An Empirical Analysis of the Credit-Output Relationship: Evidence from Peru

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Motivation

- The recent international financial crisis has motivated the debate about the role of quantities in the economy, with particular emphasis on money and credit.

- Thomas Sargent (2011):

  For most of the last 25 years, the quantity theory of money has been sleeping, but during the last year, unprecedented growth in leading central banks' balance sheets has prompted some of us to worry because the quantity theory has slept before, only to reawaken

Motivation

- The question of monitoring credit aggregates as a means of predicting/explaining future output downturns and financial crises has become increasingly relevant for policymakers.
- For most central banks, credit and money aggregates are important variables (availability, reliability), and potentially good candidates as information variables for monetary/macroeconomic policy.
- Do credit/money aggregates contain any useful information for understanding the evolution of key macroeconomic variables (output, inflation, employment, etc.)?

This Paper / Contribution

- This paper investigates empirically whether credit aggregates contain any useful information for understanding the evolution of output.
  1. Is there a stable credit-output relationship?
  2. Is there evidence of an empirical causality useful for forecasting?
  3. Is it possible to quantify the effect of credit on output?
- Empirical results might be used in a DSGE model that focuses on credit market conditions.

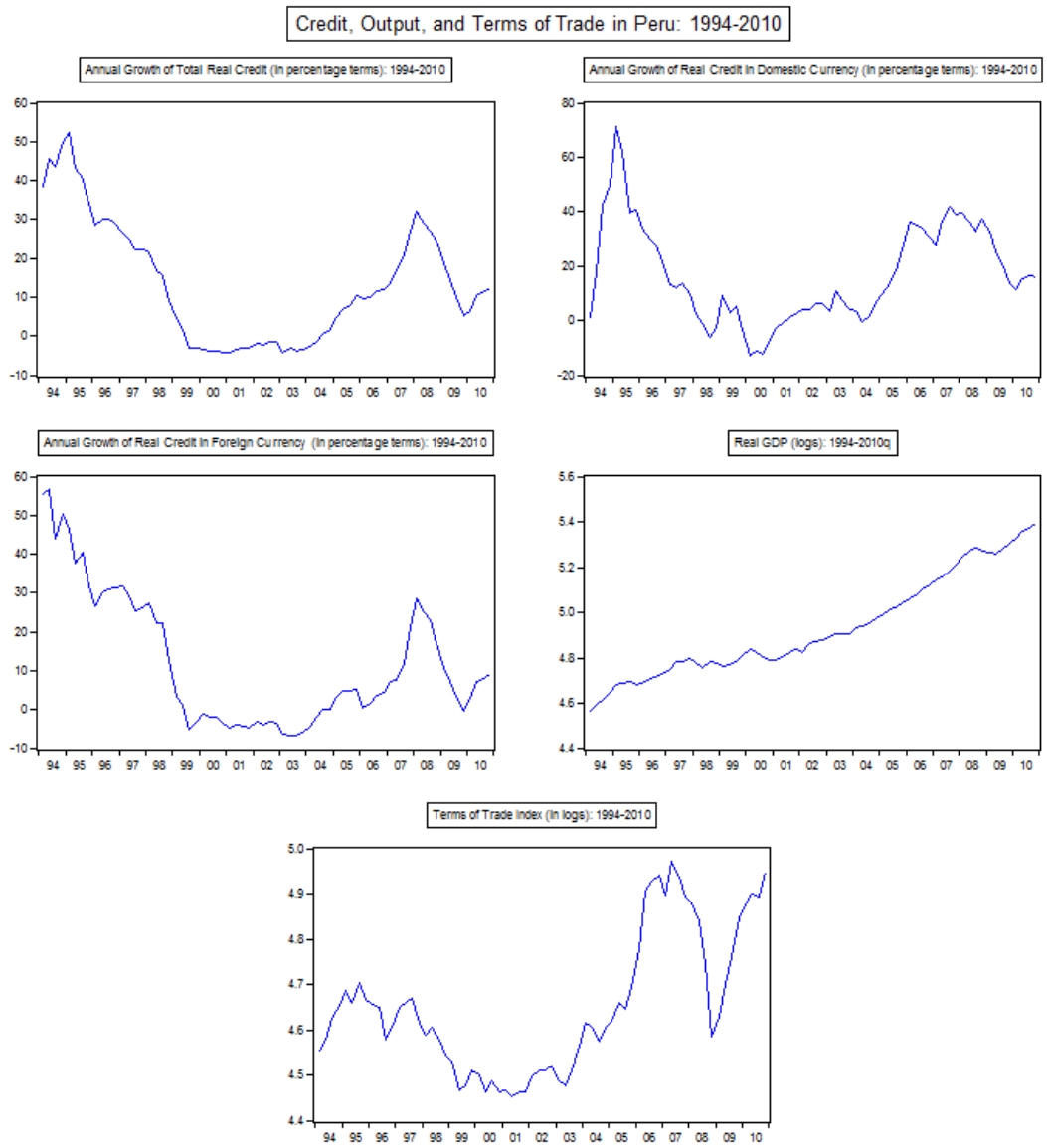
Methodology

- Extends Lahura and Vega (2010) in several dimensions.
- Main features:
  1. Empirical model is a vector error correction (VEC) model.
  2. Identification of the structural shocks based on common stochastic trends.
  3. Inclusion of terms of trade variable (Castillo and Salas, 2008).
  4. Quarterly data for Peru, period 1993-2011.

Results

- Three main results:
  1. There is a stable long-run relationship between real credit growth and output (and terms of trade).
  2. Real credit growth (in both currencies) is useful in forecasting output in the long-run, whereas credit impulse (the change in credit growth) in domestic currency helps forecasting output growth in the short run.
  3. A structural permanent shock in real credit has positive effects on output.
- Therefore, information contained in credit aggregates could be useful for policymakers.

Data Analysis/Graphs



Data Analysis/Unit root test

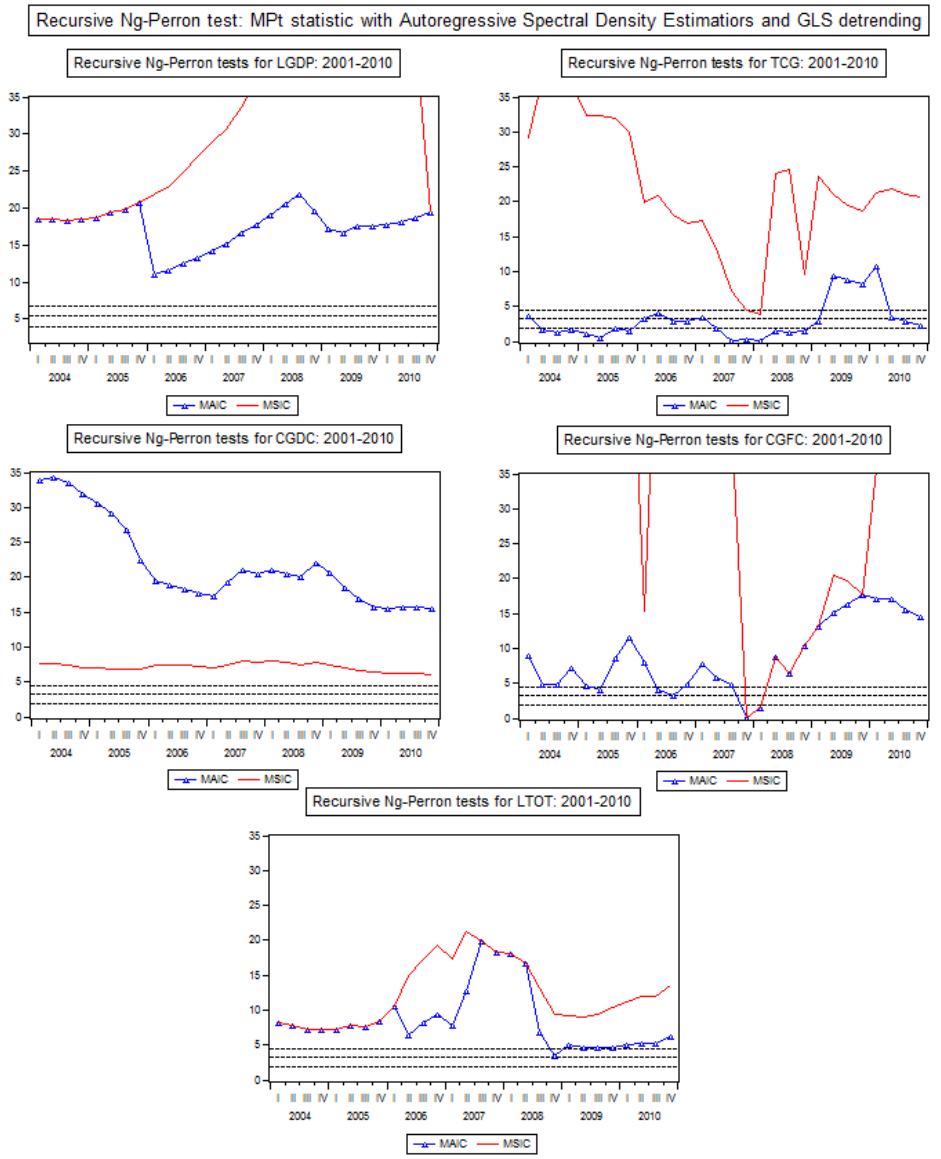
Ng-Perron tests: 1994-2010
(estimated statistics)

Autoregressive spectral density estimator based on GLS detrending

Series	Lag-length criteria	MZa	MZt	MSB	MPT
GDP	MAIC	-4.46	-1.36	0.30	19.35
	MSIC	-4.46	-1.36	0.30	19.35
TCG	MAIC	-11.17 **	-2.34 **	0.21 **	2.30 **
	MSIC	-1.02	-0.64	0.63	20.63
CGDC	MAIC	-1.55	-0.87	0.56	15.44
	MSIC	-4.01	-1.41	0.35	6.12
CGFC	MAIC	-1.48	-0.76	0.52	14.47
	MSIC	-0.33	-0.27	0.82	36.83
LTOT	MAIC	-4.29	-1.17	0.27 ***	6.14
	MSIC	-0.64	-0.26	0.40	13.47

* All tests include constant and trend in the deterministic part. The symbols "*", "**", and "***" indicate rejection of the null hypothesis of unit root at 1%, 5% and 10% significance level, respectively.

Data Analysis/Recursive Unit root test



Data Analysis/Recursive Unit root test

Cointegrating vectors (normalised with respecto to GDP)
(1994:1 - 2010:4)

	Model 1	Model 2	Model 3	Model 4
Number of cointegrating vectors	1	1	1	1
LTOT	0.93 *	0.28 *	0.32 *	0.41 *
	5.41	5.34	10.62	7.74
GCDC		0.33 *		-0.29 *
		4.80		-5.32
GCFC			0.22 *	0.22 *
			9.44	4.48
Lag length	8	10	9	2

The symbols "*", "**", and "***" represent 1%, 5% and 10% significance level, respectively.

Cointegration analysis/VEC Model

Vector Error Correction Model

$$\Delta GDP_t = \alpha_1 \left(GDP_{t-1} - \beta_0 - \beta_1 LTOT - \beta_2 Z_t\right) + \sum_{i=1}^{p} \gamma_i \Delta GDP_{t-1} + \sum_{i=1}^{p} \theta_i \Delta LTOT_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta Z_{t-1} + u_t$$

$$\Delta LTOT_t = \alpha_2 (GDP_{t-1} - \beta_0 - \beta_1 LTOT - \beta_2 Z_t) + \sum_{i=1}^{p} \gamma_i' \Delta GDP_{t-i} + \sum_{i=1}^{p} \theta_i' \Delta LTOT_{t-i} + \sum_{i=1}^{p} \varphi_i' \Delta Z_{t-i} + u_t^2$$

$$\Delta Z_t = \alpha_3 (GDP_{t-1} - \beta_0 - \beta_1 LTOT - \beta_2 Z_t) + \sum_{i=1}^{p} \gamma_i'' \Delta GDP_{t-i} + \sum_{i=1}^{p} \theta_i'' \Delta LTOT_{t-i} + \sum_{i=1}^{p} \varphi_i'' \Delta Z_{t-i} + u_t^3$$

Cointegration analysis/Exogeneity

Speed-of-Adjustment coefficients in VEC models

	Model 1	Model 2	Model 3	Model 4
Error correction equation for d(GDP)	-0.11 *	-0.43 *	-0.71 *	-0.02
	-3.76	-5.08	-4.12	-0.34
Error correction equation for d(LTOT)	0.02	0.11	-0.24	0.19
	0.19	0.19	-0.28	1.14
Error correction equation for d(GCDC)		-0.22		-0.77 *
		-0.52		-4.37
Error correction equation for d(GCFC)			0.40	-0.26 **
			0.93	-2.07

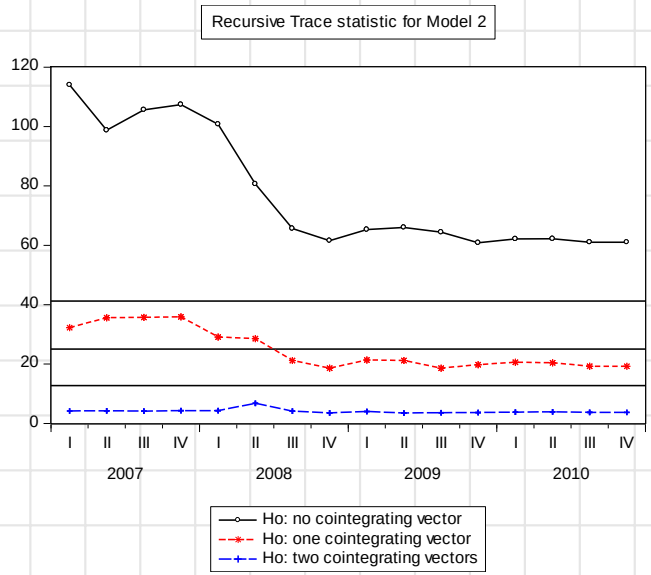
The symbols "*", "**", and "***" represent 1%, 5% and 10% significance level, respectively.

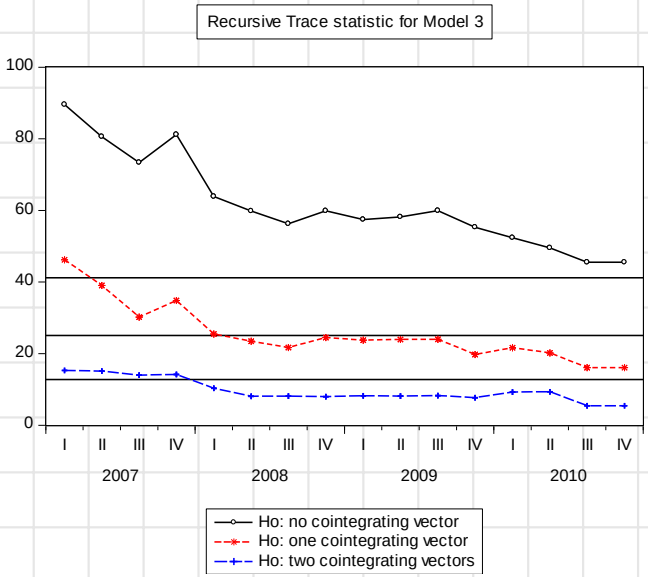
Granger Causality test in the VEC models
(probabilities)

	Model 1	Model 2	Model 3	Model 4
dLTOT ~ Granger cause dGDP	0.16	0.04	0.16	0.03
dGDP ~ Granger cause dLTOT	0.90	0.91	0.87	0.16
dCGDC ~ Granger cause dGDP		0.00		0.15
dGDP ~ Granger cause dCGDC		**0.80**		0.04
dCGFC ~ Granger cause dGDP			0.16	0.71
dGDP ~ Granger cause dCGFC			**0.40**	0.92

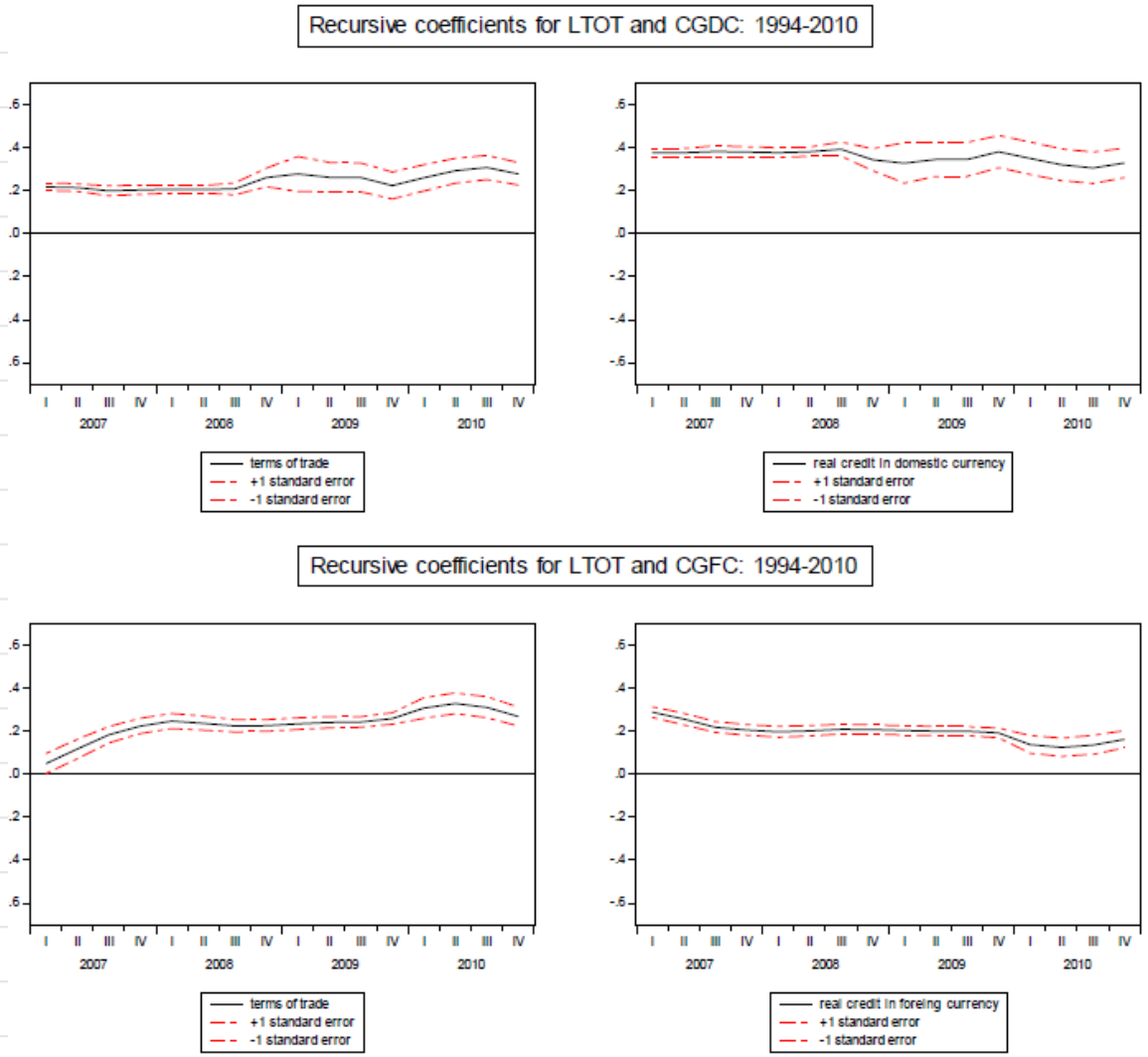
Note: The expression "~ Granger cause" means "does not Granger cause".

Cointegration analysis/Stability





Cointegration analysis/Stability

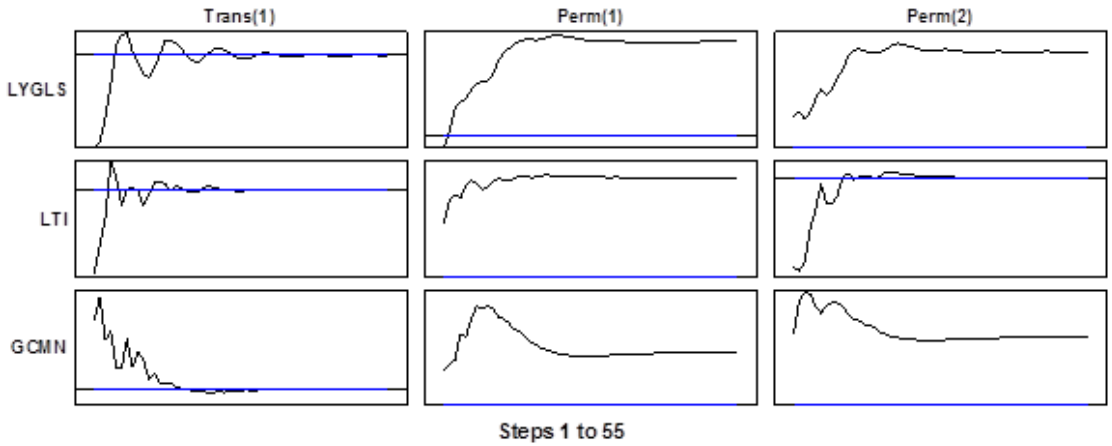


Cointegration analysis/Structural VEC model

Structural estimates from the VEC model

	Output	Terms of trade	Real Credit Growth in Domestic
Long-run effect (normalised)			
Permanent Shock 1	0.30	1.00	0.45
Permanent Shock 2	0.44	0.00	1.00
Contemporaneous effect			
Permanent Shock 1	-0.23	3.26	1.81
Permanent Shock 2	0.39	-1.36	2.80
Effect after 55 periods			
Permanent Shock 1	1.81	6.00	2.71
Permanent Shock 2	1.17	0.00	2.63

Cointegration analysis/Structural IRFs



Conclusions

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Possible extensions

- Inclusion of real public expenditure in the cointegrating vector.
- Construction of a simple theoretical model based on the empirical results.