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May 18 2015

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Middle East and Central Asia Department

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GROWTH-REMITTANCE SPILLOVER ANALYSIS

A. Context and Summary

1. Tajikistan's economy is being adversely affected through the remittance channel by the economic contraction in Russia and this is expected to lead to much lower growth in Tajikistan in 2015. Tajikistan is one of the most remittance-dependent countries in the world and relies primarily on earnings of migrants working in Russia. From end-2013, Russia has experienced a marked slowdown in its national income and real economic growth. This has adversely affected the economy of Tajikistan as remittances—almost entirely originating in Russia and equivalent to nearly half of Tajik GDP—began to shrink. In this paper, we analyze growth-remittance spillovers. First, we build a small model of Tajik remittance determination based on a construction index in Russia and use it to project the remittance inflows in the near future. Results suggest that the level of remittance inflows is likely to contract by 18.5 percent in 2015. Second, we employ an alternative model in which Tajik remittances explicitly depend on income in Russia and the ruble/U.S. dollar exchange rate, which in turn depends on the projected path of the oil price. This approach suggests that remittance inflows will fall by 37 percent in 2015. Data though April, with remittances contracting by 34 percent, favors the projection of the alternative model. Additionally, we examine the impact of these changes in remittance inflows on economic growth in Tajikistan. To ensure robustness, we employ a *heuristic approach* that exploits the sharp remittance turnaround following the 2008 global financial crisis and a *VAR model*, in which remittances, growth and prices evolve jointly and endogenously over the period 2002–14. Both approaches suggest strong real effects and imply that the projected fall in remittances would lower GDP growth by an estimated 1.8 to 5.3 percentage points in 2015.

TAJIK REMITTANCES: MODEL WITH CONSTRUCTION INDEX IN RUSSIA

2. The construction sector—both official and unofficial—remains the biggest employer of Tajik migrants working in Russia. Many migrants also work in other service sectors such as retail trade, maintenance, and transportation. But their share is small compared to people employed in construction.

3. Based on this fact, we model Tajik remittances as a function of the performance of the Russian construction sector. More specifically, we relate the log of remittances sent to Tajikistan in U.S. dollar terms ($\text{Rem\$}_t$) to the log level of the real construction index (C_rus_t), as constructed by the Russian State Statistics Committee, and the error term ε_t that captures all other potential factors affecting remittances. Because we use quarterly data (2004:Q1–2014:Q2) and there is strong seasonality, we assume the error term to follow the AR(4) process.

$$\log(\text{Rem\$}_t) = \alpha_1 + \alpha_2 \log(\text{C\_rus}_t) + \varepsilon_t$$
$$\varepsilon_t = \rho\varepsilon_{t-4} + u_t \qquad u_t \sim iid(0, \sigma_u^2)$$

4. The estimated regression confirms that there is a tight relationship between Tajik remittances and the evolution of the construction sector in Russia. All key coefficient estimates are highly statistically significant (Table 1). The model shows strong in-sample fit (red line is actual remittances and green line is the fitted ones; Figure 1) and there is no residual autocorrelation (as demonstrated by Breusch-Godfrey serial correlation LM test—see Appendix).

Table 1. Model with Construction Index

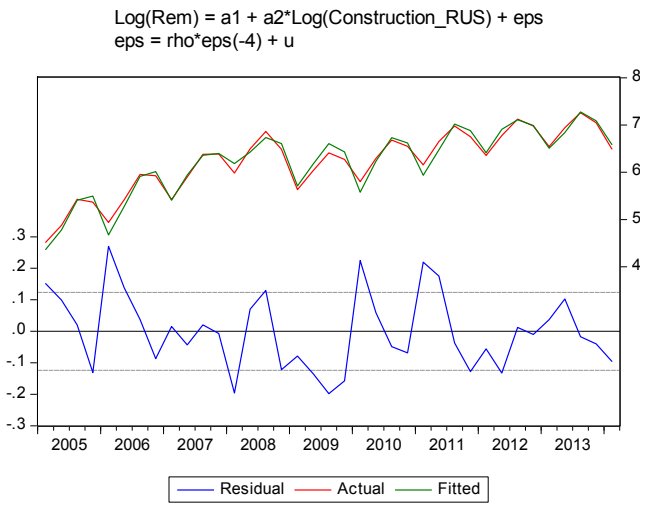
Dependent Variable: LOG(REMITTANCES_TJK)
Method: Least Squares
Date: 08/18/14 Time: 17:27
Sample (adjusted): 2005Q1 2014Q1
Included observations: 37 after adjustments
Convergence achieved after 14 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.57244	11.72219	-1.499074	0.1431
LOG(ICONST)	2.385017	0.225052	10.59763	0.0000
AR(4)	0.978082	0.036660	26.68004	0.0000

R-squared	0.967756	Mean dependent var	6.217257
Adjusted R-square...	0.965859	S.D. dependent var	0.668330
S.E. of regression	0.123490	Akaike info criterion	-1.267716
Sum squared resid	0.518488	Schwarz criterion	-1.137101
Log likelihood	26.45275	Hannan-Quinn criter.	-1.221668
F-statistic	510.2236	Durbin-Watson stat	1.578227
Prob(F-statistic)	0.000000		

Inverted AR Roots	.99	-.00+.99i	-.00-.99i	-.99

Figure 1. Actual and Fitted Remittances



5. We now use the model to project remittance inflows in the remaining quarters of 2014 and in 2015. We assume that the construction sector in Russia will contract by 5.3 percent on average in 2014 (the actual growth in Q1 2014 was -3.6 percent y-o-y) and by 9 percent on average in 2015, which is roughly two thirds of the actual contraction recorded in the crisis year 2009. Then we construct two quarterly forecasts of remittances: *dynamic* – in which autocorrelated error terms are resolved – and *static* – in which we drop the error term and ignore the previous period's forecast error. Finally, we aggregate two forecasts using 0.2 (dynamic) and 0.8 (static) weights to arrive at a single-point estimate. We tilt the weights towards the static forecast, because in 2015 Russia faces an unusual mix of sanctions, projected low oil prices, and uncertainty in the foreign exchange market - an environment in which forecast errors from 2014 will not matter much.

Figure 2. Dynamic and Static Forecast

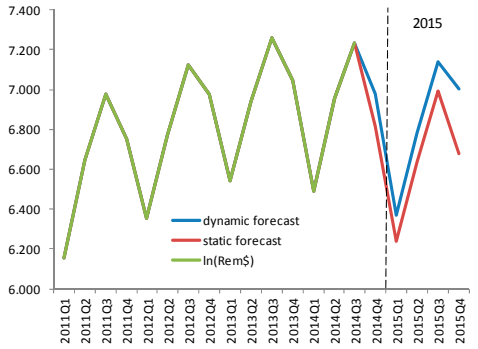
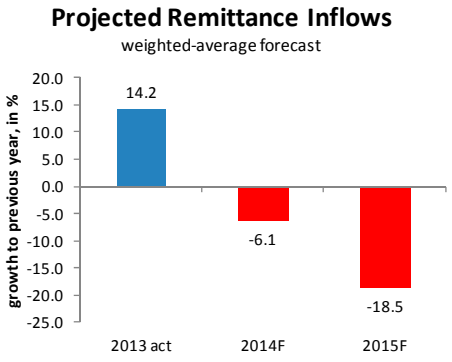


Figure 3. Projected Remittance Inflows



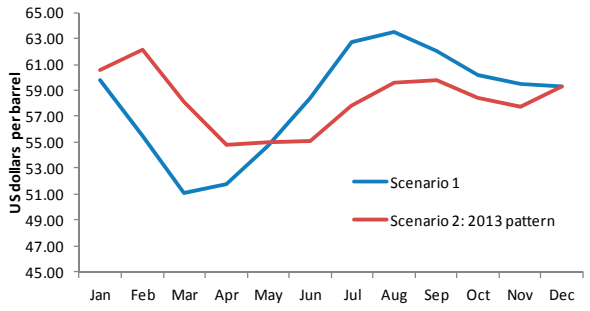
TAJIK REMITTANCES: MODEL WITH INCOME, EXCHANGE RATE, AND OIL PRICE

6. Since almost all migrants' income is earned in Russia, the recent collapse of the ruble against the U.S. dollar and a massive downward correction in oil prices will have major implications for Tajik remittance inflows, about 75 percent of which are denominated in rubles. Data for 2013 suggests that some 97 percent of remittance inflows came to Tajikistan from Russia. It also suggests that 74.2 percent of these transfers were wired in Russian rubles. In 2014, the ruble depreciated by 42 percent against the U.S. dollar, reflecting a combination of strong sanctions against Russia, a major downward correction of oil prices and episodes of extreme tension in the foreign exchange market. As Tajik migrants cannot quickly relocate to other countries, they will at best either stay in, or return to, Russia, continuing to earn ruble income and wire it back home throughout 2015. The exchange rate will come into play either in Russia prior to the transfer when a migrant exchanges rubles for dollars and wires them home, or in Tajikistan when Tajik banks need to do the ruble-U.S. dollar exchange to allow families to withdraw remittances in foreign exchange.

7. To project remittances from this angle, we employ a stylized deterministic model linking remittance inflows in U.S. dollars, ruble income earned in Russia, the exchange rate of the Russian ruble against the U.S. dollar and the projected evolution of the oil price. In a nutshell, we assume that, in any given month, the US$ amount of remittances (Rem$) is decomposed into a ruble-denominated amount (Rem_RUB) divided by the exchange rate of the ruble against the U.S. dollar (ER). Then we project the growth rates of the ruble denominated amounts of remittances and of the RUB/USD exchange rate through the end of 2014 and in 2015. The growth rate of Rem_RUB is derived based on historical trends and assumes, on average, a slowdown from 8.3 percent in 2014 to 2.5 percent in 2015. The RUB/USD exchange rate is projected from the likely path of the Urals crude oil price and using key parameters of the Russian Federation's budget revenues for 2015, such as the budgeted oil price (96 USD/barrel) and a budgeted exchange rate (37.7 RUB/USD). Basically, we assume that the ruble value of 1 barrel of Urals crude oil will not

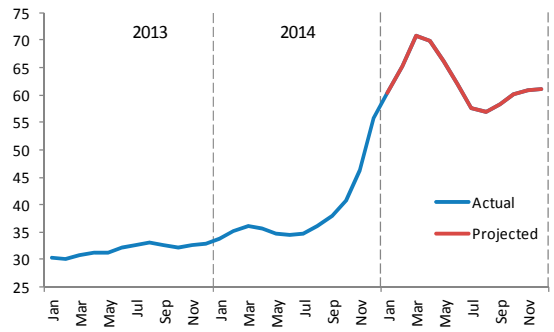
change in 2015 and fluctuations in the exchange rate will compensate for the changes in the oil price. In other words, a deeper fall in oil prices will require a more depreciated ruble against the U.S. dollar and vice versa. The likely Urals oil price is assumed to evolve according to Scenario 1. Scenario 2—yielding similar results—shares the same average price of 58 USD/barrel but features a different monthly pattern—actually historic from the year 2013.

Figure 1. Urals Crude Oil Price in 2015



* Urals crude is usually priced at a $2-4 discount against Brent.

Figure 2. Projected RUB/USD Rate in 2015



8. Putting all these pieces together, the annual amounts of US$ remittance inflows in Tajikistan are projected to decline by 8.4 percent in 2014 and by 37 percent in 2015. The "2014 monthly pattern" means that the growth rates of ruble-denominated amounts are distributed according to monthly dynamics observed in 2014 and generate a given annual average growth rate for 2015.

Figure 3. Tajikistan: Remittance Inflows in 2014

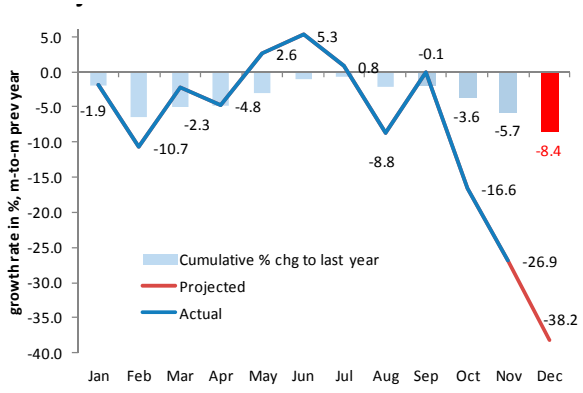
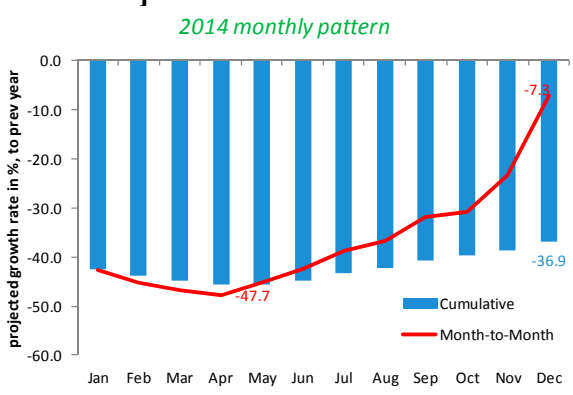


Figure 4. Tajikistan: Remittance Inflows in 2015

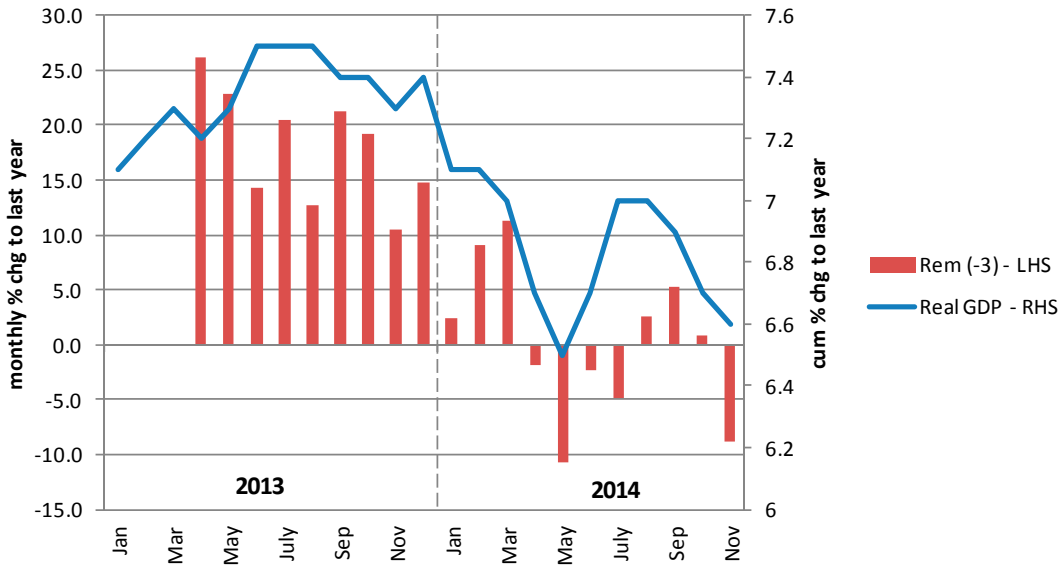


REMITTANCE-GROWTH SPILLOVERS: TWO APPROACHES

A. Stylized Facts

9. Over the last two years, remittances and economic growth in Tajikistan seem to be tightly connected, with a lag of one quarter. In Figure 8, we overlay the monthly evolution of real GDP growth and the growth of remittance inflows, lagged three months. The co-movement of the two variables is striking as the correlation coefficient is as high as 85 percent.

Figure 1. Remittance Inflows and Real GDP Growth



B. Two Approaches

10. To examine more systematically the impact of changes in remittance inflows on economic growth in Tajikistan, and to ensure the robustness of results, we use two approaches. First, we employ a *heuristic approach* that exploits the sharp remittance turnaround following the 2008 global financial crisis and relate it to the compression of growth. Second, we build a *VAR model*, in which remittances, growth and prices evolve jointly and endogenously over the period 2002–14. The first approach will help gauge the approximate remittance-growth elasticity by establishing an upper bound: by how much GDP growth may fall in a crisis year given a certain degree of remittance contraction. The second approach will be able to help with remittance-growth causality, at least in the Granger sense.

Heuristic Approach

11. In the heuristic approach, we assume that a sizable part of value-added generated in the services sector of Tajikistan is proportional to remittance inflows. Decomposing nominal GDP by production into agriculture, industry, construction and services:

$$\text{GDP} = \text{VA\_agro} + \text{VA\_industry} + \text{VA\_construction} + \text{VA\_services}$$

and assuming that

$$\text{VA\_services} = \text{VA\_services\_NR} + \alpha \cdot \text{REM\$} \cdot \text{ExRate}$$

one can show that

$$\%\ \text{chg real\_GDP} = \alpha \cdot (\%\ \text{chg REM\$}) \cdot \left(\text{REM/GDP}\right)$$

Essentially, in a partial equilibrium setting, the change in real GDP depends on a remittance-value added coefficient, the share of remittances in GDP and the percentage change in the dollar value of remittance inflows.

12. The elasticity of real GDP to remittance inflows is estimated to range from 0.126 to 0.144. Based on 2009 data—a year of significant compression of growth and remittance collapse following the 2008 global financial crisis—and attributing all the fall in real GDP (from 7.9 in 2008 to 3.4 percent in 2009) to the remittance decline (-31.3 percent), we are able to calibrate the value of α=0.39 and the share of non-remittance related value added in services at 74 percent. The resulting 2009 real GDP-remittance elasticity (α·REM/GDP) is 0.1436. Plugging in more recent data from 2012 and keeping the share of remittance-related value added in services as in 2009 generates α=0.29 and a real GDP-remittance elasticity of 0.29*49.6%=0.1262. Based on these two point estimates, if remittances were to contract by 10 percent, real GDP is estimated to decline by 1.26-1.44 percentage points.

VAR model

13. We build a VAR model, in which real GDP growth, consumer price inflation and remittance growth evolve jointly and endogenously over the period 2002–14. Following the general approach of Sims (1980)[1], we estimate an unrestricted vector autoregression (VAR) of the form:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \varepsilon_t, \qquad \varepsilon_t \sim iid(0, \sum)$$

where $Y_t = \left[\text{Real GDP growth; CPI inflation; \$ Remittance inflow growth}\right]'$ and all growth rates are quarter over corresponding quarter of the preceding year. Lag selection criteria provide quite a

[1] Sims, Christopher, 1980, "Macroeconomics and Reality," *Econometrica*, January, pp. 1–48.

broad range of lags to be included —from 1 lag (Schwarz Info Criterion) to 4 lags (AIC). With two criteria out of five favoring 2 lags (see Appendix), we choose to have 2 lags included, striking a balance between higher complexity and better fit of the model.

Figure 2. Real GDP Growth, CPI Inflation and Remittances

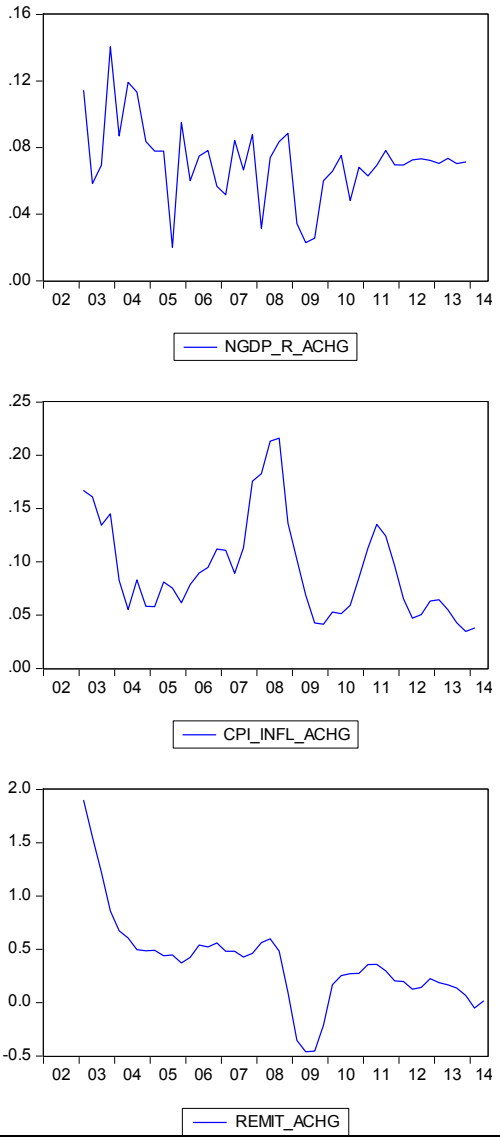


Table 1. VAR Model

Vector Autoregression Estimates
Date: 09/10/14 Time: 14:51
Sample (adjusted): 2003Q3 2013Q4
Included observations: 42 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	NGDP_R_ACHG	CPI_INFL_ACHG	REMIT_ACHG
NGDP_R_ACHG(-1)	0.076175	-0.207055	-0.463154
	(0.14411)	(0.16584)	(0.64919)
	[0.52857]	[-1.24854]	[-0.71343]
NGDP_R_ACHG(-2)	-0.028519	-0.161362	-0.212242
	(0.14521)	(0.16709)	(0.65411)
	[-0.19640]	[-0.96570]	[-0.32447]
CPI_INFL_ACHG(-1)	-0.378308	0.962486	0.783266
	(0.14702)	(0.16918)	(0.66227)
	[-2.57323]	[5.68920]	[1.18271]
CPI_INFL_ACHG(-2)	0.339708	-0.203394	-2.072695
	(0.15695)	(0.18061)	(0.70703)
	[2.16438]	[-1.12614]	[-2.93156]
REMIT_ACHG(-1)	**0.093818**	0.072301	1.165077
	(0.03029)	(0.03485)	(0.13644)
	[3.09741]	[2.07437]	[8.53896]
REMIT_ACHG(-2)	**-0.048414**	-0.045163	-0.277960
	(0.02740)	(0.03153)	(0.12343)
	[-1.76686]	[-1.43232]	[-2.25189]
C	0.055785	0.038599	0.192922
	(0.01627)	(0.01872)	(0.07327)
	[3.42955]	[2.06214]	[2.63290]
R-squared	0.413131	0.794215	0.935027
Adj. R-squared	0.312525	0.758937	0.923889
Sum sq. resids	0.013180	0.017453	0.267459
S.E. equation	0.019406	0.022331	0.087417
F-statistic	4.106418	22.51339	83.94775
Log likelihood	109.8052	103.9084	46.59022
Akaike AIC	-4.895484	-4.614685	-1.885249
Schwarz SC	-4.605872	-4.325073	-1.595637
Mean dependent	0.070865	0.091485	0.326321
S.D. dependent	0.023405	0.045482	0.316862

Determinant resid covariance (dof adj.)	1.34E-09
Determinant resid covariance	7.75E-10
Log likelihood	261.7637
Akaike information criterion	-11.46494
Schwarz criterion	-10.59610

Visual of inspection of correlograms points to little remaining autocorrelations in the residuals. The LM autocorrelation test (see Appendix) indicates that the inclusion of another lag will help purge the remaining autocorrelation, but this comes at a cost of higher model complexity.

14. The VAR model achieves good fit and captures well the joint evolution of the included variables. Of the three equations, the best fit is achieved in the remittance growth equation (adjusted R^2 = 92 percent), medium fit in the inflation equation, the lowest (but still good) fit in the

real GDP growth equation (adj. R^2 = 31 percent). Notice that in the real growth equation, the coefficients of remittance inflows lags are both significant and their sum is positive. This implies that there is indeed a strong positive relationship between remittance inflows growth and real GDP growth.

15. It turns out that causality runs from remittances to real GDP growth, but not the other way around, and that prices and remittances are interdependent. The Granger causality test that examines whether one lagged dependent variable helps predict another variable indicates that:

(i) remittance inflows growth indeed helps explain the dynamics of real GDP growth (i.e., if we drop remittance growth from the model, the fit would deteriorate materially);

(ii) there is no Granger-causality in the opposite direction from real GDP growth to remittance inflows;

(iii) there is a two-way strong endogenous relationship between price inflation and remittance inflows growth, with higher remittances driving up domestic prices and higher prices helping attract greater remittances.

Table 2. Granger Causality Test

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 09/10/14 Time: 15:36
Sample: 2002Q1 2014Q2
Included observations: 42

Dependent variable: NGDP_R_ACHG

Excluded	Chi-sq	df	Prob.
CPI_INFL_ACHG	6.621944	2	0.0365
REMIT_ACHG	18.21295	2	0.0001
All	18.84195	4	0.0008

Dependent variable: CPI_INFL_ACHG

Excluded	Chi-sq	df	Prob.
NGDP_R_ACHG	2.530938	2	0.2821
REMIT_ACHG	6.002358	2	0.0497
All	7.288732	4	0.1214

Dependent variable: REMIT_ACHG

Excluded	Chi-sq	df	Prob.
NGDP_R_ACHG	0.621892	2	0.7328
CPI_INFL_ACHG	13.96534	2	0.0009
All	13.96543	4	0.0074

16. The real GDP-remittance growth elasticity is estimated to range from 0.095 to 0.097 based on 2014 data. Since our sample ends in 2013, we take the values of *actual* remittance inflows growth in Q1, Q2 and Q3 of 2014 and in Q4 as predicted by the dynamic and static forecast

of the remittance model with a Russian construction index described above. Then we use the coefficient estimates from the VAR model to compute the contributions to real GDP growth from these observed and predicted growth rates of remittances. We average the predicted contributions across quarters in 2014 and divide by the average of remittance inflows growth rates lagged one quarter to arrive at our elasticity estimate.

Appendix I. Auxiliary Tables and Figures

A. Tajik Remittances: Model with Construction Index in Russia

Figure 1. Tajik Remittance Inflows and Construction Index in Russia, 2004:Q1–2014:Q1

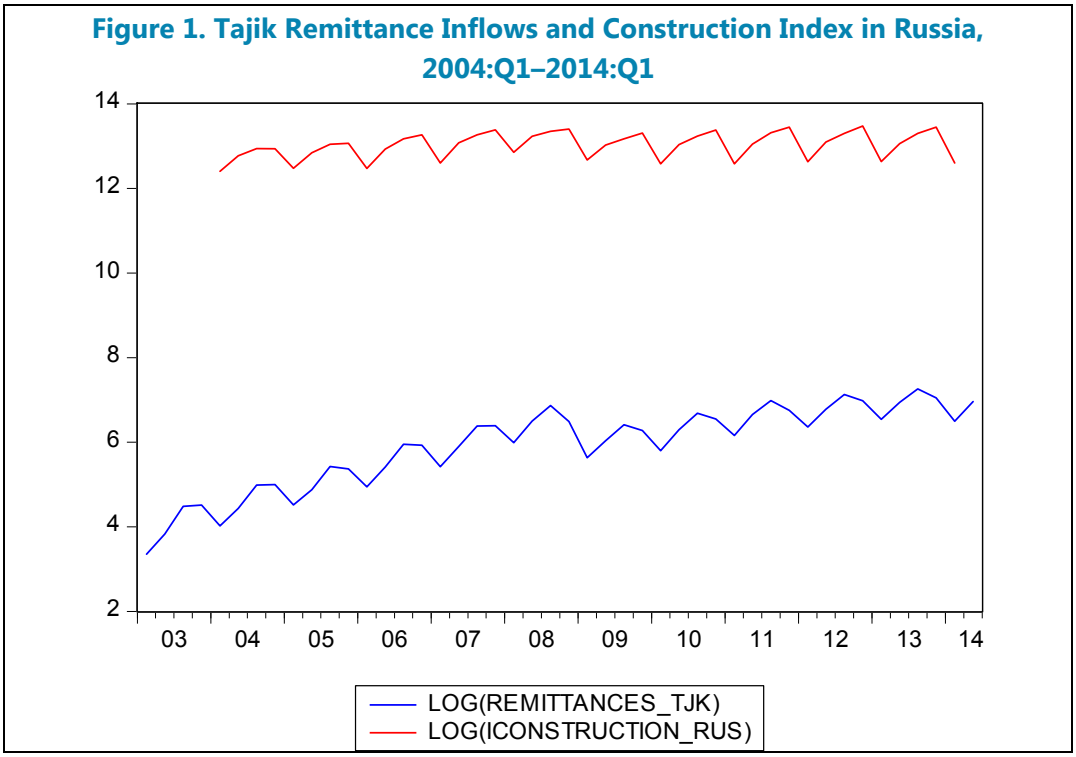


Table 1. Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.035567	Prob. F(4,30)	0.4052
Obs*R-squared	4.504628	Prob. Chi-Square(4)	0.3420

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 08/18/14 Time: 15:02
Sample: 2005Q1 2014Q1
Included observations: 37
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.771422	12.67619	-0.060856	0.9519
LOG(ICONSTRUCTION_RUS)	-0.004714	0.247926	-0.019015	0.9850
AR(4)	-0.002508	0.038779	-0.064666	0.9489
RESID(-1)	0.222750	0.199416	1.117010	0.2729
RESID(-2)	-0.237410	0.193323	-1.228046	0.2290
RESID(-3)	-0.057682	0.192221	-0.300080	0.7662
RESID(-4)	0.132494	0.192474	0.688370	0.4965

R-squared	0.121747	Mean dependent var	8.49E-06
Adjusted R-squared	-0.053904	S.D. dependent var	0.120039
S.E. of regression	0.123232	Akaike info criterion	-1.180839
Sum squared resid	0.455583	Schwarz criterion	-0.876071
Log likelihood	28.84552	Hannan-Quinn criter.	-1.073394
F-statistic	0.693118	Durbin-Watson stat	1.894828
Prob(F-statistic)	0.656923		

B. Tajik Real GDP Growth: Model with Prices and Remittances

Table 2. VAR Lag Order Selection Criteria

Endogenous variables: NGDP_R_ACHG CPI_INFL_ACHG REMIT_ACHG
Exogenous variables: C
Date: 09/10/14 Time: 15:23
Sample: 2002Q1 2014Q2
Included observations: 40

Lag	LogL	LR	FPE	AIC	SC	HQ
0	171.1087	NA	4.49e-08	-8.405435	-8.278769	-8.359637
1	237.6508	119.7758	2.53e-09	-11.28254	-10.77588*	-11.09935
2	253.9536	26.89968*	1.77e-09	-11.64768	-10.76102	-11.32709*
3	264.0201	15.09964	1.72e-09*	-11.70100	-10.43434	-11.24302
4	273.5157	12.81905	1.75e-09	-11.72578*	-10.07913	-11.13040

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 3. VAR Residual Serial Correlation LM Test

Null Hypothesis: no serial correlation at lag order h
Date: 09/10/14 Time: 15:33
Sample: 2002Q1 2014Q2
Included observations: 42

Lags	LM-Stat	Prob
1	19.22657	0.0233
2	10.86233	0.2853
3	8.908483	0.4458

Probs from chi-square with 9 df.

Figure 2. Actual and VAR Model Fitted Real GDP Growth