The Influence of the Booming Mining Industry on the Agricultural Sector in Mongolia

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ABSTRACT

Mongolia's extensive mineral deposits and attendant growth in mining-sector activities have transformed Mongolia's economy, which traditionally has been dependent on herding and agriculture. In this paper a Keynesian type equilibrium displacement model is developed to deduce hypotheses about the effects of mining on agriculture. A major hypothesis to be tested is whether the effects have been adverse, as suggested by the "Dutch Disease" hypothesis.

Keywords: agriculture, Dutch disease, mining, natural resource curse, Mongolia

INTRODUCTION

Mongolia is a resource-rich country and also a small open economy which relies on international trade. As mining grows up, the export of minerals increases. Then the Mongolian currency will strengthen and suppress the export of other products, in particular, agricultural products (like mutton, beef, etc.). The idea that currency appreciation associated with a booming natural resource sector might have adverse effects on other sectors of the economy is known as "Dutch Disease" (Corden 1984). The empirical literature on the Dutch Disease is large; notable recent examples include Acosta et al. (2009), Pegg (2010), Scott (2010), Fielding and Gibson (2013), Dülgera *et al*. (2013) and Apergisa *et al*. (2014). Most of these studies found at least some evidence that booming sectors have negative consequences for lagging sectors such as agriculture.

STUDY SITE

The research examines the economy in Mongolia from a macro perspective with particular emphasis on the mining and agricultural sectors. Mongolia's economy between 2006 and 2013 tripled in size from $3.4 to $11.5 billion (Table 1). The service sector over this period grew from 37% to 50% of the economy at the expense of the agricultural sector, which declined from 20% to 16% of the economy. Gross fixed capital investment, which reflects mining activities, increased from 33% to 44% of GDP. Foreign Direct Investment between 2006 and 2011 grew from 10% to 54% of GDP, due at least in part to mining agreement signed by the governments of Mongolia and Canada in October 2009 (Batchuluun and Lin 2010). At issue is whether currency appreciation has been an unintended consequence of the FDI-lead mining boom, and the implications for the agricultural sector.

METHODS

A Keynesian style equilibrium displacement model (EDM) is specified to determine the effects of growth in Mongolia's mining sector on its agricultural sector. The model is similar to the one developed by Glytsos (2005) to analyze the effects of foreign remittances on the growth of selected Mediterranean economies. The basic model in EDM form (Wohlgenant 2011) is:

(1) $C^* = \alpha\, Y^*$ $\quad(\alpha > 0)$

(2) ${I_{mi}}^* = \beta_{mi} Y^* + \theta_{mi} e^*$ $\quad(\beta_{mi} > 0, \theta_{mi} < 0)$

(3) ${I_{ag}}^* = \beta_{ag} Y^* + \theta_{ag} e^*$ $\quad(\beta_{ag} > 0, \theta_{ag} < 0)$

(4) ${I_{ots}}^* = \beta_{ots} Y^* + \theta_{ots} e^*$ $\quad(\beta_{ots} > 0, \theta_{ots} < 0)$

(5) $TB^* = \mu\, e^*$ $\quad(\mu < 0)$

(6) $e^* = \varepsilon_Y\, Y^* + \varepsilon_{FDI}\, \overline{FDI}^*$ $\quad(\varepsilon_Y > 0, \varepsilon_{FDI}\ (?))$

(7) $Y^* = k_c C^* + k_{mi} {I_{mi}}^* + k_{ag} {I_{ag}}^* + k_{ots} {I_{ots}}^* + k_{TB} TB^* + k_G \bar{G}^* + k_{FDI} \overline{FDI}^*$ $\quad(k_i > 0\ \forall\ i)$

where asterisks denote relative change ($Z^* = dZ/Z$); C is personal consumption expenditures; Y is national income; I_{mi}, I_{ag}, and I_{ots} are the values of production in mining, agriculture, and other sectors of the economy, respectively; $TB = X - M$ is the trade balance where X and M are the values of exports and imports, respectively; $\bar{G}$ is government expenditures; $\overline{FDI}$ is foreign direct investment (which includes remittances and foreign aid); and e is the exchange rate defined so that an increase in e implies currency *appreciation* from Mongolia's perspective. The Greek symbols are elasticities and the k terms ($k_i = i/Y$ ($i = C, I_{mi}, I_{ag}, I_{ots}, TB, \bar{G}, \overline{FDI}$) are income shares that sum to 1.

Economic theory suggests consumption and investment are positively related to income; hence α, β_{mi}, β_{ag}, and β_{oth} are assumed to be positive in sign. The Marshall-Lerner condition implies that for small open economies such as Mongolia currency appreciation reduces the trade balance; hence μ is assumed to be negative in sign. Theory is less informative about the effects of exchange rates. In a small open economy, the prices of traded goods are exogenous. Hence, higher domestic consumption associated with increased FDI will raise the price of non-traded goods only. To the extent the change in relative prices induces a re-allocation of resources between sectors the output of traded goods falls relative to non-traded goods. This could worsen income inequality if the resources employed in the traded-goods sector are owned primarily by the poor. Also, aggregate production efficiency could decline if technological progress is faster in the non-sheltered export sector (van Wijnbergen 1984, p. 41). The latter effect, in essence, is the "Dutch disease." Based on the foregoing, θ_i, θ_{ag} and θ_{ots} are assumed to be negative in sign. Since income growth in general is associated with a stronger currency, ε_Y is assumed to be positive in sign. The standard DD model predicts an increase in FDI causes the real exchange rate to increase. However, empirical evidence is not fully consistent with this prediction (Fielding and Gibson (2013) and references therein). Hence, ε_{FDI} is left unsigned.

The model contains seven endogenous variables (C, I_{mi}, I_{ag}, I_{ots}, TB, Y, e) and two exogenous variables exogenous variables ($\bar{G}$, $\overline{FDI}$). Given this structure, what hypotheses can be deduced about the effect of an isolated increase in FDI on the agricultural sector? To determine that, we solved equations (1) – (7) for simultaneously for ${I_{ag}}^*$ in terms of $\overline{FDI}^*$ to yield

(8) $${I_{ag}}^* = \frac{\overbrace{\varepsilon_{FDI}\beta_{ag}(k_{mi}\theta_{mi} + k_{ots}\theta_{ots} + k_{TB}\mu)}^{A} + \overbrace{\varepsilon_{FDI}\theta_{ag}\left(1 - \frac{\partial C}{\partial Y} - \frac{\partial I_{mi}}{\partial Y} - \frac{\partial I_{ots}}{\partial Y}\right)}^{B} + \overbrace{k_{FDI}(\beta_{ag} + \theta_{ag}\varepsilon_Y)}^{C}}{\Psi}\overline{FDI}^*$$

where $\Psi = \left(\left(1 - \frac{\partial C}{\partial Y} - \frac{\partial I_{ag}}{\partial Y} - \frac{\partial I_{mi}}{\partial Y} - \frac{\partial I_{ots}}{\partial Y}\right) - \varepsilon_Y(k_{mi}\theta_{mi} + k_{ag}\theta_{ag} + k_{ots}\theta_{ots} + k_{TB}\mu)\right) >$ 0 under the maintained hypothesis that the marginal propensities to consume and invest to sum to less than 1. The signs of terms A, B and C are uncertain. Hence, the model yields no prediction about the relationship between the agricultural sector and FDI when the mining sector and the exchange rate are permitted to adjust. The relationship is an empirical issue that rests importantly on the signs and relative magnitudes of ε_{FDI} and ε_Y. Hence, in the empirical analysis we will focus on estimating these parameters.

RESULTS

To determine the sign and relative magnitude of ε_{FDI} and ε_Y we estimated the ARDL model

$$(9) \ln ER_t = \alpha + \beta_1 \ln FDI_t + \beta_2 \ln Y_t + \tau\, TREND + \sum_{j=1}^{p} \phi_j \ln ER_{t-j} + \sum_{j=0}^{p_1-1} \gamma_{1j}\, \Delta\ln FDI_{t-j} + \sum_{j=0}^{p_2-1} \gamma_{2j}\, \Delta\ln GDP_{t-j} + v_t$$

where $t = 1, 2, \dots, 21$ (1993 – 2013 annual observations); $ER_t = (FCU/F\_CPI)/(DCU/D\_CPI)$ is the real exchange rate defined as the deflated foreign currency unit divided by the deflated domestic (Mongolian) currency unit; $FDI_t = (\text{nominal } FDI/D\_CPI)$ is real foreign direct investment; $Y_t = (\text{nominal } GDP/D\_CPI)$ is real gross domestic product; $TREND = t$ is a linear time trend; Δ is the difference operator; p is the lag order; and u_t is a serially uncorrelated error term. A trend term is included to control for unmeasured factors such as technical change that may have a systematic effect on the exchange rate. FDI_t and GDP_t are expressed in Tugriks (MNT), Mongolia's currency. Three exchange rates are considered: US dollar (USD/MNT), Chinese yuan (CN/MNT), and the euro (EURO/MNT).

Prior to estimation we tested if the data are I(0) or I(1), as required for the model. The Phillips–Perron test indicated that $\ln FDI_t$ and $\ln Y_t$ are I(1) with trend. To determine the appropriate lag length p and to confirm whether a time trend should be included, equation (9) was estimated by OLS with and without $TREND$ for $p = 1, 2, 3$. The three regressions were run over the same period from 1996 to 2013 in order to make them comparable. (The first three observations are lost due to the lag structure.) Akaike's Information Criteria (AIC) and Schwarz's Bayesian Information Criteria (SBC) were used to compare regressions under different orders. Lagrange multiplier (*LM*) statistics were used to test for residual serial correlation. *F*- and *t*-tests were used to determine the existence of a levels relationship $\ln ER_t = a + b_1 \ln FDI_t + b_2 \ln Y_t$ using the bounding test intervals in Pesaran *et al*. (2001). Because there are three equations, one for each exchange rate, the testing procedures were conducted three times to decide the orders for the three equations respectively. Results indicated a lag order of 3 when the response variables are USD/MNT and CN/MNT, and a lag order of 1 when the response variable is EURO/MNT. The bounds test indicated the levels relationship exists for USD/MNT and CN/MNT, but not for EURO/MNT. Hence, attention is restricted to the U.S. dollar and Chinese yuan relationships.

DISCUSSION

The augmented ARDL models with proper orders are obtained for equation (10) after selection from 128 models. They are the ARDL (3, 3, 3) for the USD/MNT relation and ARDL (3, 0, 3) for the CN/MNT relation. The regression results are shown in table 2 along with the long-run estimates of ε_{FDI} and ε_Y. Results indicate $\varepsilon_{FDI} = 0.39$ for USD and $\varepsilon_{FDI} = 0.01$ for CN, with both elasticities significant at the 1% level. This suggests an increase in foreign direct investment does indeed lead to appreciation in Mongolia's currency, although the effect is much stronger for the U.S. dollar than for the Chinese yuan. The estimated long-run income effects are also positive and significant at the 1% level, with $\varepsilon_Y = 0.48$ for USD and $\varepsilon_Y = 0.26$ for CN. The USD/MNT exchange rate is about twice as responsive to income growth as the CN/MNT exchange rate, although both responses are inelastic. Overall, results support the hypothesis that mining-induced increases in FDI or income leads to currency strengthening, an essential condition for the DD hypothesis to be valid.

IMPLICATIONS

Our analysis suggests each 1% increase in foreign direct investment is associated with a 0.48% increase in the value of Mongolia's currency against the U.S. dollar, and a 0.01% increase in the value of the currency against China's yuan. Hence, the necessary conditions for Dutch disease to exist are present. Whether they are strong enough to explain the relative decline in Mongolia's agricultural sector must await further research.

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Table 1. National Economy Data for Mongolia, 2006-2013 (source World Bank).

	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
GDP (million US dollars)	3,414	4,235	5,623	4,584	6,200	8,761	10,322	11,516
Foreign direct investment (% GDP)	10	9	15	14	27	54	43	19
Agricultural output (% GDP)	20	20	21	20	16	14	16	16
Industrial output (%GDP)	39	38	31	30	33	31	28	29
Services (% of GDP)	37	38	44	47	46	49	52	50
Imports (% of GDP)	64	53	58	67	58	62	87	77
Exports (% of GDP)	59	60	54	50	55	62	51	45
Government expenditure (% of GDP)	12	13	15	15	14	13	14	11
Consumption (% of GDP)	46	47	54	58	53	49	49	49
Exchange rate (per USD)	1,180	1,170	1,166	1,438	1,357	1,266	1,358	1,524
Gross fixed capital formation (% of GDP)	33	35	36	29	33	49	53	44

Table 2. Estimated Exchange-Rate Relations for Mongolia based on Annual Data for 1993-2010

Variable	Parameter	U.S. Dollar Relation - ARDL (3,3,3) Model		Chinese Yuan Relation - ARDL (3,0,3) Model	
		Estimated Parameter[a]	Long Run Elasticity[b]	Estimated Parameter[a]	Long Run Elasticity[b]
$\ln ER_{t-1}$	$\emptyset_1$	-0.75**	--	-0.85***	--
$\ln ER_{t-2}$	$\emptyset_2$	-0.31	--	-0.92***	--
$\ln ER_{t-3}$	$\emptyset_3$	0.18	--	-0.68***	--
$\ln FDI_t$	β_1	0.73***	0.39***	0.03	0.01***
$\ln Y_t$	β_2	0.91***	0.48***	0.91***	0.26***
$\Delta\ln FDI_t$	γ_{10}	-0.53***	--	--	--
$\Delta\ln FDI_{t-1}$	γ_{11}	-0.32**	--	--	--
$\Delta\ln FDI_{t-2}$	γ_{12}	-0.08	--	--	--
$\Delta\ln Y_t$	γ_{20}	-1.03***	--	-0.61***	--
$\Delta\ln Y_{t-1}$	γ_{21}	-0.57**	--	-0.42**	--
$\Delta\ln Y_{t-2}$	γ_{22}	-0.35**	--	-0.06	--
$TREND$	τ	-0.23***	--	-0.05***	--
$Constant$	α	-49.6***	--	-41.2***	--

[a]Single, double and triple asterisks denote significance at the 10%, 5%, and 1% levels respectively.

[b]Computed using the formulas $\varepsilon_{FDI} = \frac{\hat{\beta}_1}{1-\sum_{j=1}^{3}\hat{\vartheta}_j}$ and $\varepsilon_Y = \frac{\hat{\beta}_2}{1-\sum_{j=1}^{3}\hat{\vartheta}_j}$.