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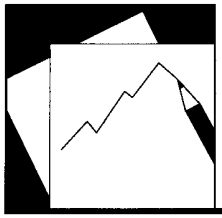

IMF Working Paper

Inflation Dynamics in Mongolia: Understanding the Roller Coaster

Steven Barnett, Julia Bersch, and
Yasuhisa Ojima

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Asia and Pacific Department

Inflation in Mongolia: Understanding the Roller Coaster [1]

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Abstract

Inflation in Mongolia resembles a roller coaster ride with sharp rises and steep drops. Understanding why is critical for formulating and assessing monetary policy. Food prices are found to be a key driver of inflation, and, not surprising given Mongolia's geography, are determined primarily by local supply conditions, highly seasonal, and subject to large but short-lived shocks (usually weather related). Nonetheless, demand factors are also found to be significant in explaining price movements and empirical evidence suggests that a 10 percent increase in government wages, for example, would push up underlying inflation by 1 percentage point. So, while inflation will remain volatile due to agricultural shocks, there is space for macroeconomic stabilization policy to help reduce inflation volatility.

JEL Classification Numbers: E31; E32; C22

Keywords: Mongolia, Inflation

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[1] We have benefited from comments by Gerald Almekinders. Any remaining errors are our own.

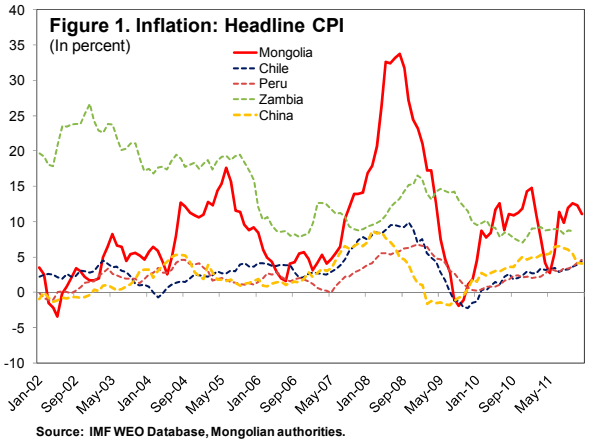
Contents

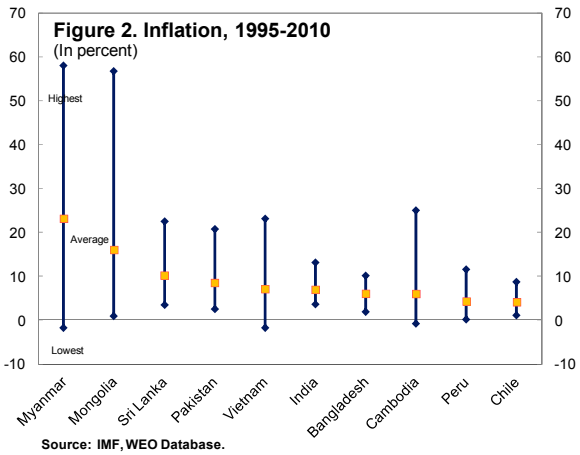
Figures

Tables

I. INTRODUCTION

Inflation in Mongolia has been volatile and fairly high (Figures 1 and 2). After peaking at over 30 percent in the summer of 2008, inflation turned negative a year later, and then returned to double digits in mid-2010. Inflation dipped again in early 2011 to return to double digits by the summer of 2011. Conducting stabilization policy when inflation seems to be on a roller coaster is, to put it mildly, quite difficult.

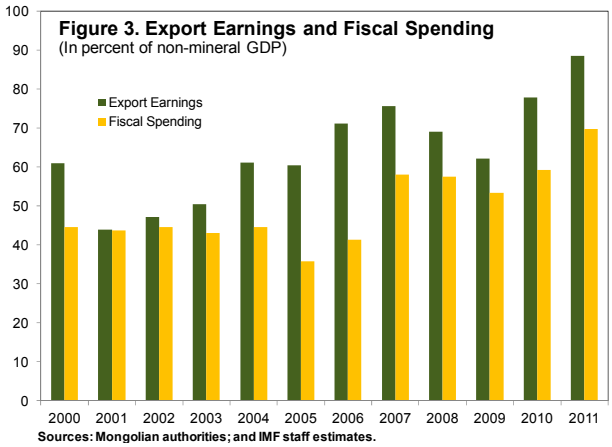




The central bank is committed to achieving low and stable inflation, and calibrates monetary policy accordingly (IMF, 2012). To do so successfully, however, requires a good understanding of the factors driving inflation, and, in particular, the ability to distinguish in real time between supply shocks—that are likely to wash out on their own—and price pressures due to excess demand. Indeed, given that monetary policy works with a lag of six months or more, the central bank could inadvertently exacerbate price volatility by mistakenly responding to a supply shock since the full force of the policy response would hit just as the supply shock was unwinding. On the other extreme, though, not responding to price pressures stemming from excess demand could lead to a period of protracted high inflation that could undermine the central bank's credibility and require a costly disinflationary response.

Moreover, the Mongolian economy is subject to large supply and demand shocks. On the supply side, Mongolia is a landlocked country, experiences harsh winter conditions, and is geographically large all of which point to high transport costs and the potential for supply bottlenecks. On the demand side, mineral exports are a key driver of the economy, but are also volatile due to global commodity price shocks. Indeed, the collapse of international copper prices in 2008 was the spark that ignited the ensuing economic crisis. The fuel, however, was an excessively loose fiscal policy characterized by rapid growth in government spending, which left the economy vulnerable to a downturn in copper prices. The crisis led the authorities to request a Stand-by Arrangement from the IMF, which succeeded fairly quickly in stabilizing the economy thanks to the authorities' strong policy implementation, financial support from the donor community, and a bit of luck as copper prices rebounded fairly fast (Barnett and Bersch, 2010). The reliance on mineral revenue makes the economy vulnerable to boom-bust policymaking whereby the economic impact of mineral price shocks

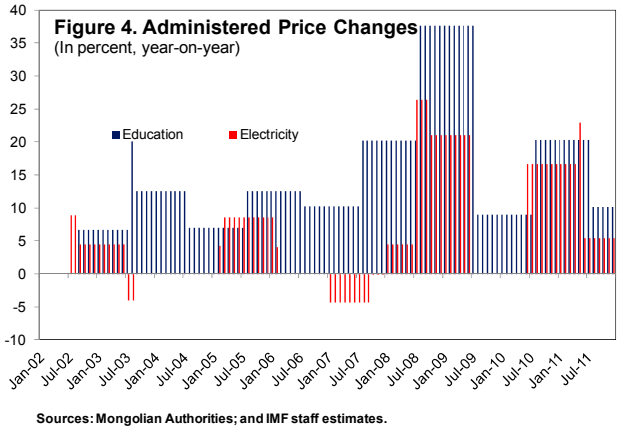
is amplified by a pro-cyclical fiscal policy. Government spending, moreover, is large relative to the non-mineral economy (equivalent to roughly two-thirds of non-mineral GDP), which makes changes in government spending a key source of demand volatility (Figure 3). Supply and demand factors are both, therefore, contributing to Mongolia's inflation volatility.



This paper is organized as follows: Section II looks closely at the composition of the CPI and presents some stylized facts; Section III examines the time series properties of inflation; Section IV empirically examines the role of demand factors; Section V examines the international context; and Section VI concludes.

II. A Closer Look at the Consumer Price Index

Inflation can be better understood by splitting the Consumer Price Index (CPI) into its components.[2] We distinguish three sub-indices: (i) administered prices; (ii) food prices; and (iii) underlying prices, which cover all non-food and non-administered prices. The combined food and underlying prices are labeled market prices (Table 1). Administered prices, accounting for 22 percent of the basket, include items whose prices are adjusted infrequently, such as tuition fees that are adjusted once a year when the new school year starts (Figure 4). It is useful to separate administered prices from others as the timing and size of price changes is not driven solely by market forces. Decisions for setting administered prices generally have a strong backward looking aspect—catching up with past inflation—and include a policy element as discretion can be exercised in deciding when and by how much to adjust administered prices.



Food prices, which account for about 40 percent of the basket, are a key driver of changes in inflation and of inflation volatility. Food prices constitute the largest bucket in the CPI and are more volatile than other components (Figures 5 and 6). Movements in food prices reflect to a large extent supply shocks to agriculture, such as the severe winter in 2010–11, rather than changes in demand conditions.

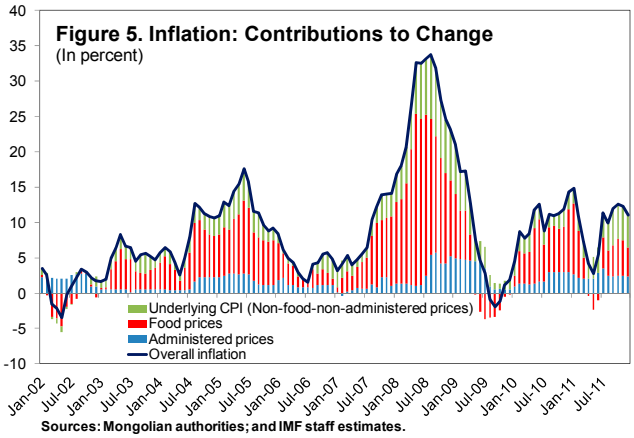
[2] The Ulaanbaatar CPI is used throughout the analysis as data are available for a longer time period than for the national CPI; the two indices closely resemble each other (see Annex).

Hence, underlying inflation, which removes food and administered prices from the CPI, is likely to give a much clearer picture of aggregate demand-driven inflationary pressures than headline inflation. A shortcoming, though, is that the constructed measure of underlying inflation represents less than half of the CPI basket making it a fairly narrow measure. Underlying inflation is a key series that IMF staff uses to analyze inflation in Mongolia.

Table 1. Descriptive Statistics of the Overall Inflation Rate and the Main Subcomponents
(Sample: Dec 2001 - Dec 2011)

	Weights	Mean (in percent)		Standard deviation		Coefficient of variation 1/	
		year-on-year	seasonally adjusted month-on-month	year-on-year	seasonally adjusted month-on-month	year-on-year	seasonally adjusted month-on-month
Overall CPI	100.0	**9.2**	**0.8**	**7.7**	**1.3**	**0.8**	**1.7**
Market prices	78.3	9.4	0.8	9.0	1.5	1.0	2.0
Food prices	41.1	11.5	0.9	12.4	2.4	1.1	2.6
Underlying CPI	37.3	7.3	0.6	5.9	1.0	0.8	1.7
Administered prices	21.7	8.8	0.7	6.8	1.8	0.8	2.5
Food and non-alcoholic beverages	41.1	11.5	0.9	12.4	2.4	1.1	2.6
Meat	16.5	15.2	1.3	17.4	4.6	1.1	3.5
Alcoholic beverages and tobacco	2.3	5.4	0.5	7.4	1.5	1.4	3.1
Clothing and footwear	12.4	6.8	0.6	7.0	1.2	1.0	2.0
Housing and utilities	13.4	7.3	0.6	7.0	2.3	1.0	3.6
Furnishing and household equipment	4.3	6.1	0.5	5.6	0.9	0.9	1.9
Health	1.6	10.0	0.7	9.3	1.7	0.9	2.4
Transport	8.7	8.9	0.7	9.8	3.3	1.1	4.4
Communications	4.0	6.8	0.5	21.2	4.4	3.1	9.3
Recreation and culture	3.3	4.2	0.3	4.1	1.2	1.0	3.6
Education	4.1	13.9	1.0	9.7	2.7	0.7	2.6
Restaurant and hotels	1.7	11.6	0.9	8.5	1.8	0.7	2.0
Miscellaneous	3.0	8.6	0.7	4.9	1.1	0.6	1.5

Sources: Mongolian authorities; and IMF staff estimates.
1/ Divided standard deviation by mean.



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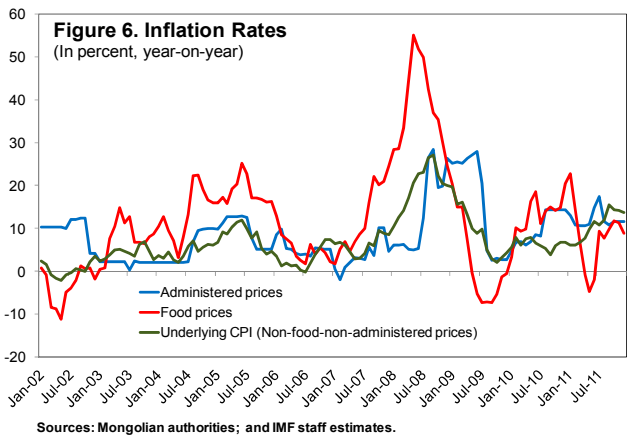
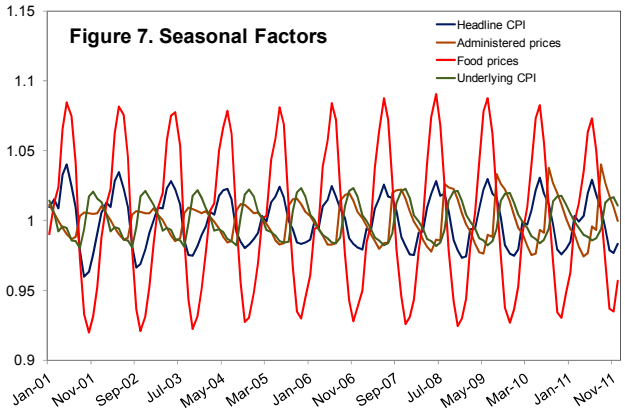


Sources: Mongolian authorities; and IMF staff estimates.

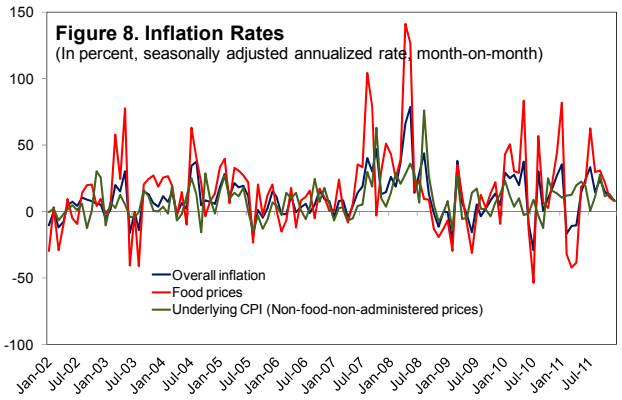
Prices in Mongolia, in particular food prices, follow a pronounced seasonal pattern. The seasonal factor for food prices, for example, in the first quarter is around 1.1, which, loosely speaking, means that food prices tend to be 10 percent higher in the early months of the year (Figure 7). This is consistent with the weather-induced seasonality in economic activity and

the difficulties those harsh winters imply for transporting food to the market.[3] Even after seasonally adjusting, food prices remain highly volatile, consistent with a market prone to supply shocks. Non-food prices, however, display a significantly less pronounced seasonality than food prices and actually move in the opposite direction. That is, non-food prices tend to be lower during the winter when economic activity is low. The seasonality in headline inflation, however, is clearly being driven by food prices, given their high weight in the basket.

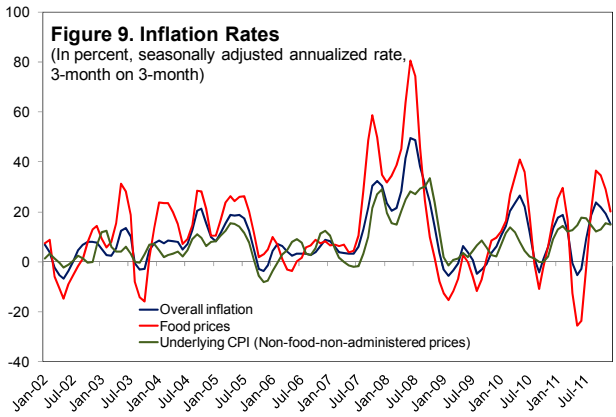


Sources: Mongolian authorities; and IMF staff estimates.

Using seasonally adjusted prices, we construct a measure of inflation momentum. As month-on-month price changes are highly volatile (Figure 8), a three-month moving average of the seasonally adjusted data is used to construct a smoother indicator of inflation with a lower noise to signal ratio. Inflation momentum is then defined as the seasonally adjusted quarter-on-quarter annualized inflation rate (labeled three-months on three-months in Figure 9).[4] While this smoother measure of inflation is less volatile, it retains the roller coaster shape. Food price inflation continues to be the highest and the most volatile (Table 1). Underlying inflation, in contrast, has the lowest average inflation and smallest standard deviation.



Sources: Mongolian authorities; and IMF staff estimates.



Sources: Mongolian authorities; and IMF staff estimates.

[3] First quarter real GDP, for example, is generally only half the size of the other quarters.

[4] Formally, we use log differences to approximate the percentage change.

III. Understanding Inflation Through its Time Series Properties

In this section, we explore the basic time series properties of inflation and its subcomponents to answer the following questions. How long does it take for inflation to converge to its equilibrium after being hit by a shock; that is, how quickly do inflation shocks dissipate? Do shocks have a permanent impact on inflation, for example, through higher inflation expectations? Which sub-components of inflation lead others? First, we use a simple auto-regressive model to capture inflation persistence. Then, we use Vector Auto-Regression (VAR) analysis to illustrate how shocks propagate and to understand which structural shocks help explain variance in forecast errors.

A. Inflation Persistence and Expectations

Inflation shocks in Mongolia are short-lived as they quickly dissipate, which is just another way of describing the inflation roller coaster. A simple auto-regressive model for headline inflation yields a coefficient of around 0.3 on its first lag, implying that two-thirds of the inflationary impact of a shock has already dissipated after one period (Table 2). Put differently, if a shock increases inflation by 10 percentage points on impact, in the following quarter inflation would be just 3 percentage points higher, and by the third quarter, 80 percent of the inflationary impact of the shock would have dissipated. This in turn has implications for inflation expectations. If expectations are formed just based on the current inflation rate, then inflation would be expected to return to its average rate broadly within a year. This suggests that there might not be a need for monetary policy to respond to shocks, as inflation will, by itself, quickly converge to its mean.[5]

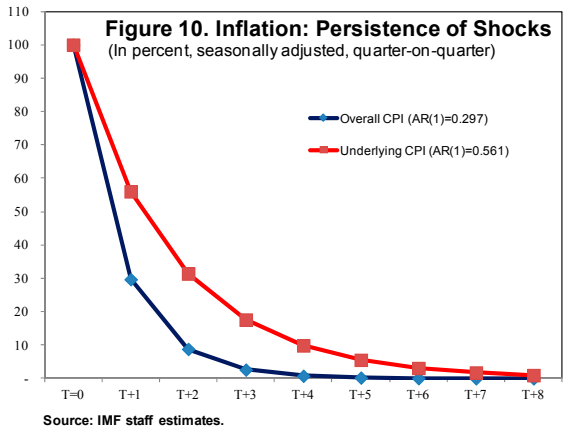
Table 2. Mongolia: Persistence in CPI and its Subcomponents
(Seasonally adjusted, average quarter-on-quarter inflation rates)

	Constant		1st lag		Adjusted R-squared	Durbin-Watson	Akaike Info	Schwarz Info
Overall prices	0.017	***	0.297	*	0.046	1.989	-4.432	-4.312
	(0.005)		(0.148)					
Administered prices	0.022	***	0.104		-0.010	1.903	-4.229	-4.105
	(0.006)		(0.158)					
Market prices	0.016	**	0.268		0.023	1.903	-4.050	-3.926
	(0.006)		(0.160)					
Food prices	0.020	**	0.127		-0.022	1.913	-3.293	-3.169
	(0.009)		(0.159)					
Underlying CPI	0.010	***	0.561	***	0.216	1.908	-5.262	-5.138
	(0.004)		(0.159)					

Sources: Mongolian authorities; and IMF staff estimates.
Note: coefficient on own lag, standard deviation in parentheses.
* Indicates 10 percent, ** indicates 5 percent, and *** indicates 1 percent significance, respectively.

[5] This skirts some complicated issues regarding whether the lack of persistence itself is the result of an effective monetary policy that succeeds in quickly neutralizing shocks. Though, through much of the sample period, monetary policy in Mongolia was in general not too responsive to changes in inflation.

Underlying inflation, however, is more persistent than headline inflation, but even shocks to underlying inflation do not last too long. After one year, only around 10 percent of the inflationary impact of a shock would persist (Figure 10) and, hence, a shock driving up underlying inflation by 10 percentage points would be expected to lead to only a 1 percentage point higher inflation a year later.



This all refers to inflation momentum, defined as the seasonally adjusted annualized rates of growth. Actual headline inflation would peak much more and later. Using the same 10 percentage point shock, headline inflation would actually peak one year after the shock and be 10 percentage points higher than without a shock. This also indicates the importance of using seasonally adjusted high frequency—such as quarterly-data to examine inflation pressure. Year-on-year inflation rates reflect all shocks during the previous year, and would peak well after the fact, that is, when the shock has already passed through the system. Monetary policy, therefore, needs to look at current momentum in inflation and not the year-on-year inflation rates, when considering policy responses.

Food prices, not surprisingly given their high volatility, show the least persistence. Nearly 90 percent of a shock decays each period. Market price inflation, which is a weighted average of food and underlying inflation, falls in the middle in terms of persistence.

Inflation in Mongolia is also more volatile and generally less persistent than in other copper producing countries. Compared with Chile, Papua New Guinea, Peru, and Zambia, the inflation rate in Mongolia is more volatile as measured by the coefficient of variation, and less persistent than all but Papua New Guinea (Table 3).

Table 3. Mongolia and Other Copper Producers 1/

	Volatility 2/	Persistence 3/
Mongolia	**1.25**	**0.30**
Chile	0.74	0.67
Papua New Guinea	1.07	0.23
Peru	0.86	0.78
Zambia	0.56	0.60

Sources: Mongolian authorities; and IMF staff estimates.
1/ Quarter-on-quarter, seasonally adjusted inflation rate.
2/ Volatility is measured with the coefficient of variation.
3/ Persistence is measured by the coefficient from a first order autoregressive process.

B. Vector Auto-Regression Analysis

One implication from the analysis so far is that the sub-indices of inflation have distinctly different properties. This suggests that they are being pushed and pulled by different forces. Not that there could not also be common factors, but the evidence points to the existence of at least some distinct shocks to food prices and others to underlying inflation. This section looks at modeling this explicitly using VAR analysis.

We estimate a VAR on the quarter-on-quarter seasonally adjusted underlying and food inflation rates. Unit root tests (Augmented Dickey Fuller and Phillips-Perron) confirm that both inflation series are stationary. The lag length selection criteria suggest using one lag.

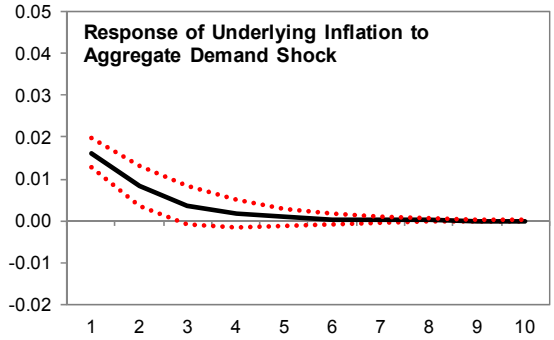
The key assumption for identification is that underlying inflation is largely hit by aggregate demand shocks, while food prices, in contrast, are subject to both aggregate demand and supply shocks (such as weather-related shocks to agriculture). These supply shocks will also affect underlying inflation through higher food prices but with a lag. This identifying assumption is implemented through a Cholesky decomposition. Granger-causality tests suggest that there is some, albeit weak, evidence of food price inflation leading underlying inflation, supporting our identifying assumption.[6]

The impulse response functions suggest that the aggregate demand shock affects food and underlying inflation roughly equally, with a slightly larger impact on food prices (Figure 11). Specifically, a one-standard deviation aggregate demand shock pushes food price inflation up by around 2.3 percentage points in the first quarter and underlying inflation by 1.6 percentage points. Though, based on the standard error bands, the difference is not statistically significant. A one-standard deviation supply shock, which by construction affects only food prices immediately, increases food inflation by 3.8 percentage points in the initial period, but dissipates very quickly and has no statistically significant effect afterwards. Working through food price inflation, the supply shock has an impact on underlying inflation in the following period, although the impact is small—a one-standard deviation supply shock pushes underlying inflation up by 0.5 percentage points in the second period, but the effect is not statistically significant.

Hence, if supply-side shocks affecting food prices are transmitted to underlying inflation, policymakers should not assume that inflation measures that exclude food prices will provide a clear picture of underlying inflation pressures (see Walsh, 2011).

[6] Granger-causality tests suggest that changes in administered prices follow changes in headline and market-based prices. This is consistent with the arguments above that administered prices are set with a strong backward-looking element.

Figure 11: Impulse Response Functions
Response to Cholesky one standard deviation innovations +/- 2 standard deviations



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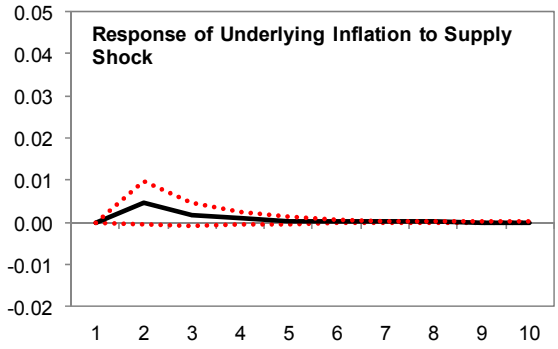

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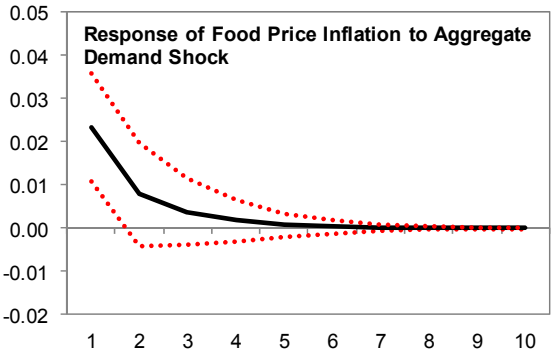

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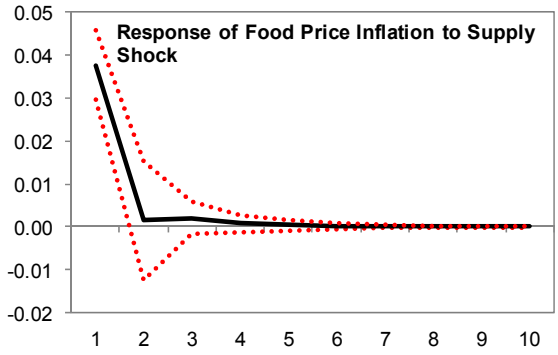
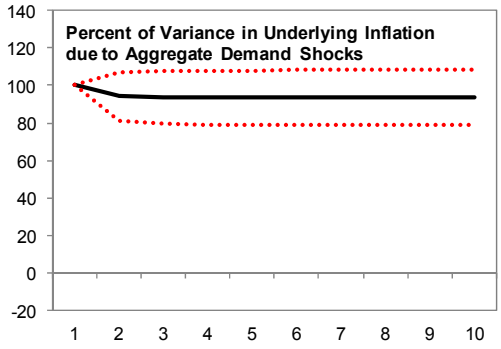


Sources: Mongolian authorities; and IMF staff estimates.

Variance decomposition indicates that about 30 to 40 percent of the forecast error for food inflation can be explained by the aggregate demand shock or, put differently, 60 to 70 percent of food price volatility can be attributed to supply shocks (Figure 12). Volatility in underlying inflation can be nearly exclusively explained through aggregate demand shocks, while supply shocks—again, working through the knock-on effects that higher food prices have on underlying inflation—account for only 2 percent of the volatility and the effect is not statistically significant.

Figure 12: Variance Decomposition
Variance decomposition +/- 2 standard deviations



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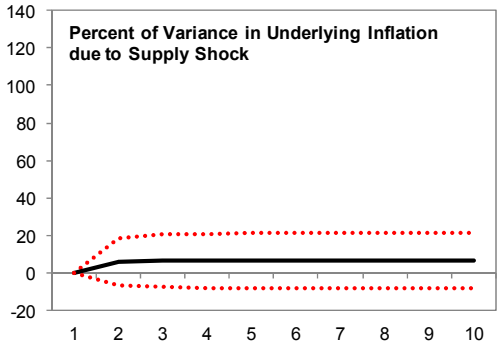

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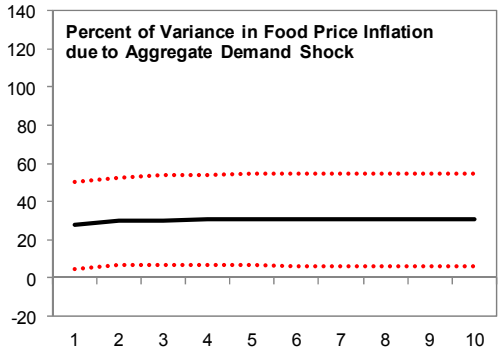

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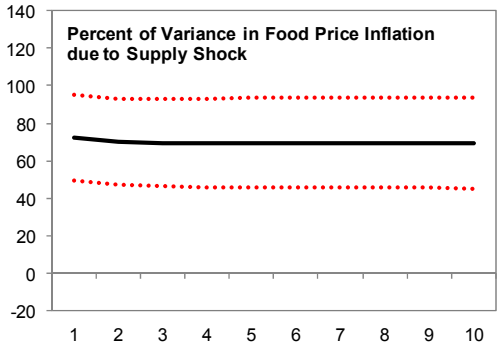


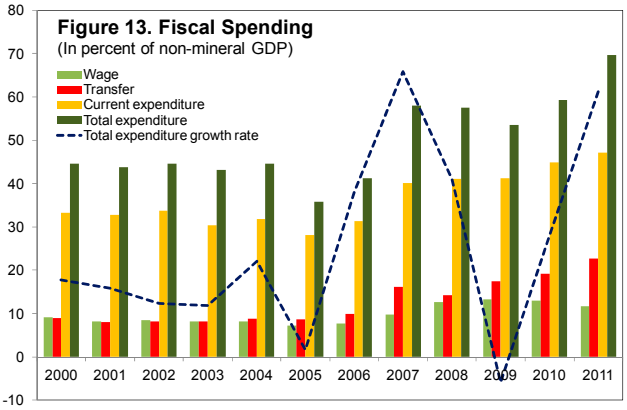
Sources: Mongolian authorities; and IMF staff estimates.

IV. Demand-Pull Factor of Inflation

So far, we have focused just on the inflation indices and set aside other macroeconomic variables that could be contributing to inflation. For example, rapidly increasing government spending, economic overheating, or a depreciating currency could all drive up inflation. In this section, we examine to what extent such factors help explain underlying inflation.

A. The Role of Fiscal Spending

Government spending in Mongolia has been volatile, and has grown extremely fast at times (Figures 13 and 14). As argued in the introduction, government spending represents a large share of the non-mineral economy and could thus be expected to exert a strong influence on aggregate demand and hence inflation. We examine three measures of government spending: (i) current expenditures; (ii) wages; and (iii) transfers. Ex ante, wage increases would be expected to have a particularly strong impact on inflation as there is a direct impact from the increase in government employees' income and an indirect impact as private sector wages are likely to follow suit, triggering a wage-price inflationary spiral. Capital expenditure and net lending are excluded as the timing of payments in Mongolia often occurs after the economic activity, and therefore the impact on inflation, has already taken place.



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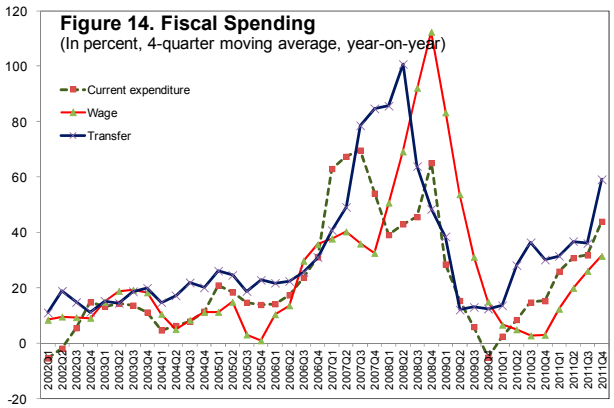


Sources: Mongolian authorities; and IMF staff estimates.

There is robust evidence that government wage hikes push up underlying inflation (Table 4). The quantitative impact, however, is not too large. The point estimate of around 0.05 suggests that a 10 percent increase in the wage bill would immediately increase underlying inflation by about 0.5 percentage points. The full-year impact would be larger and amount to around 1 percentage point. The elasticity of underlying inflation at the one-year horizon (year-on-year basis), therefore, is around 10 percent. For instance, the recent 50 percent wage increase would be expected to boost underlying inflation by around 5 percentage points with a one-year lag. Regarding the robustness of the results, the increase in the government wage bill is statistically significant in all specifications in which it is included and the parameter estimate is fairly stable. The results in columns 1 and 2 also suggest that the impact of wage spending is statistically different from that of other types of current spending. Moreover, wage spending appears to be the component of government expenditure that is contributing the most to underlying inflation, as current spending is not statistically significant when the wage bill is included and the transfers' terms are never statistically significant. The results in column 6 are qualitatively and quantitatively similar when the regression is repeated using just the last seven years of data (results not shown).

Table 4. Mongolia: Inflationary Impact of Government Spending, 2000-11 1/

	Underlying Inflation						Food Inflation					
	1	2	3	4	5	6	7	8	9	10	11	12
Constant	0.006	0.005	0.007	0.007	0.006	0.010	0.018	0.017	0.018	0.018	0.019	0.021
(Std. error)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)
[Pval]	[0.096]	[0.143]	[0.061]	[0.085]	[0.084]	[0.014]	[0.056]	[0.048]	[0.043]	[0.033]	[0.027]	[0.022]
Lagged dependent	0.517	0.508	0.543	0.534	0.487	0.494	0.100	0.105	0.117	0.120	0.102	0.142
(Std. error)	(0.133)	(0.133)	(0.137)	(0.136)	(0.129)	(0.137)	(0.159)	(0.156)	(0.154)	(0.151)	(0.157)	(0.157)
[Pval]	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]	[0.532]	[0.504]	[0.450]	[0.431]	[0.522]	[0.372]
Current spending	0.020	0.016	0.038	0.034	…	…	0.086	0.083	0.098	0.096	…	…
(Std. error)	(0.023)	(0.023)	(0.022)	(0.021)	…	…	(0.063)	(0.062)	(0.058)	(0.056)	…	…
[Pval]	[0.400]	[0.494]	[0.091]	[0.121]	…	…	[0.186]	[0.187]	[0.097]	[0.094]	…	…
Wage bill	0.048	0.045	…	…	0.053	…	0.037	0.035	…	…	0.074	…
(Std. error)	(0.025)	(0.025)	…	…	(0.023)	…	(0.072)	(0.070)	…	…	(0.065)	…
[Pval]	[0.065]	[0.079]	…	…	[0.024]	…	[0.610]	[0.624]	…	…	[0.259]	…
Transfers	-0.020	…	-0.017	…	…	-0.010	-0.012	…	-0.009	…	…	0.008
(Std. error)	(0.018)	…	(0.019)	…	…	(0.019)	(0.050)	…	(0.050)	…	…	(0.050)
[Pval]	[0.282]	…	[0.374]	…	…	[0.596]	[0.807]	…	[0.851]	…	…	[0.873]
R-squared	0.361	0.341	0.301	0.286	0.333	0.247	0.094	0.093	0.088	0.087	0.051	0.020
Observations	43	43	43	43	43	43	43	43	43	43	43	43

Sources: NSO; and IMF staff estimates.

1/ Variables are seasonally adjusted quarterly averages; regressions use first difference of the log (approximates quarter-on-quarter percent change).

The results for food inflation are different, but there is some weak evidence that government spending contributes to food price inflation. Looking at columns 7–12, the parameter estimate on current spending is significant at the 10 percent level when included by itself, or with transfers (but not with wages). The evidence would suggest, therefore, that all types of current spending have roughly the same inflationary impact. The point estimate of nearly 0.1 would suggest that a 10 percent increase in current spending immediately increases food inflation by 1 percentage point. However, food price inflation is not very persistent (as argued above and reinforced by a point estimate on lagged food inflation of less than 0.2), therefore, the full year impact on year-on-year inflation would be just a bit higher at 1.2 percentage points. In general, though, the regressions have less explanatory power for food inflation as evidenced by the low R-squared.

Together, the above results provide evidence that government spending is inflationary. Nonetheless, the quantitative impact is relatively small. To further explore the relationship, we also looked at results using lagged government spending. However, the lagged terms were never statistically significant at the 10 percent level, which suggests that the impact of government spending on inflation is contemporaneous. Finally, we repeated the regressions using the headline CPI (that is the entire basket) and the government spending variables were not statistically significant. This is not surprising given that administered prices would not be linked to contemporaneous changes in government spending and would suggest that the overall noise in the headline measure drowns out the impact of government spending on the sub-components of inflation.

B. The Role of Output Gaps and the Exchange Rate

A Phillips curve depicts the relationship between inflation and excess demand, referred to as the output gap. In the short run, a positive output gap—with GDP above potential GDP—results in higher prices as shortages of labor drive up wages and goods shortages drive up the price of goods. A key challenge in estimating this relationship, however, is deriving a measure of the output gap. Bersch and Sinclair (2011) explore options for estimating an output gap in Mongolia, including univariate filters such as the Hodrick and Prescott (HP, 1997) and the Christiano-Fitzgerald (CF, 2003) filter. They conclude, however, that a multivariate technique, the Blanchard-Quah (1989) decomposition, provides the best estimates. This technique, however, uses inflation itself to derive the output gap and is hence not adequate for our purposes.

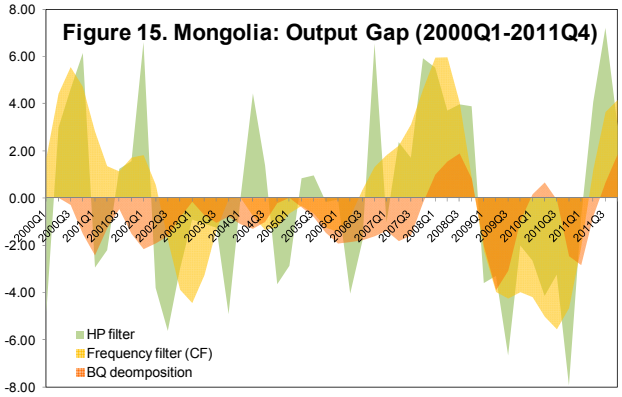
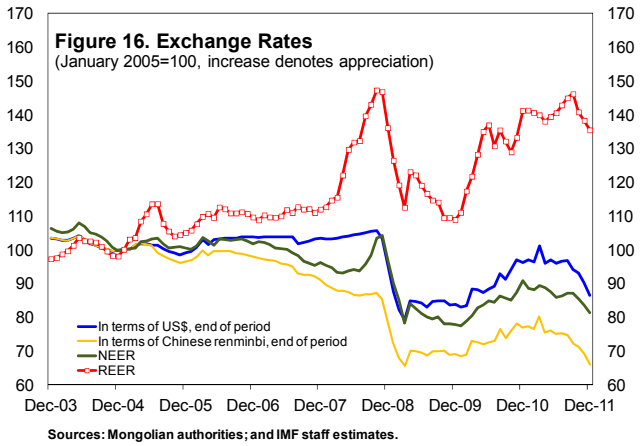


Figure 15. Mongolia: Output Gap (2000Q1-2011Q4)

Sources: Mongolian authorities; and IMF staff estimates.

The well-known end-point problems of the HP filter would be potentially problematic in view of Mongolia's record high growth rate in 2011 and, therefore, we use the CF filter (Figure 15).

Changes in the exchange rate are also expected to affect inflation. Mongolia imports a large share of final and intermediate goods, and a depreciation of the togrog would likely raise the price of these goods. A statistical challenge, however, is that for much of the sample period the central bank was tightly managing the exchange rate against the U.S. dollar, limiting its variability. The nominal effective exchange rate (NEER), a trade-weighted index of bilateral exchange rates, displays somewhat more but still limited variation (Figure 16).



We estimate a Phillips-curve relationship along the lines of Bailliu et al (2003), specifically:

$$\boldsymbol{\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 gap_{t-1} + \beta_3 \Delta s_{t-1} + \varepsilon_t}$$

π_t is the quarter-on-quarter seasonally adjusted inflation rate (end-of-period). Inflation expectations are proxied by the lagged inflation rate (π_{t-1}), gap_{t-1} is the output gap, Δs_{t-1} the lagged quarterly rate of change of the NEER (end-of-period), and ε_t the error term.

Table 5 summarizes the regression results, for overall inflation (specifications 1 and 2) and for underlying inflation (specifications 3 and 4). The output gap has a positive and statistically significant impact on inflation, whereas changes in the nominal exchange do not seem to have a statistically significant effect. This suggests that domestic demand factors might help to explain movements in inflation.

Table 5. Phillips-Curve Estimation
Inflation rate (average, seasonally-adjusted, quarter-on-quarter), sample period (2002Q2-2011Q4)

	Overall inflation		Underlying CPI	
	1	2	3	4
Constant	0.022 ***	0.022 ***	0.023 ***	0.023 ***
(Std. error)	(0.006)	(0.007)	(0.007)	(0.008)
[Pval]	[0.001]	[0.006]	[0.001]	[0.008]
lagged inflation (-1)	0.142	0.180	0.132	0.147
(Std. error)	(0.176)	(0.182)	(0.178)	(0.180)
[Pval]	[0.425]	[0.329]	[0.461]	[0.420]
lagged inflation (-2)		-0.065		-0.051
(Std. error)		(0.188)		(0.187)
[Pval]		[0.732]		[0.785]
Output gap (-1)	0.003 **	0.006 **	0.003 *	0.008 **
(Std. error)	(0.001)	(0.003)	(0.002)	(0.004)
[Pval]	[0.050]	[0.050]	[0.075]	[0.039]
Output gap (-2)		-0.004		-0.006
(Std. error)		(0.003)		(0.004)
[Pval]		[0.250]		[0.176]
Δ Nominal exchange rate (-1)	-0.035	0.031	-0.048	0.027
(Std. error)	(0.114)	(0.127)	(0.136)	(0.151)
[Pval]	[0.763]	[0.811]	[0.725]	[0.861]
Δ Nominal exchange rate (-2)		-0.010		0.037
(Std. error)		(0.122)		(0.144)
[Pval]		[0.938]		[0.800]
Observations (after adj)	**39**	**39**	**39**	**39**
R-squared	0.191	0.242	0.161	0.220

Source: IMF staff estimates.
Notes:
Lagged inflation is used as proxy for inflation expectations and the output gap is measured applying the Christiano-Fitzgerald frequency filter on seasonally adjusted real GDP. The nominal exchange rate is shown as togrog per US$ at the end of the period, i.e., an increase represents a depreciation. * indicates 10 percent, ** indicates 5 percent, and *** indicates 1 percent significance, respectively.

V. International Context

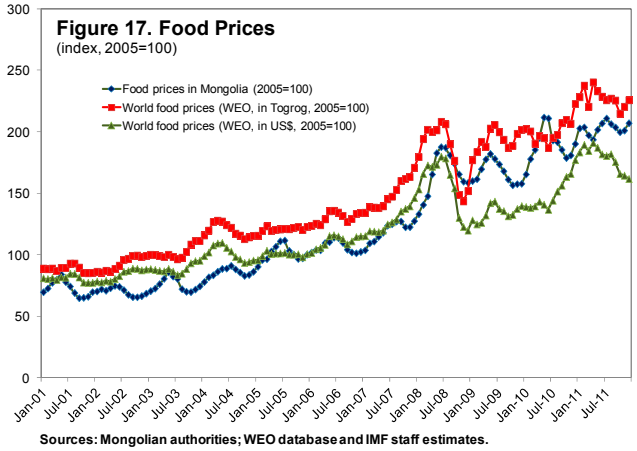
Mongolia is an open economy and relies heavily on imports of consumption goods, the prices of which would be expected to follow global prices. In this section, we thus look beyond the exchange rate, and examine if prices in Mongolia track international prices and if there are spillovers from inflation developments in the two large neighbors, China and Russia.

A. Commodity Prices

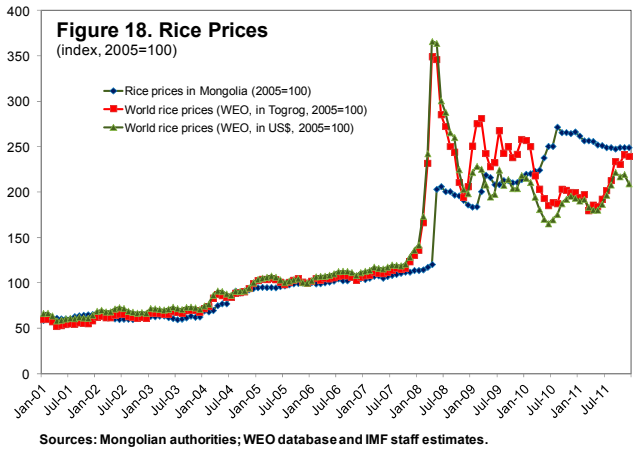
A large share of Mongolia's food consumption is imported (e.g., rice and potatoes from China), and food price inflation in Mongolia tends to commove with international food prices, as we would expect (Figure 17). However, international prices have little explanatory power for Mongolian food inflation.

We look at two specific commodities, rice and wheat, for which we would expect a particularly close resemblance between local and world market prices given that Mongolia imports virtually all the rice it comsumes and a large share of its flour consumption.

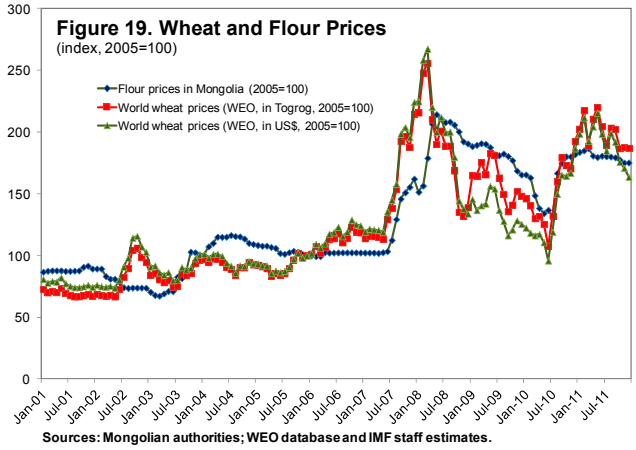
Indeed, we find that the price of rice in Mongolia basically tracks global prices, but they are not perfectly correlated, suggesting some pricing to market, as local prices tend to be somewhat less volatile (Figure 18). Flour prices also move together with world market prices for wheat but the relation is weaker than for rice (Figure 19). This can be partly explained by the fact that the flour prices recorded in the CPI basket are for domestically produced flour even though prices might not be independent from imported flour which accounts for a large share of overall consumption. Regression results suggests that international wheat prices have some explanatory power for flour prices in Mongolia, but this is very marginal.



Sources: Mongolian authorities; WEO database and IMF staff estimates.



Sources: Mongolian authorities; WEO database and IMF staff estimates.



Sources: Mongolian authorities; WEO database and IMF staff estimates.

B. Price Spillovers from Neighboring Countries—China and Russia

Mongolia is bordered by Russia and China, countries that are also key trading partners. It is natural, therefore, to consider how inflation in Mongolia is correlated with inflation in these neighbors. Headline inflation in Mongolia is contemporaneously correlated with China's inflation, but this could reflect that the economies are hit with common shocks (such as changes related to global commodity prices or weather). Indeed, food prices in China and Mongolia are correlated—consistent with a common shock explanation—whereas underlying inflation does not appear to be correlated (Table 6). As regards Russia, there is little evidence that inflation in Mongolia and Russia are correlated.

Table 6. China and Russia

	Headline CPI					
	1	2	3	4	5	6
Constant	0.004 ***	0.005 ***	0.004 ***	0.003	0.007 ***	0.005 **
(Std. error)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Lagged dependent	0.334 ***	0.336 ***	0.337 ***	0.326 ***	0.348 ***	0.318 ***
(Std. error)	(0.081)	(0.084)	(0.082)	(0.084)	(0.083)	(0.084)
Chinese CPI	0.565 **		0.576 **			
(Std. error)	(0.255)		(0.261)			
Lagged Chinese CPI		0.053	-0.059			
(Std. error)		(0.263)	(0.264)			
Russian CPI				0.148		0.616 *
(Std. error)				(0.230)		(0.329)
Lagged Russian CPI					-0.199	-0.638 *
(Std. error)					(0.226)	(0.324)
NEER	0.023	0.024	0.024	0.026	0.025	0.029
(Std. error)	(0.058)	(0.059)	(0.058)	(0.059)	(0.059)	(0.058)
Observations	142	142	142	142	142	142
R-squared	0.153	0.123	0.153	0.126	0.128	0.150
	Food CPI			**Underlying CPI**		
	7	8	9	10	11	12
Constant	0.005 **	0.005 **	0.004 *	0.004 ***	0.004 ***	0.004 ***
(Std. error)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Lagged dependent	0.223 ***	0.209 **	0.210 **	0.284 ***	0.285 ***	0.284 ***
(Std. error)	(0.084)	(0.087)	(0.086)	(0.084)	(0.084)	(0.085)
Chinese Food CPI	0.414 **		0.388 *			
(Std. error)	(0.202)		(0.206)			
Lagged Chinese Food CPI		0.225	0.163			
(Std. error)		(0.204)	(0.204)			
Chinese Non-food CPI				0.022		0.024
(Std. error)				(0.173)		(0.174)
Lagged Chinese Non-food CPI					0.021	0.023
(Std. error)					(0.175)	(0.177)
International Food Price	0.007	0.027	0.004			
(Std. error)	(0.056)	(0.055)	(0.056)			
Observations	142	142	142	142	142	142
R-squared	0.085	0.064	0.089	0.083	0.083	0.083

Source: IMF staff estimates.

Notes: * indicates 10 percent, ** indicates 5 percent, and *** indicates 1 percent significance, respectively.

VI. CONCLUSION

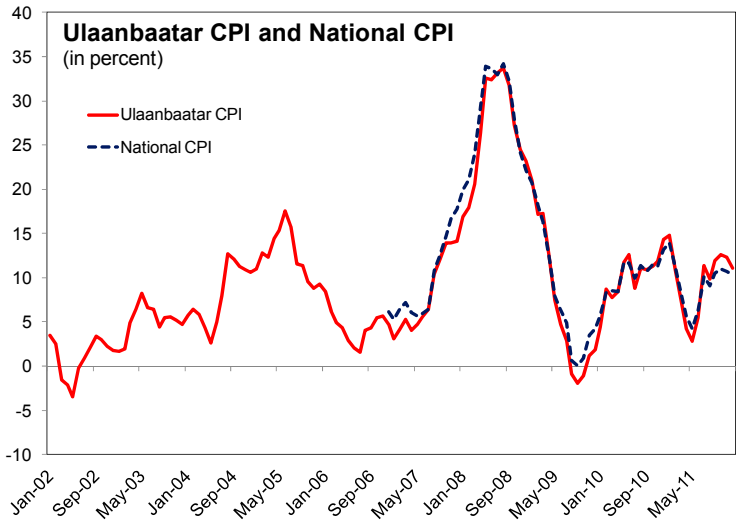
Inflation in Mongolia largely reflects volatility in food prices. However, domestic demand pressures have also played an important role in explanation inflation. To improve the ability of monetary policy to control inflation, a good understanding of inflation dynamics is critical. This is particularly relevant for Mongolia as inflation has been volatile, much more so than in comparable economies. Key characteristics of inflation dynamics in Mongolia are that it is (i) highly seasonal; (ii) not very persistent, with inflation returning to its mean in about 12 months; (iii) largely independent of international price movements; and (iv) dominated by changes in food prices, which in turn are largely explained by supply shocks to agriculture. Nonetheless, demand factors, such as higher fiscal spending through wage hikes and excess demand also play an important role in explaining price movements. And, moreover, food price inflation also feeds through to underlying inflation. Therefore, it is important for policymakers to remain vigilant to both headline and food price inflation for economic as well as social reasons. The prominence of agricultural supply shocks in Mongolia suggests that inflation is likely to remain volatile. However, demand factors—especially government wages—also have contributed to inflation highlighting the scope for monetary (and fiscal) policy to promote price stability.

ANNEX. THE ULAANBAATAR AND NATIONAL CPIS

The analysis of inflation is based on the Consumer Price Index (CPI) for Ulaanbaatar, the capital of Mongolia. This consumer basket comprises a set of goods and services representative of the average household's consumption and widely used by most of the population. The basket contains 287 items which are classified into 12 groups using the Classification of Individual Consumption According to Purpose. The expenditure weights are based on the 2004 Household Income and Expenditure Survey (HIES) and December 2005 is the reference period for prices. The expenditure weights for the CPI were updated in line with the 2005 HIES. The National Statistical Office (NSO) further updated its CPI weights based on the 2010 HIES and started to use new weights in 2012.

The National CPI is calculated as a weighted average of the CPIs at the provincial (aimag) and city level. The weights are determined by the relative contributions of annual household expenditures in each aimag and city to overall national expenditures. Since January 2008, with a revised methodology for the CPI, the NSO has adopted the international methodology of estimating the national CPI based on a weighted average of the 2005 HIES consumption expenditures of aimags and Ulaanbaatar (see NSO, 2011).

Even though the weights of the items and categories differ slightly between the Ulaanbaatar CPI and the National CPI, the two inflation rates are highly correlated (see the figure).



Sources: Mongolian authorities; and IMF staff estimates.

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