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Volume Author/Editor: Gerardo della Paolera and Alan M. Taylor

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Chapter Author: Gerardo della Paolera, Alan M. Taylor

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Appendix 4
Money and Exchange Rates, 1884–1913

In this appendix we briefly discuss the evolution of money supply, exchange rate determination, and money demand during the 1884–1913 period.

Money Supply

As we have already seen (Table 2.4 and Figure 2.3), the 1890–99 stabilization period was characterized by a dramatic change in the source of monetary expansion. Most of the change in the money stock took the form of bank-created money; 58 percent of that change is explained by a fall in the currency-money ratio alone, and 19 percent by change in the the monetary base. In contrast, during the gold-standard 1900–1913, the monetary base explained 82 percent of the growth in the money stock, and this increase in the base was fully backed by specie reserves at the margin. We can also see that the secular decline in the currency and reserve ratios from 1892 onward reflects a slow but continuous process of improved financial intermediation (Figure 2.4).

These changes can be summarized through more formal econometrics. Table A4.1 presents parameter estimates of the long-run determinants of the money stock for the subperiods 1885–99, 1900–1913 and the entire period of study 1885–1913. For the period 1885–99, the currency-money ratio plays a more significant role in the money supply process than during the gold-standard. The lower degree of correlation for the 1885–99 period shows the relative importance of an omitted interaction reflecting a higher degree of volatility in the money multiplier.

Overall, we find the hypothesis that the elasticity of money stock with respect to the monetary base is unity is, again, strongly corroborated.

Exchange Rate Determination

We have already seen that during the flexible exchange-rate regime, the growth in real money stock was sluggish with respect to real output growth (Table 2.4). On the other hand, during the gold-standard, money stock growth exceeded output growth. This result bears great similarity to the experience of countries under the sterling-bloc during the Great Depression of 1870–95 and then, during the boom that followed the new discoveries of gold in Alaska, South Africa, and Colorado.[1]

We will assume that Argentina, a small economy closely integrated into the sterling block, could not sustain in the long run an independent monetary policy. This is a restatement of the classic Mundellian trilemma. Inflating (or deflating) the domestic

1. See Bordo (1986, p. 347)

Table A4.1. *Money Supply Estimation, 1884–1913*

Dependent Variable and Period	$\Delta \ln c$	$\Delta \ln r$	$\Delta \ln MB$	R-squared	SEE
$\Delta \ln m$					
1885–1913	-0.49	-0.38		0.97	0.02
	(0.02)	(0.02)			
1885–99	-0.50	-0.30		0.97	0.03
	(0.03)	(0.03)			
1900–1913	-0.42	-0.45		0.99	0.00
	(0.02)	(0.01)			
$\Delta \ln M$					
1885–1913	-0.48	-0.38	0.97	0.98	0.02
	(0.02)	(0.02)	-0.03		
1885–99	-0.49	-0.36	0.96	0.97	0.03
	(0.03)	(0.03)	-0.05		
1900–1913	-0.42	-0.45	0.99	1.00	0.01
	(0.02)	(0.01)	-0.02		

Notes: See text. Standard errors in parantheses.
Sources: See Appendix 1.

economy at a different pace than the rest of the world would not be sustainable because price or exchange rate adjustments, or both, would take place to restore real exchange rate equilibrium. That is, we are invoking an assumption of long-run purchasing power parity.

We first tested a restricted version of the asset approach to the exchange rate determination for the floating period (1885–99), treating the United Kingdom as the rest of the world.

In equilibrium the existing supply of monetary base must be willingly held, so that

$$MB/P = L,$$

$$MB^*/P^* = L^*,$$

where L is the demand for base money, and an asterisk denotes the U.K. level of each variable in this two-country model.

Purchasing power parity (PPP) is assumed to hold between Argentina and the rest of the world (here proxied by the United Kingdom). For the period 1884–99 we performed a regression test of purchasing power parity in the form $\ln P = \alpha + \beta \ln(EP^*)$. The results were

$$\begin{array}{lcccc} \ln P & = & 0.074 & + & 0.915 \quad \ln(EP^*) \\ & & (0.48) & & (0.09) \end{array}$$

with $DW = 1.81$, $\rho = 0.64$, Adjusted $R^2 = 0.97$. We take this as evidence in favor of PPP. Hence, we assume $P = EP^*$. Substituting for P and P^* in the equations for money market equilibrium and solving for E, we obtain

$$E = \frac{MB}{MB^*}\frac{L^*}{L}.$$

Taking log first differences and making the money demand a function of real output and the interest rate yields the expression

$$\hat{E} = \alpha + \beta(\hat{MB} - \hat{MB}^*) + \gamma(\hat{Y}^* - \hat{Y}) + \delta(\Delta i - \Delta i^*),$$

Table A4.2. *Exchange Rate Determinants, 1884–1913*

Dependent Variable	$\Delta \ln E$	$\Delta \ln E$	$\Delta \ln E - \Delta \ln (SP/MB)$
$\Delta \ln MB - \Delta \ln MB^*$	0.49	—	—
	(0.23)		
$\Delta \ln MB$	—	1.15	0.99
		(0.18)	(0.31)
$\Delta \ln MB^*$	—	-1.29	-0.97
		(0.54)	(0.84)
$\Delta \ln Y - \Delta \ln Y^*$	1.03	1.38	1.26
	(0.93)	(0.46)	(0.51)
$\Delta i - \Delta i^*$	0.07	-0.03	-0.02
	(0.05)	(0.04)	(0.05)
DW	1.90	2.03	1.85
ρ	0.06	-0.49	0.16
R-squared	0.62	0.86	0.70

Notes: See text. Standard errors in parentheses.
Sources: See Appendix 1.

where the hats denote log differences of the variables ($\hat{x} = \Delta \ln x$) and

E = paper-gold exchange rate;
MB = Argentine monetary base;
MB^* = U.K. monetary base;
Y = Argentine real output;
Y^* = U.K. real output;
Δi = change in internal bond yield;
Δi^* = change in foreign bond yield.

Here, the differential in long-term interest rates is used as a proxy for the anticipated rate of inflation.[2]

In this simple form the money supplies and outputs are restricted to have the same coefficient. We estimated this equation and the regression results were as shown in the first column of Table A4.2.

The explanatory power of this regression satisfactory as a preliminary estimate and all estimated coefficients have the correct sign indicated by the theory.

However, upon more inspection we found that the data reject the hypothesis that the coefficient of the difference in the rate of change in the money supplies is unity. Several factors could account for this:

1. The fact that the respective monetary bases were restricted to have the same coefficient may not be an accurate specification;
2. The sample period under consideration cannot be characterized as a clean float (recall the intervention in the exchange market during 1889–90); and
3. The proxy for the Argentine interest rate is a poor predictor of inflation rates.

Thus, we augmented the equation with two modifications to address for these problems. First, we allowed the monetary variables to have different coefficients. Second, we included a measure of exchange rate pressure to augment the variable E for the years

2. All data from Appendix 1 except MB^* from Bordo (1982) and Y^* from Feinstein (1972).

Table A4.3. *Money Demand Estimation, 1884–1913*

Dependent Variable and Period	ln Y	ln $(1 + \pi)$	ρ	DW	R-squared
1884–91					
ln M/P	2.03	-1.35		2.11	0.76
	(0.44)	(0.37)			
ln M/P (including specie hoarding)	2.13	-0.81		2.61	0.91
	(0.25)	(0.21)			
1891–1900					
ln M/P	1.10	-0.15		1.96	0.87
	(0.17)	(0.11)			
ln M/P (including specie hoarding)	0.73	-0.219		2.17	0.83
	(0.15)	(0.09)			
1884–99					
ln M/P	1.42	-0.21	0.89	1.49	0.95
	(0.52)	(0.21)	(0.10)		
ln M/P (including specie hoarding)	1.28	-0.16	0.80	1.64	0.98
	(0.34)	(0.15)	(0.14)		
1900–1913					
ln M/P	1.28	-0.09	0.48	1.18	0.99
	(0.10)	(0.19)	(0.28)		
ln M/P (including specie hoarding)	1.13	-0.13	0.41	1.15	1.00
	(0.07)	(0.15)	(0.29)		
1884–1913					
ln M/P	1.19	-0.22	0.87	1.45	0.95
	(0.22)	(0.13)	(0.08)		
ln M/P (including specie hoarding)	1.01	-0.20	0.77	1.46	0.97
	(0.12)	(0.10)	(0.11)		

Notes: See text. Standard errors in parantheses.
Sources: See Appendix 1.

when specie reserves shared the brunt of the adjustment in the foreign exchange market, defining a new variable SP/MB equal to the change in specie backing of paper notes divided by the monetary base at the end of the previous year. The augmented results are shown in the final two columns of Table A4.2.

The augmented results provide a better fit, and they reveal that the elasticity of the exchange rate with respect to the domestic stock of paper notes did not differ significantly from unity. The coefficients of the absolute change in interest rates have the expected sign only in the previous regression, but in all cases the coefficients are statistically insignificant.

Money Demand

Finally, we estimated money demand functions. We estimated only the simplest money demand equations because the paucity of the data precludes a more elaborate analysis. Two definitions of money were used: M defined as the sum of currency in the hands of the public plus total deposits (demand plus time deposits); and M defined as above plus the public hoarding of specie.

Two alternative measures of the opportunity cost of holding money were tried. In Table A4.3 we used the ex-post inflation rate π, and estimated an equation of the form

Table A4.4. *Money Demand Estimation, 1884–1913*

Dependent Variable and Period	ln Y	ln $(1+i)$	ρ	DW	R-squared
1884–91					
ln *M/P*	2.09	-19.79		1.90	0.58
	(0.61)	(8.36)			
ln *M/P* (including specie hoarding)	2.12	-10.79		2.01	0.81
	(0.39)	(5.32)			
1891–1900					
ln *M/P*	1.31	2.12		1.90	0.83
	(0.36)	(5.95)			
ln *M/P* (including specie hoarding)	0.75	-2.08		1.92	0.70
	(0.37)	(6.18)			
1884–99					
ln *M/P*	1.51	-6.85	0.88	1.73	0.95
	(0.50)	(6.15)	(0.10)		
ln *M/P* (including specie hoarding)	1.36	-3.92	0.81	1.88	0.97
	(0.34)	(4.54)	(0.14)		
1900–1913					
ln *M/P*	1.00	-8.86	0.25	1.58	0.98
	(0.15)	(4.12)	(0.29)		
ln *M/P* (including specie hoarding)	1.00	-4.11	0.32	1.46	0.99
	(0.13)	(3.60)	(0.29)		
1884–1913					
ln *M/P*	1.16	-6.01	0.88	1.73	0.94
	(0.24)	(4.21)	(0.08)		
ln *M/P* (including specie hoarding)	0.95	-2.43	0.72	1.76	0.97
	(0.13)	(3.22)	(0.12)		

Notes: See text. Standard errors in parantheses.
Sources: See Appendix 1.

$$\ln(M/P) = \alpha + \beta \ln Y + \gamma \ln(1+\pi).$$

In Table A4.4 we used the long-term interest rate proxied by the yield of an internal government bond i, and estimated an equation of the form

$$\ln(M/P) = \alpha + \beta \ln Y + \gamma \ln(1+i).$$

In most of these regressions the coefficients have the signs predicted by economic theory, but the statistical significance of the opportunity cost coefficients is weak. This may be a data problem: a long-term bond yield could be constructed for most of the period examined; but during the 1892–99 deflationary period, except for two major changes in 1892 and 1896, the long-term yield moved very little while changes in the rate of inflation were considerable. This explains the better performance of the specification using the inflation rate as a measure of the opportunity cost of money.

The relationship between the real money stock and the real income and interest rates appears relatively stable and well defined for the whole period 1884–1913. Breaking the period under consideration into a number of subintervals shows that the estimated parameters are not *perfectly* stable from a statistical point of view. For example, an F-test shows that the 1884–91 and 1891–1900 regression coefficients are significantly different from each other at the 5 percent level. Several statistical and economic factors may have accounted for this structural change.

First, the quality of the data is always a problem. The wholesale price index for 1884–99 is weighted heavily with the prices of primary export products; hence it fluctuates much more widely than an ideal consumer price index, Moreover, since prices for services could not be obtained, our price index may underestimate the inflationary pressures of 1884–91 and overestimate the deflation prevailing up to 1899.

Second, the drastic differences in monetary and financial regimes before and after 1891 could be a very plausible explanation for the observed structural changes. We have seen in Tables 2.3 and 2.4 the extreme volatility of the money multiplier and the dramatic rise of the currency-money ratio for 1890 and 1891, evidence consistent with a lack of confidence in the financial system that could have led to the dramatic fall in the money stock.

Pooling the observations into a 1884–99 money demand regression and comparing it to the 1900–1913 fitted demand, the two regressions are statistically different (at the 5 percent level). In general, for the entire period 1884–1913, the coefficients are within the expected range of magnitude, but the large autocorrelation coefficient suggests that some important variables have been omitted from the specified equation.

A significant conclusion from these simple money demand estimations is our finding of the importance of including the public's hoarding of gold in the definition of money. For the period 1884–91, in which currency substitution was an important phenomenon, the definition of money including specie empirically outperforms the standard definition in terms of a higher variance explained by the simple model.

We also note that money demand sensitivity to changes in the interest rate (or inflation rate) is considerably reduced in the regressions using the definition of money including specie by comparison to the use of the standard definition. This can be largely attributed to the fact that the substitution between paper currency and specie is not captured when using the specie-inclusive definition of money.

Note, however, that the currency substitution phenomenon plays an almost negligible role during the 1900–1913 gold standard years and, therefore, the money definition is rather inconsequential for the empirical estimation of Argentine money demand under the fixed exchange-rate regime.