The Demand for Money, Adaptive Expectations, and Currency Movements

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Currency Movements

- Hard to Explain, Forecast
  - Meese and Rogoff (1983, time series forecast of spot returns)
    - Random Walk Does Better than More Sophisticated Models
- Cross-Sectional Predictors
  - Carry
  - Output Gap
  - Net Foreign Investment
  - Momentum
  - External Trade Imbalance
  - Several Others
  - UMVE (currency return weighting: estimated to be unconditionally MV efficient)
  - Others

This Paper: Focus on Fundamental Information
Trader Info vs Accurate (Revised) Fundamentals

- Trader Info on Fundamentals Correlates with FX Returns
  - Contemporaneously
  - In Future Months
    - An Efficient Markets Anomaly
- More Accurate Fundamental Info (Future & Final Revisions)
  - Little Correlation with Currency Movements
- Trader Signal: Excess Money Demand
  - Subsumes Carry as an Out-of-Sample Predictor
  - Forecasts Inflation
- Novel Way to Estimate Demand from Central Bank Supply

Theory of Money Demand (D) given Real C

- Utility Gain (U) from Money's Convenience

$$U = uC\ ln\left(D - a\right)$$

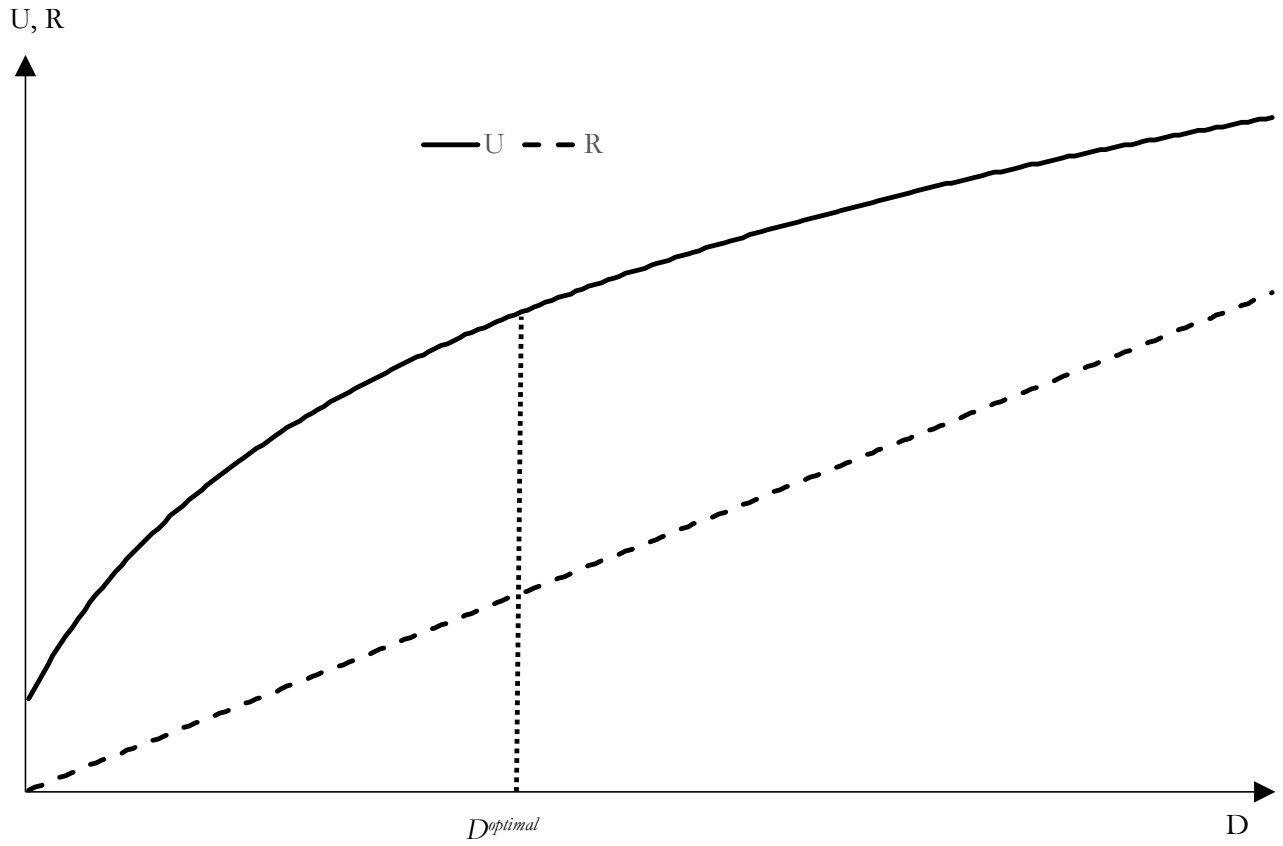
- Utility Reduction (R) from Money rather than Assets Earning More

$$R = r\frac{D}{p}$$

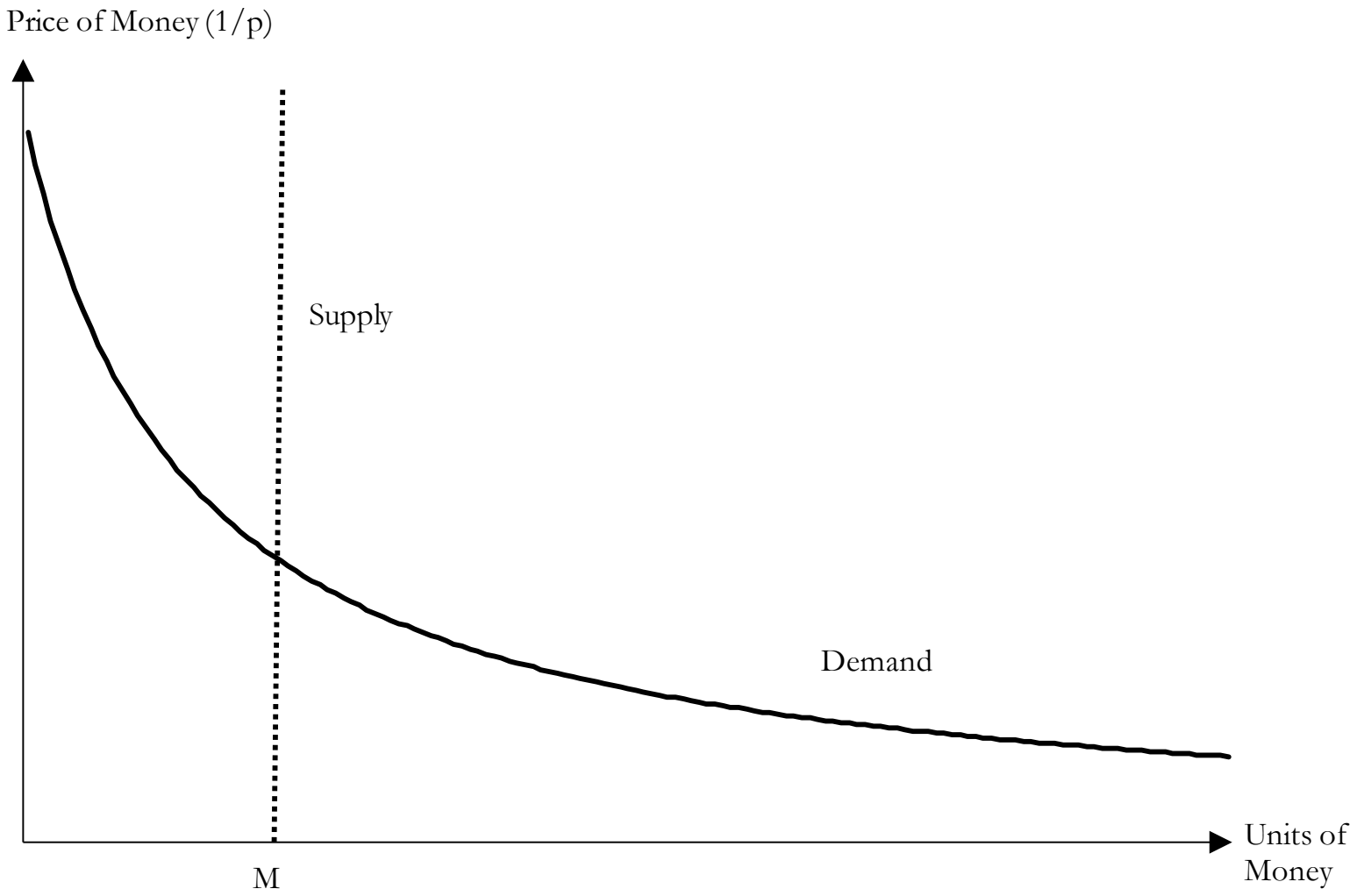
- Optimal Money Demand: Linear in C (volume of goods, services)

$$D = \frac{u}{r}pC + a$$

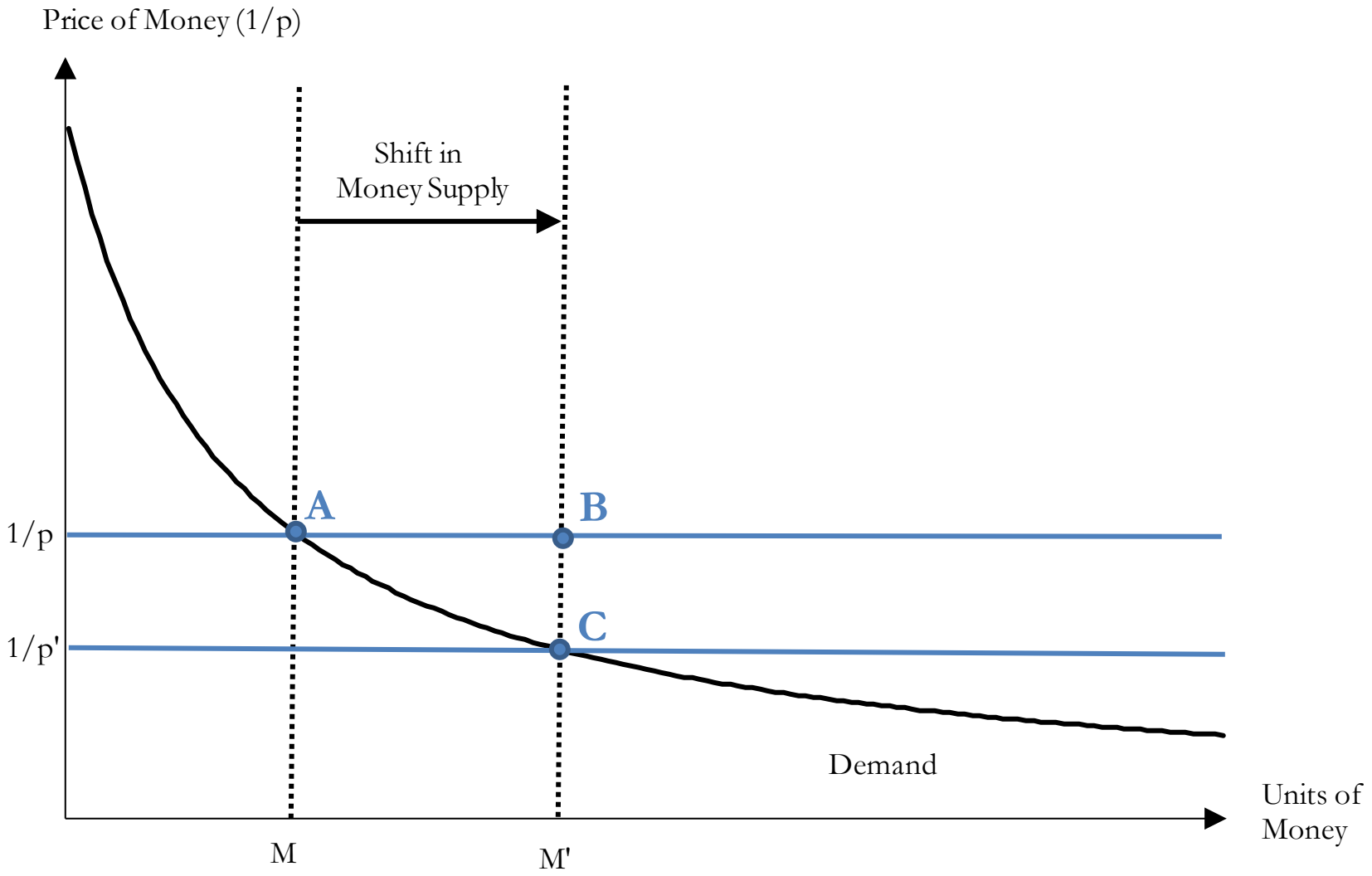
Demand in a Picture: Maximize Height Spread



Price of Money in Equilibrium: Supply = Demand *(In Units of Consumption Good)*



Excess Demand and Adaptive Expectations

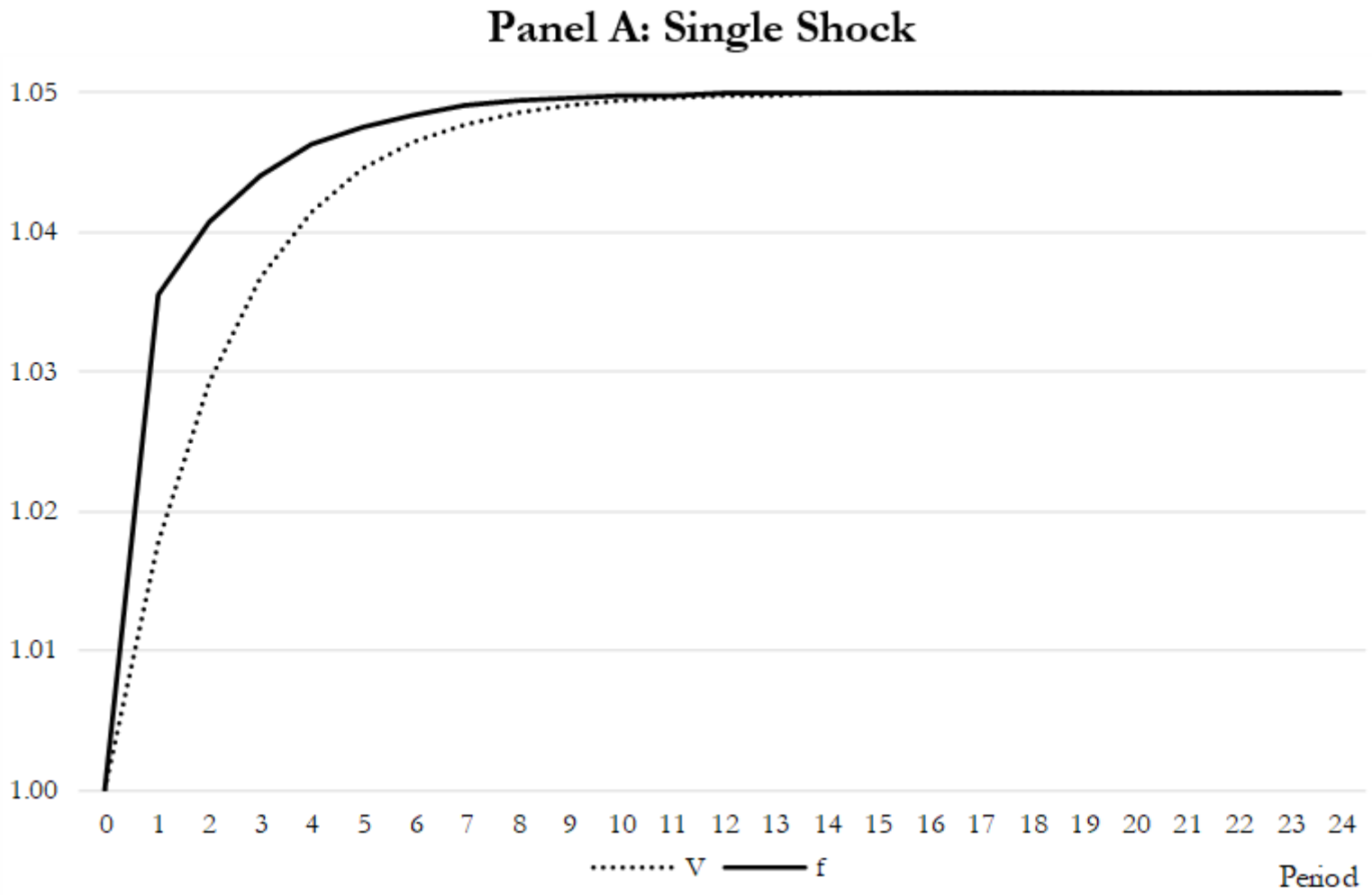


Generalizing the Demand Equation
(to GDP, Exports, and Imports)

$$D = D_Y + D_X + D_I = a + b_Y pGDP + b_X pX + b_I f p^* I$$

- Estimated with historical (60-month rolling panel, 16 OECD countries)
  - Includes time and country fixed effect
- Using M1 (supply) in place of D in the regression
- Excess Money Demand: (D – M1)/M1
    - Changes each month
    - Scaling of last residual from each of many 60-month rolling regressions
    - Novel way to estimate demand and excess demand
- Relate Excess Demand to
  - Contemporaneous Currency Movement
  - Next-Month and other Future Currency Movements

Slow FX Signal Reaction: Capital Constrained Agents Use a Reference Value V, a weighting of lagged V and new f (i.e., Adaptive Expectations)



Fundamental Data: GDP, X, I, M1

- Contemporary Vintage (CV signal)
  - Known to Traders at the end of Month T (last date of each rolling regression)
  - Obtained form OECD's ORDR for GDP, X, I
  - Use last value of these variables even if they apply to earlier periods: GDP
- Final Vintage (FV signal)
  - Not known to Traders or Central Banks
  - Final Revised Values for GDP, X, I
  - Most Accurately Portrays Economy's Workings
- M1 not in ORDR (Original Release Data and Revision Database)
  - Known by central banks but not traders due to 1-2 month report lag
  - No issue for observation 1,..,58 or for CV or FV signal
  - Observations 59 and 60 in each CV rolling regression: Use AR(2)

Currency Returns and Benchmark Adjustment

Currency Return

$$R_{i,t} = \frac{f_{i,t} - F_{i,t-1}}{F_{i,t-1}}$$

Panel Regression Adjustment

$$R_{i,t} = \gamma_0 ExcessM1Demand_{i,t-k} + \sum_{j=1}^{J} \gamma_j Control_{i,j,t-1} + \delta_t + e_{i,t}$$

Factor Model Adjustment

$$R_{q,t} = \alpha_q + \sum_{k=1}^{K} \beta_{qk} RiskFactor_{k,t} + \varepsilon_{q,t}$$

Summary Statistics

	Observations	Mean	Standard Deviation	Correlation with CV (T)	Q5–Q1 Average	Q5–Q1 *t-stat*
Excess Money Demand CV (*T*)	2,805	1.51	4.41	1.00	7.18	27.5
Excess Money Demand FV (*T*)	2,805	1.75	4.99	0.91	7.82	23.6
Currency Returns (*T*)	2,805	0.02	2.17	0.07	0.44	2.96
Currency Returns (*T*+1)	2,805	0.02	2.19	0.07	0.38	2.51
Carry Trade (*T*) * 100	2,805	0.10	0.30	0.34	0.31	16.9
1-Month Momentum (*T*) * 100	2,805	-0.05	2.15	0.07	0.46	3.15
3-Months Momentum (*T*) * 100	2,805	-0.10	3.75	0.13	1.31	4.92
12-Months Momentum (*T*) * 100	2,800	-0.05	7.46	0.17	3.22	5.72
Filter Rule Combination (*T*)	2,805	1.06	0.31	0.05	0.01	0.75
Dollar Exposures (*T*)	2,726	0.60	0.36	-0.04	0.12	3.95
Term Spread (*T*) * 100	2,528	0.28	1.28	0.04	0.10	0.87
Output Gap (*T*) * 100	2,697	-0.77	6.11	-0.11	1.24	2.96
Currency Value (*T*) * 100	2,805	1.93	14.4	0.10	4.69	4.27
Taylor Rule (*T*) * 100	2,697	-0.10	3.16	-0.09	0.91	4.11
Inflation Rate (*T*+1) * 100	2,805	0.21	0.40	0.07	0.10	4.17
Growth in M1 (*T*) * 100	2,805	0.76	1.38	-0.09	0.06	0.55

Panel Regression Coefficients & t-statistics: Non-Parametric (weakest results)

	CV		FV	
Return Month	Same	Next	Same	Next
Carry Control				
Signal Q5	0.404	0.357	0.182	0.074
	[2.46]	[1.85]	[1.03]	[0.41]
Carry Q5	0.108	0.044	0.271	0.203
	[0.44]	[0.20]	[1.19]	[0.94]
All Controls				
Signal Q5	0.440	0.409	0.229	0.116
	[2.65]	[2.24]	[1.32]	[0.69]
Carry Q5	0.091	0.006	0.253	0.173
	[0.38]	[0.03]	[1.09]	[0.80]

Panel Regression Coefficients & t-statistics: Parametric (weakest results)

	CV		FV	
Return Month	Same	Next	Same	Next
Carry Control				
Signal	0.024	0.029	0.009	0.021
	[1.44]	[1.69]	[0.51]	[1.32]
Carry	36.84	41.99	41.07	43.98
	[1.01]	[1.17]	[1.14]	[1.24]
All Controls				
Signal	0.039	0.043	0.018	0.031
	[2.08]	[2.28]	[0.86]	[1.68]
Carry	28.07	38.25	32.94	40.86
	[0.75]	[1.00]	[0.88]	[1.07]

Non-Parametric and Parametric Panel Regressions with Controls: One at a Time (Next-Month Returns)

	Control											
	Growth in M1	Carry Trade	1-Month Momentum	3-Months Momentum	12-Months Momentum	Filter Rule Combination	Dollar Exposures	Term Spread	Output Gap	Currency Value	Taylor Rule	Growth in M2
Non-Parametric Excess Money Demand												
CV Q5	0.417	0.299	0.427	0.449	0.499	0.419	0.422	0.416	0.418	0.466	0.416	0.408
	[2.22]	[1.45]	[2.25]	[2.38]	[2.58]	[2.19]	[2.28]	[2.19]	[2.23]	[2.34]	[2.23]	[2.17]
Control	0.391	38.40	-2.022	-2.479	-2.186	-0.229	-0.022	1.562	0.150	-0.492	0.879	4.858
	[0.17]	[1.03]	[-0.55]	[-1.06]	[-1.72]	[-1.07]	[-0.11]	[0.34]	[0.16]	[-0.88]	[0.47]	[1.34]
Parametric Excess Money Demand												
CV	0.036	0.029	0.037	0.038	0.046	0.036	0.036	0.036	0.039	0.045	0.040	0.036
	[2.43]	[1.69]	[2.42]	[2.56]	[3.01]	[2.35]	[2.43]	[2.46]	[2.47]	[2.84]	[2.57]	[2.41]
Control	0.566	41.99	-1.891	-2.384	-2.181	-0.227	0.018	2.015	0.646	-0.643	1.896	5.350
	[0.24]	[1.17]	[-0.51]	[-1.01]	[-1.69]	[-1.06]	[0.09]	[0.45]	[0.66]	[-1.08]	[0.95]	[1.47]
Non-Parametric Excess Money Demand												
FV Q5	0.220	0.082	0.225	0.240	0.284	0.214	0.219	0.219	0.220	0.261	0.218	0.209
	[1.23]	[0.44]	[1.23]	[1.29]	[1.51]	[1.18]	[1.30]	[1.22]	[1.22]	[1.45]	[1.22]	[1.16]
Control	0.483	54.72	-1.769	-2.242	-1.887	-0.224	0.007	1.658	0.102	-0.383	0.857	5.323
	[0.21]	[1.53]	[-0.47]	[-0.93]	[-1.43]	[-1.04]	[0.04]	[0.37]	[0.11]	[-0.69]	[0.46]	[1.46]
Parametric Excess Money Demand												
FV	0.027	0.021	0.027	0.028	0.034	0.027	0.027	0.027	0.029	0.033	0.030	0.027
	[1.88]	[1.32]	[1.86]	[1.91]	[2.23]	[1.80]	[1.88]	[1.91]	[1.91]	[2.19]	[2.00]	[1.85]
Control	0.575	43.98	-1.717	-2.219	-2.023	-0.218	0.019	2.029	0.586	-0.568	1.787	5.332
	[0.24]	[1.24]	[-0.46]	[-0.95]	[-1.59]	[-1.02]	[0.09]	[0.46]	[0.60]	[-0.97]	[0.90]	[1.47]

Factor Model Alpha Spreads (same month) Across CV Quintiles

	CV Signal										Q5-Q1 (high - low)	
	Q1 (low)		Q2		Q3		Q4		Q5 (high)			
	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat
LRV 2-Factor Model												
Intercept	-0.187	[–1.40]	-0.042	[–0.45]	-0.025	[–0.24]	0.039	[0.34]	0.165	[1.35]	0.352	[2.30]
Dollar Factor	1.265	[13.5]	1.202	[17.5]	1.474	[17.3]	1.396	[16.4]	1.273	[15.3]	0.008	[0.09]
Carry Factor	-0.142	[–1.49]	-0.100	[–2.55]	-0.139	[–2.58]	-0.075	[–1.20]	0.146	[2.09]	0.287	[2.98]
R-Squared	0.64		0.74		0.77		0.73		0.70		0.11	
Observations	187		187		187		187		187		187	
Global Imbalance Factor												
Intercept	-0.176	[–0.89]	-0.020	[–0.11]	-0.002	[–0.01]	0.081	[0.40]	0.274	[1.35]	0.450	[3.17]
Output Gap Factor												
Intercept	-0.189	[–0.94]	-0.038	[–0.21]	-0.019	[–0.09]	0.058	[0.27]	0.242	[1.12]	0.431	[2.94]
Sovereign Risk Factor												
Intercept	-0.155	[–0.76]	0.026	[0.15]	0.051	[0.24]	0.089	[0.41]	0.274	[1.26]	0.428	[2.82]
CDL UMVE Currency Factor												
Intercept	-0.189	[–0.94]	-0.040	[–0.22]	-0.019	[–0.09]	0.076	[0.36]	0.248	[1.15]	0.437	[2.97]
6-Factor Combination Model												
Intercept	-0.205	[–1.59]	-0.064	[–0.72]	-0.017	[–0.17]	0.048	[0.44]	0.167	[1.39]	0.372	[2.46]

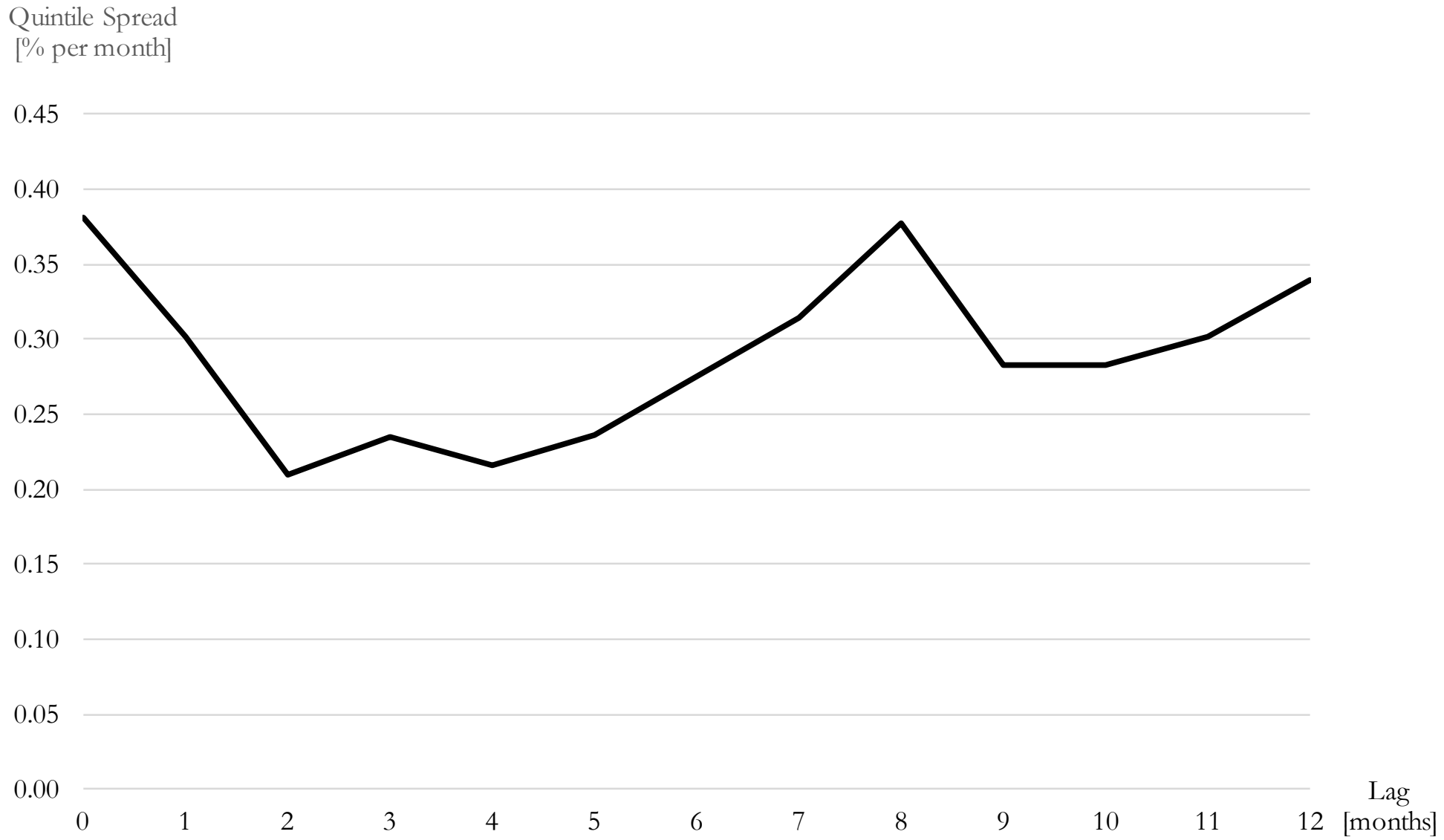
Factor Model Alpha Spreads (next month) Across CV Signal Quintiles

	CV Signal										Q5-Q1 (high - low)	
	Q1 (low)		Q2		Q3		Q4		Q5 (high)			
	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat
LRV 2-Factor Model												
Intercept	-0.107	[–0.81]	-0.013	[–0.13]	0.057	[0.52]	-0.086	[–0.73]	0.179	[1.39]	0.287	[1.91]
Dollar Factor	1.257	[11.4]	1.265	[17.9]	1.365	[13.6]	1.443	[17.3]	1.295	[15.2]	0.038	[0.36]
Carry Factor	-0.191	[–2.02]	-0.145	[–3.47]	-0.115	[–1.68]	0.027	[0.40]	0.137	[1.90]	0.328	[3.74]
R-Squared	0.64		0.75		0.75		0.75		0.69		0.14	
Observations	187		187		187		187		187		187	
Global Imbalance Factor												
Intercept	-0.124	[–0.65]	-0.019	[–0.10]	0.066	[0.33]	-0.032	[–0.14]	0.269	[1.29]	0.393	[2.62]
Output Gap Factor												
Intercept	-0.137	[–0.69]	-0.033	[–0.18]	0.050	[0.25]	-0.053	[–0.23]	0.245	[1.10]	0.382	[2.50]
Sovereign Risk Factor												
Intercept	-0.097	[–0.50]	0.038	[0.21]	0.120	[0.59]	-0.043	[–0.18]	0.276	[1.24]	0.373	[2.47]
CDL UMVE Currency Factor												
Intercept	-0.146	[–0.74]	-0.031	[–0.16]	0.061	[0.30]	-0.043	[–0.19]	0.245	[1.11]	0.391	[2.58]
6-Factor Combination Model												
Intercept	-0.106	[–0.88]	-0.029	[–0.31]	0.079	[0.79]	-0.119	[–1.07]	0.194	[1.52]	0.300	[2.06]

CV vs. Carry: Factor Model Comparison

	Signal										Q5-Q1	
	Q1 (low)		Q2		Q3		Q4		Q5 (high)		(high - low)	
	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat	Coef	*t*-stat
Excess Money Demand CV Portfolios												
Intercept	-0.143	[–1.31]	-0.017	[–0.22]	0.063	[0.80]	-0.076	[–0.83]	0.173	[1.95]	0.316	[2.11]
Dollar Factor	0.922	[12.23]	0.943	[25.16]	1.036	[16.97]	1.103	[25.67]	0.996	[28.78]	0.074	[0.90]
Carry Factor	-0.041	[–0.64]	-0.114	[–4.14]	-0.119	[–3.45]	0.039	[0.78]	0.234	[4.71]	0.275	[2.93]
R-Squared	73%		84%		85%		85%		86%		17%	
Observations	187		187		187		187		187		187	
Intercept	-0.189	[–0.94]	-0.063	[–0.34]	0.012	[0.06]	-0.131	[–0.60]	0.123	[0.62]	0.312	[2.08]
Carry Factor	0.210	[1.80]	0.142	[1.74]	0.161	[2.24]	0.338	[3.78]	0.505	[7.27]	0.295	[2.99]
R-Squared	5%		2%		3%		9%		22%		16%	
Observations	187		187		187		187		187		187	
Carry Portfolios												
Intercept	0.022	[0.25]	-0.098	[–1.09]	-0.056	[–0.71]	0.050	[0.62]	0.082	[0.66]	0.060	[0.35]
Dollar Factor	0.802	[11.94]	0.942	[16.21]	1.027	[28.55]	1.175	[30.86]	1.054	[11.81]	0.251	[1.84]
CV Factor	-0.223	[–3.37]	-0.129	[–1.97]	0.001	[0.03]	0.099	[2.21]	0.252	[2.47]	0.474	[3.20]
R-Squared	73%		82%		86%		89%		74%		21%	
Observations	187		187		187		187		187		187	
Intercept	-0.040	[–0.22]	-0.171	[–0.88]	-0.135	[–0.65]	-0.037	[–0.16]	-0.003	[–0.01]	0.038	[0.21]
CV Factor	-0.025	[–0.24]	0.103	[0.98]	0.254	[1.78]	0.388	[2.44]	0.511	[2.95]	0.536	[3.92]
R-Squared	0%		1%		4%		6%		10%		16%	
Observations	187		187		187		187		187		187	

Delayed CV Signal Implementation: Little Decay



Next Month Inflation: Predicted by Excess Money Demand

Controls:		Lag Inflation	Lag Inflation Lag △M1/M1	Lag Inflation Lag △M1/M1 Lag △f/f
Time Fixed Effects:	YES	YES	YES	YES
Parametric Regressions 1 CV Signal Coefficient	0.006	0.006	0.005	0.005
	[3.02]	[3.16]	[2.82]	[2.83]
Parametric Regressions 2 FV Signal Coefficient	0.007	0.007	0.005	0.005
	[3.95]	[4.10]	[3.74]	[3.69]

Conclusion

- CV and FV Positively Forecast Inflation
- Only CV Correlates with Contemporaneous and Future Returns
  - What traders know matters more
  - Efficient Markets Anomaly
- Carry could be Excess Money Demand's Noisy Proxy
- New Theory that Explains Why
  - Predictability is based on Reference Values
  - Grinblatt and Han (1985)