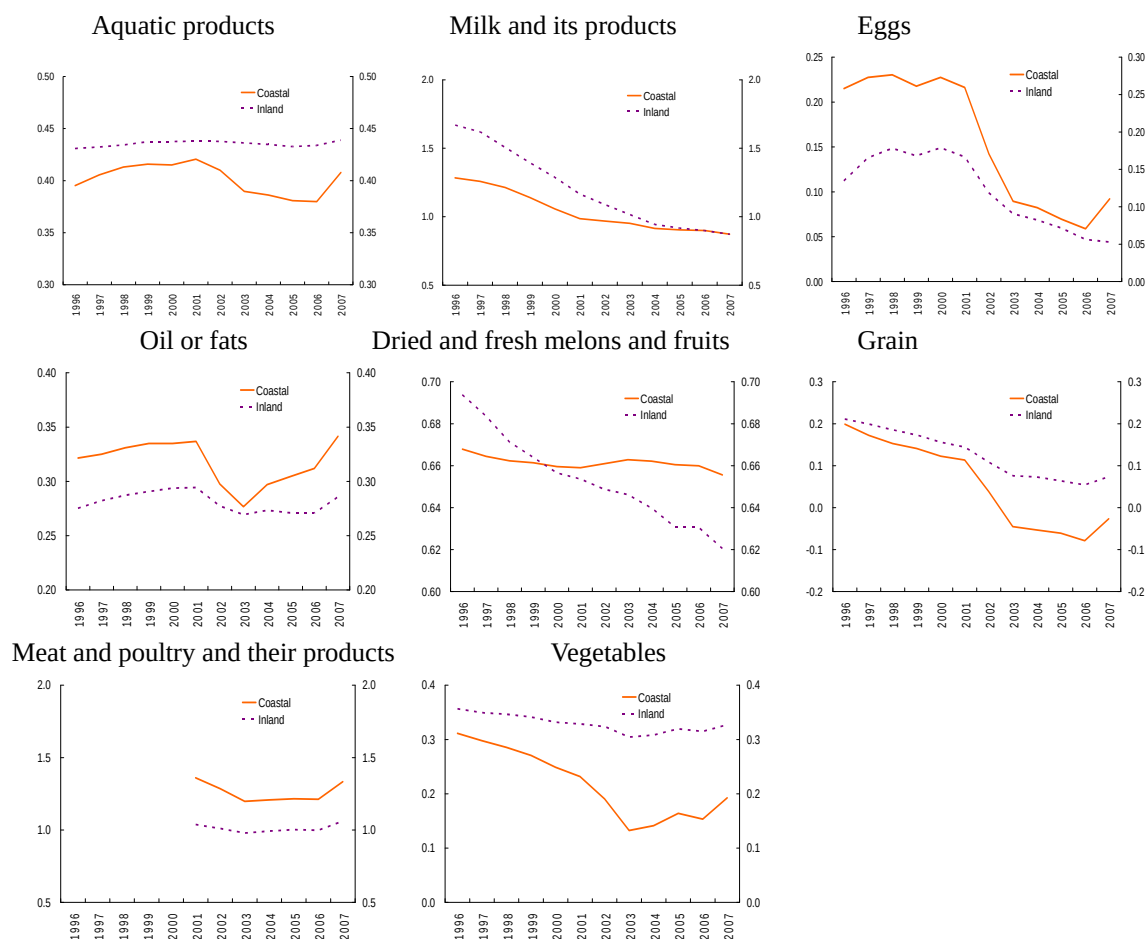
World Bank (2007), “Quarterly update May 2007”, World Bank Office, Beijing, at www.worldbank.org.cn.

----- (2008), “Quarterly update February 2008”, World Bank Office, Beijing, at www.worldbank.org.cn.

Zhang, Q. and M. Reed (2008), “Examining the impact of the world crude oil price on China’s agricultural commodity prices: the case of corn, soybean, and pork”, paper presented at the Southern Agricultural Economic Association Annual Meetings, Dallas, TX, 2 – 5 February, 2008.

APPENDIX

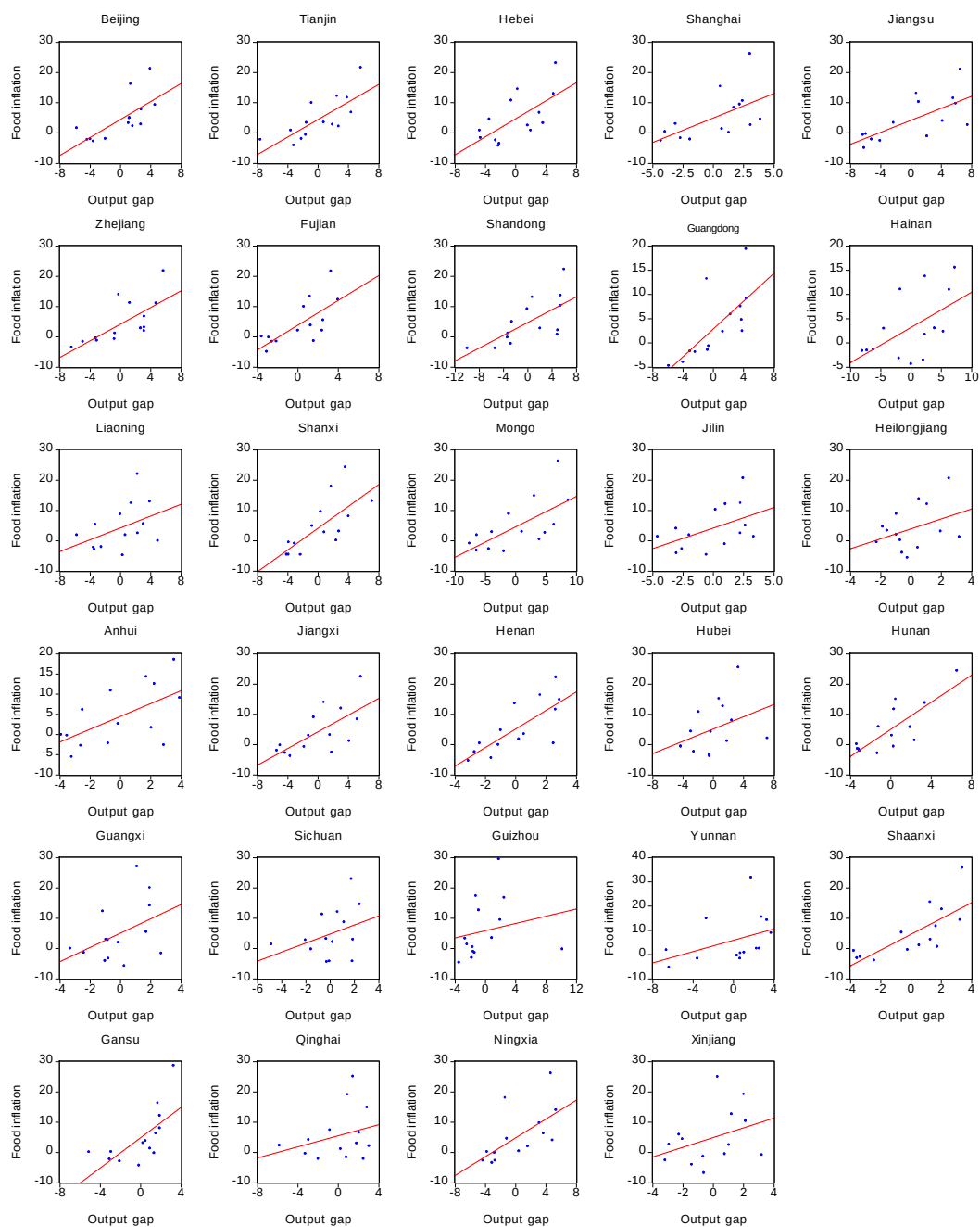
Figure A-1: Expenditure elasticities for major food items in China



Note: Coastal areas include those in Beijing, Fujian, Hainan, Hebei, Jiangsu, Liaoning, Shandong Shanghai, Tianjin and Zhejiang. Inland areas include the remaining areas of these provinces and cities, except Chongqing and Tibet for which not all required data are available.

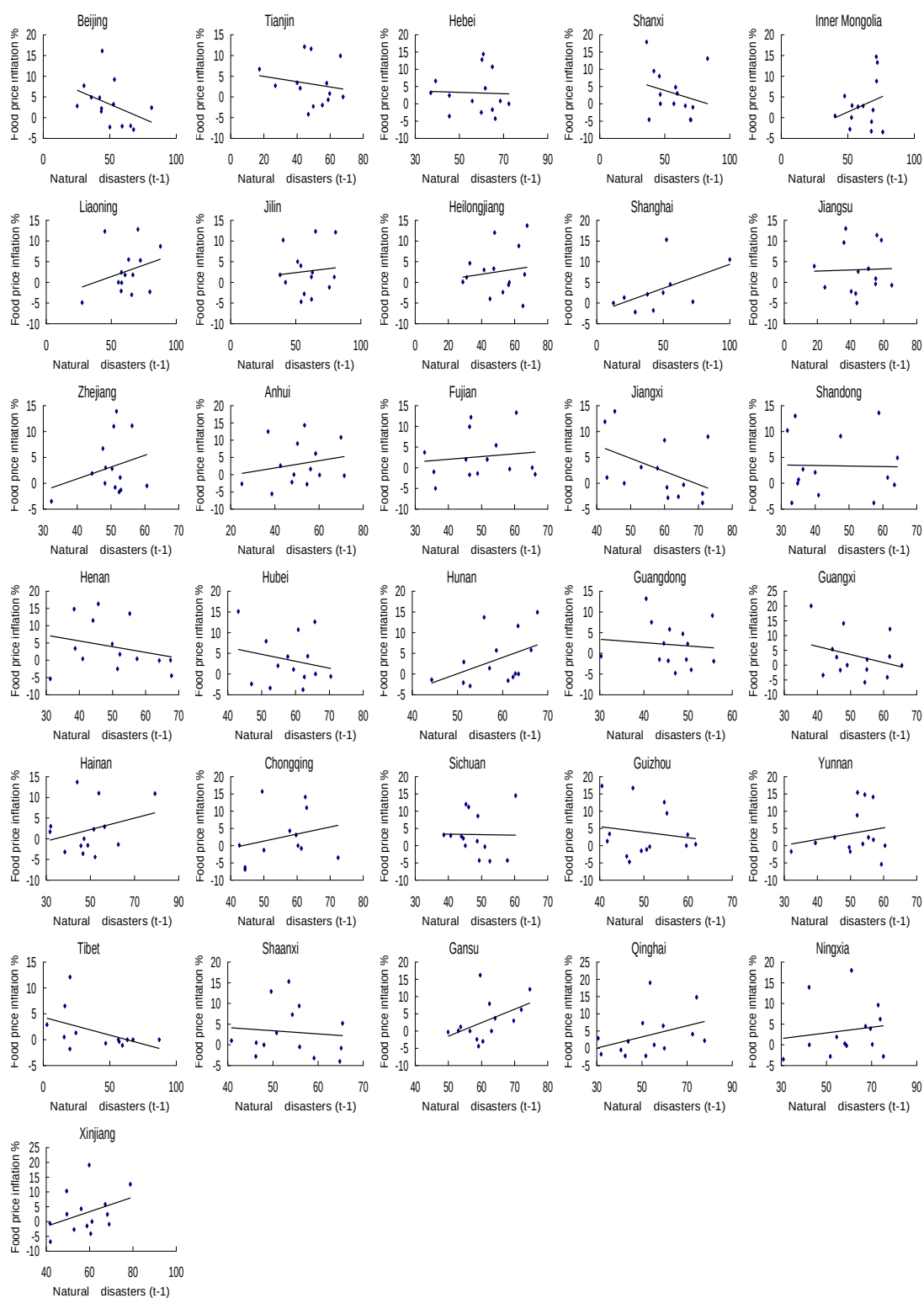
Sources: China Urban Life and Price Yearbooks 1996 – 2008 and authors' estimates.

Figure A-2: Output gap and food-price inflation of 1995 – 2008 (%)



Sources: CEIC and authors' estimates.

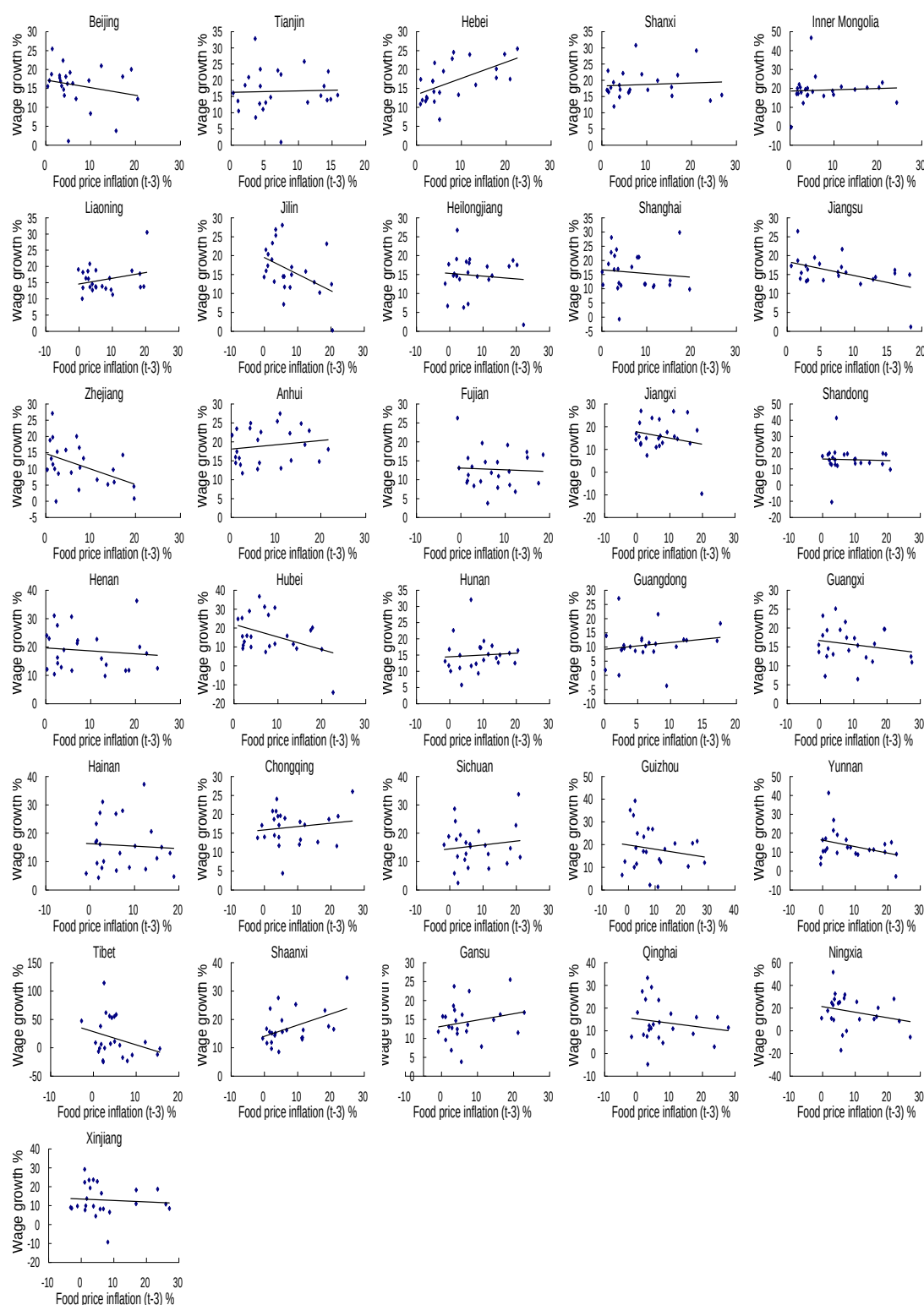
Figure A-3: Natural disasters and food-price inflation (1995 – 2008)



Note: Natural disasters are measured as the ratio of disaster-affected areas to disaster-covered areas.

Sources: China Statistical Yearbooks (various issues) and authors' estimates.

Figure A-4: Food-price inflation and wage growth (2003 Q1 – 2009 Q4)



Sources: CEIC and authors' estimates.