Monetary Shocks and Real Exchange Rates in the Long Run

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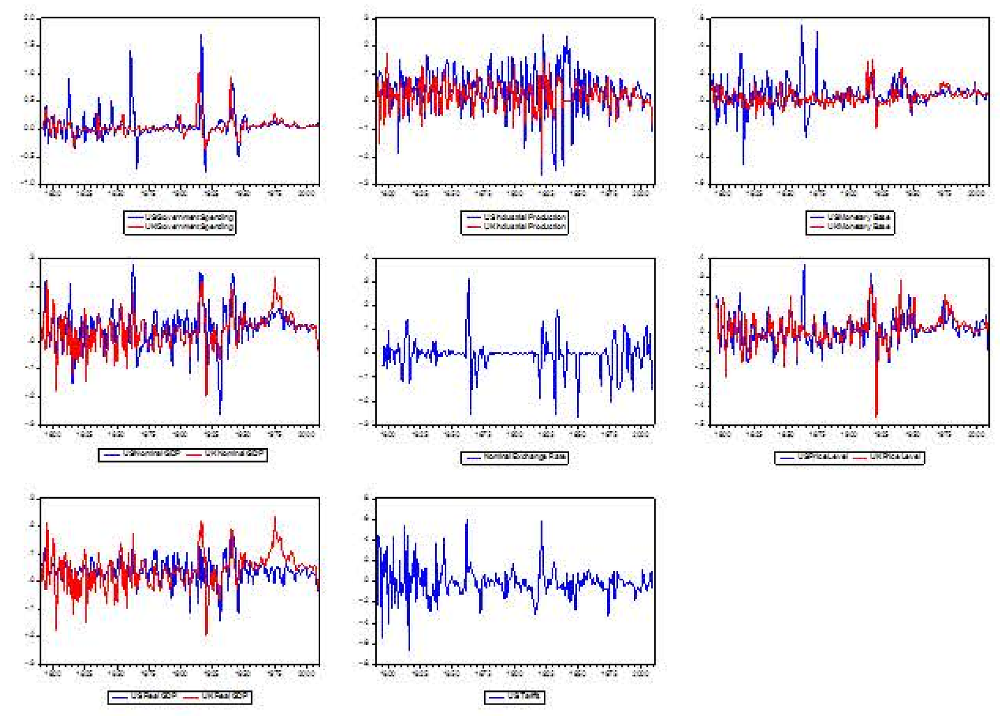
Introduction

In Rogers (1999), the author explored the importance of monetary shocks on real exchange rates. Using the VAR (vector autoregression) technique to identify shocks and annual observations of 6 data series (prices, output, government spending, exchange rate, monetary base and money supply) from 1889 to 1992, he found that monetary shocks accounted for about 40.6% of the variability in real exchange rate movements, which implies that monetary shocks are important for exchange rate fluctuations. In the introduction of his paper, Rogers makes one claim, he states that he uses "annual observations from 1889, the earliest availability of the US GNP components." That claim turns out to be inaccurate as Prof. Craighead was able to find data that goes all the way back to 1790. Hence the purpose of this project is to make use of the longer term data (1790-2011) to replicate Rogers' research and see if his results hold up. The longer time series allows us to assess whether there are variations in the importance of monetary shocks during different time periods and across various monetary and exchange rate regimes. My role in this project mainly involved tracking down the data, digitalizing the paper data, and investigating the properties of the data in Eviews. I mainly focused on testing for stationarity.

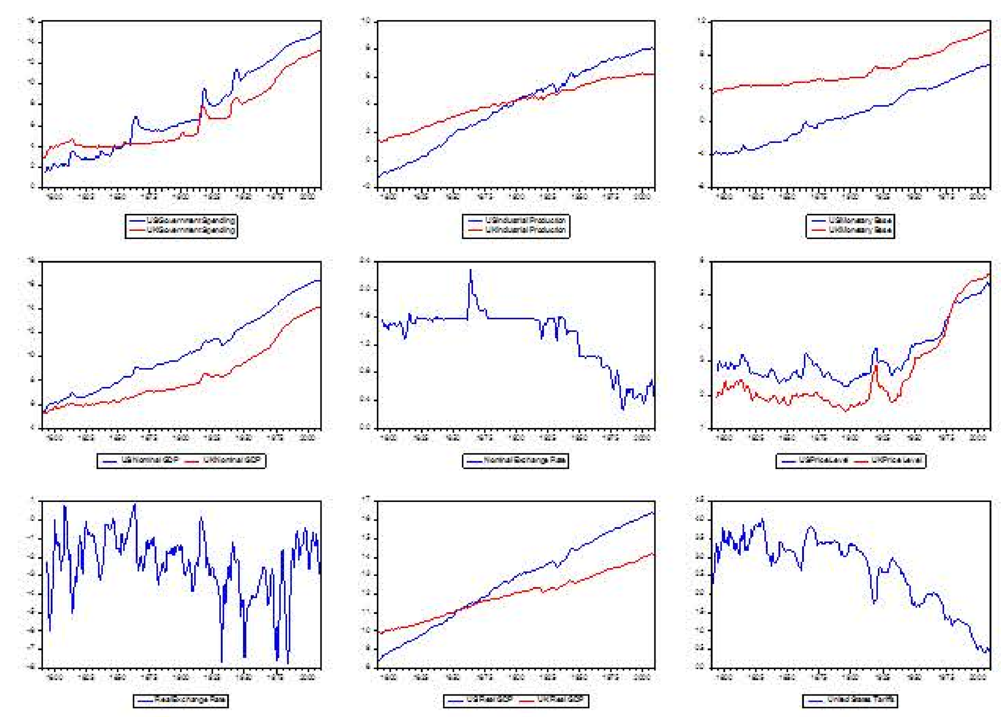
Stationarity -- On a technical level, a time series y_t is *stationary* if its probability distribution does not change over time, i.e. if the joint distribution of $(y_{s+1}, y_{s+2}, \ldots, y_{s+T})$ does not depend on s; otherwise y_t is said to be *nonstationary*. Stationarity requires the future to be like the past, at least in a probabilistic sense. For time series regressions, if the dependent variable and the regressors are nonstationary, then conventional hypothesis tests, confidence intervals, and forecasts can be unreliable. Hence it is important to know the stationarity properties of the data before conducting further analysis.

First Differenced Data



Country	Variable	Structure	Test	Lag Length/Bandwidth	Test Statistic	Stationarity
United States	price level	Constant	ADF	0	-10.87736	Yes, at 1% level
		Constant	KPSS	0	0.646434	Yes, at 5% level
	ngdp	Constant	ADF	0	-9.316789	Yes. At 1% level
		Constant	KPSS	1	0.224605	Yes
	rgdp	Constant	ADF	0	-10.84338	Yes, at 1% level
		Constant	KPSS	7	0.281309	Yes
	industrial production	Constant	ADF	0	-13.74812	Yes, at 1% level
		Constant	KPSS	8	0.388636	yes, at 10% level
	m base	Constant	ADF	0	-12.08883	yes, at 1% level
		Constant	KPSS	7	0.126267	Yes
	gov spending	Constant	ADF	1	-10.74955	yes, at 1% level
		Constant	KPSS	10	0.118275	yes
	tariffs	Constant	ADF	1	-8.878985	Yes, at 1% level
		Constant	KPSS	1	0.269133	yes
United Kingdom	price level	Constant	ADF	0	-10.07516	yes, at 1% level
		Constant	KPSS	6	0.683806	yes, at 5% level
	ngdp	Constant	ADF	1	-7.287076	yes, at 1% level
		Constant	KPSS	8	0.974516	No, at 1% level
	rgdp	Constant	ADF	0	-13.69045	yes, at 1% level
		Constant	KPSS	8	0.088988	yes
	industrial production	Constant	ADF	0	-15.66153	Yes, at 1% level
		Constant	KPSS	12	0.556128	yes, at 5% level
	m base	Constant	ADF	0	-9.813206	yes, at 1% level
		Constant	KPSS	8	0.744795	No, at 1% level
	gov spending	Constant	ADF	1	-7.905355	yes, at 1% level
		Constant	KPSS	5	0.320349	yes

Logged Data



Country	Variable	Structure	Test	Lag Length/Bandwidth	Test Statistic	Stationarity
Mixed	NOME	C+T	ADF	2	-2.074044	No
		C+T	KPSS	11	0.43122	No, at 1%
	Q	C	ADF	1	-5.112445	yes, at 1%
		C	KPSS	10	0.676173	Yes, at 5%
United States	Interest Rate	C	ADF	2	-2.055477	YES, at 1%
		C	KPSS	10	0.259717	YES
	price level	C+T	ADF	1	0.423124	NO
		C+T	KPSS	11	-1.26147	NO, at 1%
	ngdp	C+T	ADF	1	0.7234	NO
		C+T	KPSS	11	0.381105	No, at 1%
	rgdp	C+T	ADF	1	-2.742226	NO
		C+T	KPSS	11	0.347168	No, at 1%
	industrial production	C+T	ADF	0	-1.202609	No
		C+T	KPSS	11	0.409152	No, at 1%
	m base	C+T	ADF	1	-3.63786	Yes, at 5%
		C+T	KPSS	11	0.158614	No, at 5%
	gov spending	C+T	ADF	2	-2.944688	No
		C+T	KPSS	11	0.361642	No, at 1%
	tariffs	C	ADF	2	-0.625601	No
		C	KPSS	11	1.575319	No, at 1%
United Kingdom	Interest Rate	C	ADF	2	-2.496051	YES
		C	KPSS	11	0.426758	YES
	price level	C+T	ADF	1	-0.743969	No
		C+T	KPSS	11	0.436026	No, at 1%
	ngdp	C+T	ADF	1	0.006335	No
		C+T	KPSS	11	0.437341	No, at 1%
	rgdp	C+T	ADF	0	-2.044009	No
		C+T	KPSS	11	0.177095	No, at 5%
	industrial production	C+T	ADF	0	-1.15943	No
		C+T	KPSS	11	0.3607	No, at 1%
	m base	C+T	ADF	1	-0.176548	No
		C+T	KPSS	11	0.468828	No, at 1%
	gov spending	C+T	ADF	2	-1.191414	No
		C+T	KPSS	11	0.455781	No, at 1%

Data Sources

Finding and pruning the data was a large part of this project. Back in the 16th and 17th century Britain used gold and specie instead of common currency, so a lot of careful conversions had to be done. In addition, we had to splice together several different data sets to get the full span of 220 years, but at each splice we checked to make sure the data seemed consistent.

We wanted to use for both the US and UK the real exchange rate, interest rates, price level, real GDP, industrial production, tariffs, the monetary base, and government spending. We got our data from several sources, including the Bank of England, Federal Reserve, World Bank, UK Office of National Statistics, OECD, and many papers (including most importantly Broadberry's "British Economic Growth").

Conclusions and Future Research

The results showed that most of the data, when looked at in levels, did not exhibit stationarity (except for interest rates and the real exchange rate). This is consistent with economic theory. First differencing the series that are nonstationary in levels appear to solve the unit root problem. Here we use two different types of stationarity tests for robustness, the Augmented Dickey Fuller test and the Kwiatkowski–Phillips–Schmidt–Shin Test. For most of the series both tests reach the same conclusions regarding the stationarity of the series being tested. This gives us more confidence regarding the accuracy of the results.

Future Research:

Now that we know the unit root properties of the data, the next step would be to conduct cointegration tests to make sure the VAR model is specified correctly. After these initial tests are completed, we will be able to run the VAR using long-run identifying restrictions to identify monetary shocks and analyze the impact of these shocks on exchange rate fluctuations.

Literature cited

Rogers, John H., "Monetary Shocks and Real Exchange Rates," Journal of International Economics, vol. 49, December 1999, pg. 269-288.