

A Multi-Asset Approach to Inflation Hedging for a US Investor Ludwig Chincarini, Ph.D., CFA January 17, 2012

Russell Investments

Background

Inflation threats during financial crisis

- Decrease in interest rates to near zero
- Increase in liquidity
- How can a pension plan protect against this?
 - Little existing quantitative research
 - Not an attempt to forecast inflation
 - Which asset classes provide the best hedges?





Inflation 1901-2009 USA



The Task

- Find the relation between inflation and asset classes
 - Variety of historical investment periods
- Find the optimal portfolio
 - Minimize the tracking error of the portfolio vs inflation
 - Meet target real return



The Data

- Global Financial Data
- Bloomberg L.P.
- National Association of Real Estate Investment Trusts
- Factset Research Systems

Potential Asset Classes

Gold & Commodities

- Tendency for rise in price if belief in this idea exists
- Depreciation in currency
- Commodity price increase
- Short-term government bonds or short-term bank deposits
 - Expected inflation built into interest rate
 - Rolling Maturities



Potential Asset Classes

- Equities
 - Expected rise in future nominal profits
- Real Estate
 - Rise in land prices



Actual Asset Classes

- Equities: Main, Small-Cap, Growth, Value
- Sector Equities: 10 sectors
- Bonds: One-Month CD, Bills, 10-year, 30-year, Corporate, High-Yield, and Inflation-Protected
- Commodities: Oil, Gold, Silver, Commodity Index, and Wheat
- Foreign Exchange: \$/Yen, \$/Euro, \$/Pound
- Real-Estate: REITs
- World Exposure: Equities, Bonds, Emerging Units
 Emerging Bonds

Historical Evidence (Several Horizons)

• 1901

- Start of data observations
- 1930
 - Beginning of deflationary period following Great Depression
- 1970
 - Gold standard and fixed ex rates to floating ex rate
- 1990
 - Cold war, emergence of Eastern Europe types of data

Generating Real Return Portfolios

Mean-Variance Optimization of Real Returns

$$\min \left[V \left(r_{P,t,t+k} - \pi_{t,t+k} \right) \right] \qquad \text{s.t.} \qquad r_{P,t,t+k} - \pi_{t,t+k} = \tilde{\mu}_P \tag{1}$$

where $r_{P,t,t+k}$ is the return of the investor's portfolio from time t to t + k, $\pi_{t,t+k}$ is the inflation rate from time t to t + k, and $\tilde{\mu}_P$ is the real return target of the portfolio (\tilde{x} denotes the real return of variable x).⁴ We will want to select the group of assets for the investor that achieves this goal. Thus, the problem can be rewritten as:

$$\min_{w_i} \left[V \left(\sum_{i=1}^N w_{i,t} r_{i,t,t+k} - \pi_{t,t+k} \right) \right] \qquad \text{s.t.} \qquad \left(\sum_{i=1}^N w_{i,t} r_{i,t,t+k} - \pi_{t,t+k} \right) = \tilde{\mu}_P \tag{2}$$
(3)

Generating Real Return Portfolios

Question: What was the best portfolio to own which provided a 4.5% real return for a US investor?

• Target 4.5% return

Period	Portfolio Composition	Tracking error, return/risk profile
1901	37.4% equities, 6.5% govt treasury bills, 39.5% 10-yr govt bonds, 16.6% oil	10.2%, 0.44
1930	9.2% equities, 9.7% govt treasury bills, 54.3% corp bonds, 9.4% oil, 1% gold, 2.1% silver, 14.2% emerging equity	8.3%, 0.54
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• Target 4.5% return

Period	Portfolio Composition	Tracking error, return/risk profile
1970	26.6% corp bonds, 6.1% oil, 3.9% gold, 54% one-month CD, 10% emerging equity	4.3%, 1.05
1990	7.2% consumer staples stocks, 1% energy stocks, 21.8% 30-yr gvt bonds, 3.4% corp bonds, 4.9% oil, 5% gold, 53.1% one-month CD, 0.2% real estate, 3.3% emerging equities	2.7%, 1.67

Common themes

- Short-term fixed income (large component 50%)
 - Government treasury bills or USD one-month CD or LIBOR
- Less than 10% in gold and oil
- Combination of govt bonds
- Few equities
 - Reduce downside risk

Question: OK, but how did it compare to basic investing rules of thumb that we typically use?

Benchmarks

Portfolio	Average yearly real return	Volatility	Worst YoY real return	% of periods w returns less th inflation	vith Ian
1970 period	4.5%	4.30%	-11.69%	13.11%	1974:09
All equity	6.38%	18.43%	-50.89%	31.71%	1980.03
All bonds	4.22%	11.85%	-27.57%	38.69%	1380.03
50/50	5.3%	12.56%	-31.51%	36.58%	

Out-of-Sample Results

Question: Would a strategy like this have been useful in real-time?



Out-of-Sample Results

Portfolio	Average yearly real return	Volatility	Worst YoY real return	% of periods with returns less than inflation
1930	3.52%	6.83%	-10.97%	40.87%
1970	3.38%	3.92%	-5.03%	38%



Out-of-Sample Results

Question: Why worry about all this, we already have a great product for hedging inflation – TIPS?



The Role of TIPS

- Treasury Inflation Protected Securities
 - Approximate duration 4
- No difference in results for insample (Feb98-May09)
- Out of sample results similar
- Little benefit from including TIPS



The Role of TIPS

Portfolio	Average yearly real return	Volatility	Worst YoY real return	% of periods with returns less than inflation
OS TIPS				
	2.46	4.93	-5.60	36.84
OS No TIPS	2.60	4.78	-4.85	38.16

Note: Period covered 2003:02 – 2009:05

An Example of US Allocation



Other Countries

Common themes

- Europe has similar qualitative results
- Asia shows similar qualitative results to US
- Latin America does poorly
 - Lack of available instruments
 - Hyperinflation

An Example of Germany Allocation



Industry Practice in Japan

TABLE 2: ASSET ALLOCATION OF JAPANESE CORPORATE PENSION FUNDS

Asset Allocation of Corporate Pension (%)	March 31, 2000	March 31, 2010 Conventional Type	March 31, 2010 New Type*
Japanese Bond	23.1	23.6	28.0
Japanese Equity	36.5	25.0	18.5
Foreign Bond	7.4	11.5	12.7
Foreign Equity	18.0	18.3	15.4
Others	12.5	17.3	21.2
Cash	2.5	4.3	4.1
Total	100	100	100

Data: PFA 2010, PFA 2000

2000 data include all types of corporate pension funds

* New Type: newly created corporate pension funds that returned government in-sourced portion.



Practice in Japan: (GPIF)

- Conservative
- 75% bonds
- 11% domestic equity
- 9% international equity
- 5% cash
- Much lower return targets (2-4%) than U.S. counterparts (7-8%)

Inflation versus Deflationary Periods

 Use the Bai-Perron methodology (2003) to find structural breaks in the inflation series.

		Avg. Inflation (y/y)
1901:01	1916:07	2.23
1916:08	1920:10	16.42
1920:11	1922:09	-8.48
1922:10	1930:08	0.09
1930:09	1933:05	-9.11
1933:06	1941:04	1.05
1941:05	1946:05	5.25
1946:06	1948:07	12.8
1948:08	1973:04	2.43
1973:05	1982:06	9.12
1982:07	2009:05	3.11



Inflation versus Deflationary Periods

The optimal portfolios

Inflationary	Periods	Stock	Oil	Silver	Gold	Wheat	1MonthCD	REIT	EE Equity	Tbill	World Equity	World Bor
1916:08	1920:10	16.57%	63.33%	20.10%	0	0	0	0	0	0	0	0
1946:06	1948:07	0	0	18.21	18.02	63.77	0	0	0	0	0	0
1973:05	1982:06	0	9.28	0	0	0	61.72	17.57	10.54	0	0	0
Deflationar	y Periods											
1920:11	1922:09	0	22.66	16.78	0	0	0	0	0	60.56	0	0
1930:09	1933:05	0	23.11	0	0	0	0	0	0	32.09	7.14	37.66

Conclusions

- Domestic equities surprisingly low
- Bills, CDs, and bonds play larger role for limited range of real returns.
- Emerging markets play a role. Great place to use the Russell ETFs (EMVX and EMGX).

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Inflation-protected bonds not as important thought

Conclusions

• Papers available.

http://pages.pomona.edu/~lbc04747/

Exh	ibit 2	: As	set C	lass l	Keal .	Retu	rn Oj	ptimi	zatio	ns to	r the	Unit	ed Stat	tes
					It	i-Sampl	e Weigh	18					Out-of-S:	imple Weights
		1901-			1930-		1 al	1970-			1990-		1930-	1970-
							Rea	l Return	1 Target					
Asset Class	0.75	2.5	4.5	0.55	2.5	4.5	0.5	2.5	4.5	0.5	2.5	4.5	4.5	4.5
Equity Index	0	17.1	37.4	0	5.1	9.2	0	0	0	0	0	0	15.0	1.1
Small-Cap			-			-		-	-	0	0	0		
Value	-	-	_		-	-	-	-	-	-	-	-	-	-
Growth			-			-		-	-	-				
S. CD			-			-		-		0	0	0		
8. CS										0	0	7.2		
S. Energy	-	-	-	-	-	-	-	-	-	0	0.9	1	-	-
S. Finance			-			-		-		0	0	0		
S. Health			-			-				0	1	0		
S. Indust.			-			-				0	0	0		
S. IT			-			-		-		0	0	0.1		
S. Material			-			-				0	0	0		
S. Telcomm			-			-				0	0	0		
S. Utility	-	-	-	-	-	-	-	-	-	0	0	0	-	-
Bill Govt.	100	58.5	6.5	100	56	9.7	82	0	0	72	0	0	8.9	0.0
10-Yr Govt.	0	13.7	39.5	0	0	0.2	0	0	0	0	0	0	7.7	0.0
30-Yr Govt.	0	0	0	0	0	0	0	0	0	0	5.8	21.8	0.2	0.0
Corp. Bond	-	-	-	0	23.8	54.3	0	0	26.6	0	1.9	3.4	45.3	16.0
HY Bond			-			-				0	0	0		
IP Bond			-			-		-	-	-	1.1	-		
Commodity	-	-		-	-	_	2.4	0	0	2.8	0	0	-	0.0
OII	0	9.1	16.6	0	5.5	9.4	0.8	1.9	6.1	0	2	4.9	5.4	6.0
Gold	0	0	0	0	1.2	1	0	3.2	3.9	0	5	6	0.4	3.1
Silver	0	1.6	0	0	1.7	2.1	0.3	0	0	0	0	0	3.2	0.0
Wheat							0	0	0		0	0		0.0
FAI						-		1		10.8	3.2			0.0
FX2			-			-	0	1.5	0	0	0.3	0		0.0
FX3	-	-	-	-	-	-	14.6	0	0	14.4	0	0	-	0.0
One-Month CD							0	90.5	53.7	0	77.9	53.1		82.7
R. Estate			-		1.1	1			-	0	1.7	0.2		
world Eq.				0	0	0	0	0	0	0	0	0	4.0	0.0
world Bond				U	0	0	0		0	U	0		0.0	0.0
Emerge Eq.			-	U	6.7	14.2	0	1.9	9.6	0	0.3	3.3	10.1	11.1
Emerge Bond														
Tracking Error	4.9	6.1	10.2	4.1	b.1	8.3	2.4	2	4.3	1.9	1.2	2.7	9.7	4.1
Return/Risk	0.15	0.41	0.44	0.13	0.49	0.54	0.21	1.25	1.05	0.26	2.09	1.67	0.5	1.1

Exhibit 4: In-Sample and Out-of-Sample Real Return Portfolio Performance

					N	fax	N	/tin				
Country	Period	T.R.	Mean	S.D.	Value	Date	Value	Date	Number $\leq \pi$	MAE	RMSE	nobs
				1	in-Sample	Optimizati	ons					
Optimal Portfolio	1930	4.50	4.50	8.34	45.34	1933:06	-24.54	1947:05	24.66	7.23	9.47	953.00
Optimal Portfolio	1970	4.50	4.50	4.30	15.43	2000:02	-11.69	2008;10	13.11	5.12	6.22	473.00
100% Equity	1930	-	7.81	21.90	167.23	1933:06	-57.92	1932:06	33.37	17.90	23.24	953.00
100% Equity	1970		6.38	18.43	58,60	1983:06	-50.89	1974:09	31.71	16.03	19.49	473.00
50% Equity-50% Bond	1930	-	5.09	12.78	90.90	1933:06	-31.51	1974:09	34.84	10.45	13.75	953.00
50% Equity-50% Bond	1970	-	5.30	12.56	48.10	1983:06	-31.51	1974:09	36.58	10.62	13.62	473.00
100% Bond	1930		2.37	9.66	45.88	1986:03	-27.57	1980:03	39.35	7.07	9.95	953.00
100% Bond	1970	-	4.22	11.85	45.88	1986:03	-27.57	1980:03	38.69	9.31	12.56	473.00
				Ou	it-of-Samp	ie Optimiza	tions					
Optimal Portfolio	1935	4.50	3.52	6.83	8.49	2009:05	-10.97	1980:03	40.87	1.45	1.99	893.00
Optimal Portfolio	1975	4.50	3.38	3.92	4.81	2009:05	-5.03	2008;10	38.01	0.87	1.16	413.00
100% Equity	1935		7.58	16.07	25.39	1938:06	-24.51	1938:03	40.65	3.54	4.68	893.00
100% Equity	1975		7.81	15.53	12.83	1987:01	-21.80	1987:10	40.92	3.46	4.52	413.00
50% Equity-50% Bond	1935		4.70	9.38	12.72	1938:06	-12.41	1940:05	42.78	2.09	2.73	893.00
50% Equity-50% Bond	1975		6.20	9.85	9.48	1982:10	-7.95	1987:10	42.62	2.23	2.89	413.00
100% Bond	1935	-	1.81	7.34	13.22	1980:04	-10.46	1980:02	45.46	1.42	2.12	893.00
100% Bond	1975		4.59	9.59	13.22	1980:04	-10.46	1980:02	42.13	2.06	2.79	413.00
		In	-Sample	and Out-	of-Sample	Portfolio v	ith and w	vithout TIP	8			
Optimal w/ TIPS IS	1998:02	4.5	4.5	2.28	9.81	2008:02	-3.62	2008;10	1.47	4.57	5.04	136.00
Optimal w/ TIPS OS	2003:02	4.50	2.46	4.93	4.16	2008:12	-5.60	2008:10	36.84	1.07	1.43	76.00
Optimal w/o TIPS IS	1998:02	4.5	4.5	2.28	9.82	2008:02	-3.54	2008;10	1.47	4.57	5.04	136.00
Optimal w/o TIPS OS	2003:02	4.5	2.60	4.78	3.82	2008:12	-4.85	2008:10	38.16	1.05	1.39	76.00
100% TIPS	1998:02		4.31	6.33	6.00	2008:12	-7.68	2008;10	38.97	1.30	1.85	136.00
100% TIPS	2003:02		2.89	7.71	6.00	2008:12	-7.68	2008:10	43.42	1.63	2.22	76.00



	Fra	nce	Gerr	nany	Ita	aly	Spa	ain	U	К	U	SA
	1930-	1970-	1930-	1970-	1930-	1970-	1930-	1970-	1930-	1970-	1930-	1970-
						Real Ret	urn Target					
Asset Class	-1.55	4.50	4.50	4.50	4.50	4.50	-0.50	4.50	2.63	4.50	4.50	4.50
Equity Index	-		37.97	0.00	96.00	0.00	-		100.00	0.00	9.16	0.00
Small-Cap	-	-	-	-	-	-	-		-	-	-	
Value		-	-		-		-			-	-	-
Growth	-	-	-	-	-	-	-			-	-	
8. CD	-	-	-	-	-	-	-		-	-	-	-
S. CS	-	-	-	-	-	-	-		-	-	-	-
S. Energy	-	-	-		-	-	-			-	-	-
S. Finance		-	-		-		-			-	-	-
S. Health	-	-	-	-	-	-	-		-	-	-	-
S. Indust.	-	-	-	-	-	-	-		-	-	-	-
S. IT	-	-	-	-	-	-	-		-	-	-	-
S. Material		-	-		-		-			-	-	-
S. Telcomm		-	-		-		-			-	-	-
S. Utility	-	-	-	-	-	-	-		-	-	-	-
Bill Govt.	0.00	52.85	28.06	39.34	0.00	64.45	100.00	14.62	0.00	0.00	9.72	0.00
10-Yr Govt.		-	-		-	-	-			25.40	0.17	0.00
30-Yr Govt.	100.00	27.63	33.98	44.03	4.00	7.58	-	47.22		-	0.00	0.00
Corp. Bond		-	-		-		-			-	54.31	26.60
HY Bond	-	-	-	-	-	-	-		-	-	-	-
IP Bond	-	-	-		-	-	-		-	-	-	-
Commodity		0.00	-	0.00	-	0.00	-	0.00		0.00	-	0.00
Oll		5.81	-	4.76	-	6.53	-	10.53		4.88	9.39	6.13
Cold	-	6.04	-	3.29	_	6.77	-	8.27	-	4.28	0.99	3.92
Silver	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	2.06	0.00
Wheat		0.00	-	0.00	_	0.00	-	0.00		0.00	-	0.00
FX1		0.00	-	0.00	-	0.00	-	0.00		0.00	-	0.00
FX 2		0.00	-	0.00	-	0.00	-	0.00		0.00	-	0.00
FX 3	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00
LIBOR	-	-	-		-	-	-		-	59.17	-	53.73
R. Estate	-	-	-	-	-	-	-		-	-	-	
World Eq.		0.00		0.00	-	0.00	-	0.00	-	0.00	0.00	0.00
World Bond	-	0.00		0.00		1.20	-	0.00	-	0.00	0.00	0.00
Emerge Eq.	-	7.67		8.59		13.46	-	19.35	-	6.27	14.21	9.63
Emerge Bond	-						-		-	-		
Tracking Error	19.3	4.5	13.1	4.0	49.3	6.2	9.0	9.3	20.0	4.3	8.3	4.3
Return/Risk	-0.08	1.00	0.34	1.13	0.09	0.72	-0.06	0.48	0.13	1.05	0.54	1.05

		Ex-Ante			M	fax	N	lin				
Country	Period	Target	Mean	S.D.	Value	Date	Value	Date	Number $\leq \pi$	MAE	RMSE	nobs
	1050		M	IUITI-AS	set In-Sai	mpie Resu	lts	1010.00	10.00	10.10	10.00	
Tance	1930	-1.65	-1.55	19.33	45.94	1935:01	-101.45	1948:02	42.92	12.12	19.38	963
Tance	1970	4.50	4.50	4.52	20.24	1993:08	-6.96	1975:02	14.16	6.02	6.37	473
Joi many	1930	4.00	4.50	13.09	140.27	1000-08	-09.74	1949.05	39.21	5.00	13.04	203
-ermany	1970	4.50	4.50	3.98	15.80	1993.08	-0.14	1970:05	12.47	5.05	40.51	473
taly	1930	4.50	4.50	43.33	00.40	1009-08	-310.43	1075-00	10.87	20.07	7.09	470
nain	1970	4.00	4.50	8.96	19.02	1993.00	-19.10	19/0.02	49.94	5.94	8.97	91.3
nain	1970	4.50	4.50	0.99	97.79	1999-08	-21.46	1975:02	34.04	8.05	10.35	475
R .	1980	2.63	2.63	19.98	111 99	1975-12	-77.26	1974-11	42.29	15.75	20.14	953
IK	1970	4.50	4.50	4 29	14.87	2000:02	-12.67	1975:05	9.94	5.34	6.22	473
Inited States	1930	4.50	4.50	8.94	45.94	1933-06	-24.54	1947:05	24.66	7.99	9.47	953
inited States	1970	4.50	4.50	4 30	15.43	2000-02	-11.69	2008-10	13 11	5.12	6.22	479
aned beates	12/0	4.00	4.50 Mu	1.4 A 880	t Out-of-3	Sample Re	sults	2000.10	13.11	0.12	0.22	917.2
Tance	1930	6 39	-1.95	9.84	17.03	1949-01	-27.14	1946:08	47.14	1.76	2.84	803
Tance	1970	4.50	4.40	4.51	5.63	1988-01	-3.74	1987:09	39.71	1.02	1.35	415
formany	1930	4.48	9.19	11.18	92.04	1949-10	62.42	1948:07	42.67	1.55	9.99	80
formany	1970	4.50	4.35	4.45	5.45	1970:07	-4.35	1981:02	38.26	1.01	1.33	415
alv	1930	3.86	3.52	92.69	58.82	1948-04	-144.58	1944-01	47.48	5.40	9.44	89
taly	1970	4.50	3.95	5.10	6.19	1992:09	-4.78	1987:10	40.44	1.16	1.51	415
pain	1930	2.20	-0.84	6.28	5.42	1930:05	-47.67	1939:07	42.78	0.66	1.81	893
pain	1970	4.50	5.04	9.40	19.72	1977:07	-8.07	1987:09	44.55	2.02	2.74	413
JK .	1930	1.75	2.15	16.59	49.98	1970:01	-27.09	1987:10	41.10	3.23	4.79	893
JK	1970	4.50	4.42	5.19	5.87	1979:09	-4.42	1987:10	41.16	1.16	1.54	413
inited States	1930	4.50	3.52	6.83	8.49	2009:05	-10.97	1980:03	40.87	1.45	1.99	893
Inited States	1970	4.50	3.38	3.92	4.81	2009:05	-5.03	2008:10	38.01	0.87	1.16	413
		Static Po	rtfolios a	nd Opt	imized wi	th Equitic	s, Bonds,	and Bills				
Tance	100% Bill		2.69	2.90	9.32	1992:11	-2.77	1979:08	19.03	3.11	3.95	473
Tance	IS Equity/Bill/Bond†	4.50	4.50	10.30	38.14	1986:08	-28.09	1980:03	32.77	8.81	11.22	473
Tance	OS Equity/Bill/Bond†	2.77	4.42	4.91	6.62	1988:01	-4.33	1989:02	36.56	1.03	1.46	413
fermany	100% Equity		3.65	22.52	72.26	1986:04	-53.23	2003:03	45.67	18.11	22.79	473
ermany	50/50 Equity/Bill		2.86	11.34	38.49	1986:04	-25.67	2003:03	41.44	18.11	11.69	473
formany	100% Bill	-	2.08	1.87	8.15	1991:01	-3.35	1972:12	12.26	2.35	2.79	473
formany	IS Equity/Bill/Bond	4.50	4.50	7.18	20.26	1986:04	-13.20	1980:03	26.85	7.03	8.46	473
Fermany	OS Equity/Bill/Bond	3.96	4.70	5.74	6.50	1980:04	-7.79	1981:02	38.98	1.30	1.70	413
taly	100% Equity		5.78	37.98	179.78	1981:05	-55.16	1974:10	46.30	27.40	38.38	473
aly	50/50 Equity/Bill	-	4.11	19.37	90.47	1986:04	-34.39	1974:10	44.40	27.40	19.78	473
taly	100% Bill		2.44	4.34	11.00	1993:03	-13.62	1974:10	22.41	3.98	4.97	473
aly	IS Equity/Bill/Bond	4.50	4.50	17.05	60.33	1986:05	-45.81	1974:12	39.53	12.65	17.61	473
aly	OS Equity/Bill/Bond	3.47	4.36	13.81	25.12	1986:03	-17.52	1981:09	43.34	2.32	4.00	413
pain	100% Bill		1.18	4.93	9.61	1993:03	-15.74	1977:08	33.62	4.03	5.06	473
pain	18 Equity/Bill/Bond†	2.29	2.29	11.42	40.85	1985:01	-24.14	1980:01	39.96	8.80	11.63	473
pan	US Equity/Bul/Bondi	2.40	2.37	3.92	3.14	1998:09	-8.13	1987:04	34.62	10.03	1.15	413
K.	50 (50 Equity	-	3.23	21.94	411.33	1976:12	-77.26	1974:11	37.21	16.94	22.16	473
N. Contraction of the second s	100% BU	-	2.75	4.47	48.49	1975:12	-41.71	1974:11	34.25	4 99	5.01	473
n.	100% Bill	4.00	4.00	4.47	0.97	1986.05	-10.30	1975.08	23.20	4.33	0.01	472
n.	OS Faulty/Bill/Bond	4.02	4.02	8.33	36.98	1982:10	-20.33	1980:04	26.85	7.44	9.24	473
n States	100% Eastry	3.37	2.60	14.09	13.55	1989-04	-27.09	1987.10	99.00	16.02	4.07	41
alted States	50/50 Equity (BIII		0.30	0.70	00.00	1089-00	-00.00	1074:00	21.71	10.03	10.50	410
nited States	100% BU	-	1.00	9.76	7 50	1082-04	-27.43	1074:09	31.71	2 20	10.00	413
inited States	19976 Bill 19 Faulty /Bill /Bond	4 50	4.50	10.22	90.70	1089-04	24.40	1974.12	30.02	8 51	11.17	413
Inited Contes	OC Faulty/Bill/Based	4.00	4.00	0.00	10.00	1084-05	15.00	1007-10	49.94	1.04	0.05	417
Janed States	OS Equity/BIII/B000	3.32	4.29	9.09	10.66	1984:08	-10.26	1987:10	43.34	1.89	2.66	- 41

	Arge	ntina	Brazil		Ch	lle	Me	xico	Peru		
	1930-	1970-	1930-	1970-	1930-	1970-	1930-	1970-	1930-	1970-	
					Real Retu	rn Targei					
Asset Class	-	4.50		4.50	-14.42	4.50	-	4.50	26.27	4.50	
Equity Index	-			0.00				0.00	100.00	74.58	
Small-Cap	-			-		-	-		-		
Value	-			-		-	-		-		
Growth	-			-		-	-		-		
8. CD	-	-	-	_	-	-	-	-	-	-	
S. CS	-			-		-	-		-		
S. Energy	-			-		-	-		-		
S. Finance									-		
S. Health	-			-					-		
S. Indust.	-			-					-		
S. IT					-				-	-	
S. Material	-			-		-	-		-	-	
S. Telcomm	-			-		-	-		-		
S. Utility	-			-		-	-		-		
Bill Govt.	-			-	100.00	61.33	-	83.05	-	-	
10-Yr Govt.	-			-		-	-		-	-	
30-Yr Govt.	-			-		-	-		-		
Corp. Bond	_	-		_	-	_	-	-	_	-	
HY Bond	-			-		-	-		-		
IP Bond	-			-		-	-		-		
Commodity		0.00		0.00		0.00		2.67		0.00	
011		0.00		49.79		9.81		3.00		0.00	
Gold		0.00		0.00		0.00		5.95		0.00	
Silver	-	0.00		0.00		0.00	_	1.98	_	0.00	
Wheat		0.00		0.00		0.00		2.92	-	0.00	
FX1		0.00		8.38		0.00		0.00	-	0.00	
FX2	-	18.93		0.00		0.00		0.00	-	0.00	
FX3	_	0.78		0.00		0.00	_	0.42	_	0.00	
LIBOR											
R. Estate											
World Eq.		0.00		0.00		16.56		0.00	-	0.00	
World Bond		80.29		13.09		4.99		0.00	_	0.00	
Emerge Eq.		0.00		28.75		7.31		0.00		25.42	
Emerge Bond											
Tracking Error	-	1999 7		181.0	77.0	85.4	-	10.2	403.4	987.1	
Roturn/Bisk	-	0.00		0.02	-0.19	0.07		0.44	0.07	0.01	

	Table	e 8: Real	Returi	1 Portfo	lio Resul	ts for t	he Latin	Americ	an Region			
		Ex.Anto				Max						
Country	Period	Target	Mean	S.D.	Value	Date	Value	Date	Number $< \pi$	MAE	RMSE	nobs
		9		Multi-	Asset In-Sa	mple Res	ults					
Argentina	1930	0.00			-	· · ·	-			-		
Argentina	1970	4.50	4.50	1241.02	15261.58	1990:02	-11800.00	1990:03	58.14	239.07	1239.71	473
Brazil	1930	0.00	-	-	-	-	-	-		-		
Brazil	1970	4.50	4.50	181.22	537.04	1994:06	-2490.16	1990:03	40.38	64.52	181.08	473
Chile	1930	-14.42	-14.42	77.01	156.49	1976:05	-681.82	1974:04	51.00	28.37	78.31	953
Chile	1970	4.50	4.50	65.44	311.19	1974:01	-458.05	1974:07	18.39	29.10	65.53	473
Mexico	1930	0.00										
Mexico	1970	4.50	4.50	10.25	44.61	1987:03	-28.90	1983:08	31.50	7.62	11.18	473
Peru	1930	26.27	26.27	403.62	10243.06	1990:09	-1981.83	1989:08	63.59	83.13	404.26	953
Peru	1970	4.50	4.50	387.50	5001.68	1990:09	-3273.63	1990:08	45.45	126.76	387.12	473
				Multi-A:	set Out-of-	Sample R	osults					
Argentina	1930											
Argentina	1970	4.81	89.41	695.67	3466.21	1982:08	-119.93	1990:03	65.62	16.82	171.91	413
Brazil	1930			-		1000-01		1000-00	17 70	1.00		
Brazii	1970	4.50	6.72	30.00	73.83	1999001	-73.41	1990:03	47.70	4.92	8.66	413
Chile	1930	14.85	-7.39	14.87	31.94	2008:12	-83.41	1973:10	49.94	1.92	4.34	893
Chile	1970	4.60	6.62	11.39	28.91	2008:12	-27.94	1981:01	40.44	1.98	3.33	413
Mexico	1930	4.50	0.75	14.00	50.80	1089-08	17.04	1082-00	07.77	1 70	4.15	419
Dete	1970	4.00	0.10	14.20	00.02	1962.00	-17.39	1962.09	58.00	1.70	4.10	413
Peru	1930	9.64	3.76	25 01	203.36	1990:09	-269.63	1990.08	40.90	0.83	15.67	893
Pulu	1970	4.47	II.co	Ilos and O	110.20	ith Foult	-auto.ro	and Pills	49.39	0.01	21.71	413
Deseil	100% Fourtry	Dist	72.04	756.08	E191 04	1004-01	EE84 50	1000-04	49.94	970.49	750.91	479
Chile	100% Equity		15.11	107.00	150.40	1076-05	-0004.00	1074-04	93.39	40.90	109.31	470
Maxico	100% Eastry		-10.11	117.50	100.49	1976.05	-901.02	1974.04	41.86	40.39	108.63	473
Maxico	50/50 Foutry /Bill	-	16.61	61 67	540.08	1087-08	-110.34	1989-19	40.17	58.97	63.80	479
Mexico	100% BIII	-	2.85	19.88	45.27	1989-01	-50.18	1983-01	92.95	9.97	14 39	473
Mexico	IS Equity/Bill/Bondtt	4.50	4.50	14.90	56.92	1987:08	-51.63	1983-01	28.54	9.80	15.54	473
Mexico	OS Equity/Bill/Bondtt	4.25	9.07	18.26	31.31	1984:01	-24.78	1982:05	33.90	2.72	5.32	413
Peru	100% Equity		60.01	571.07	10243.06	1990:09	-1981.83	1989:08	50.32	155.31	573.61	473
		-										

	Aust	ralia	Hong	Kong	India		Japan		Singapore		South Korea	
	1930-	1970 -	1930-	1970-	1930-	1970-	1930-	1970-	1930-	1970-	1930 -	1970-
					E	teal Retu	rn Target					
Asset Class	3.13	4.50		4.50	0.55	4.50	1.66	4.50		4.50		4.50
Equity Index	0.00	0.00			-		100.00	0.32		1.62		-
Small-Cap		-	-		-		-	-	-	-		-
Value		-	-		-		-	-	-	-		-
Growth		-	-	-	-	-	-	-	-	-		-
S. CD		-	-		-		-	-	-	-		-
S. CS		-	-		-		-	-	-	-		-
S. Energy		-	-		-		-	-	-	-		-
S. Finance		-	-	-	-	-	-	-	-	-		
S. Health		-	-		-		-	-	-	-		-
S. Indust.		-	-		-		-	-	-	-		-
S. IT		-	-		-		-	-		-		-
S. Material		-	-		-		-	-	-	-		-
S. Telcomm		-	-		-		-	-	-	-		-
S. Utility	-	_	-	-	-	-	-	-	-	-	-	-
Bill Govt.	0.00	55.95	-	24.86	0.00	56.95	0.00	0.00		27.18		85.23
10-Yr Govt.		-	-	-	-	-	0.00	76.83	-	-		0.00
30-Yr Govt.	100.00	13.65	-		100.00	0.00	-	-	-	-		-
Corp. Bond		-	-		-		-	-		-		-
HY Bond		-	-	-	-	-	-	-	-	-		-
IP Bond		-	-		-		-	-	-	-		-
Commodity		0.00	-	0.00	-	0.00	-	0.00	-	0.00		0.00
Oll	-	7.80	-	8.17	-	6.37	-	11.23	-	11.24	-	5.89
Gold		4.57	-	7.36	-	12.20	-	4.64		7.44		0.10
Silver		0.00	-	0.00	-	0.00	-	0.00	-	0.00		0.00
Wheat		0.00	-	0.00	-	0.00	-	0.00	-	4.46		0.00
FX1		0.00	-	0.00	-	0.00	-	0.00		0.00		2.17
FX 2		0.00	-	0.00	-	0.00	-	0.00	-	0.00		0.00
FX3		0.00	-	0.00	-	0.00	-	0.00	-	0.00		6.61
LIBOR		-	-		-		-	-		-		-
R. Estate	-	-	-	-	-	-	-	-	-	-	-	-
World Eq.		0.00		0.00	-	0.26	-	0.00		0.00		0.00
World Bond		6.30		42.22	-	20.94	-	0.00		34.73		0.00
Emerge Eq.		11.73		17.39	-	3.28	-	6.98		13.33		0.00
Emerge Bond		-		-	-		-			-		-
Tracking Error	12.8	5.5		8.6	12.0	6.5	72.8	5.9		7.4		4.7
Return/Risk	0.24	0.82	-	0.52	0.05	0.69	0.02	0.76		0.61		0.97

	Table	11: Rea	l Retu	rn Po	rtfolio	Results	for the	Asian I	Region			
		Ex.Anto			Max			Un				
Country	Period	Target	Mean	S.D.	Value	Date	Value	Date	Number < +	MAE	RMSE	nobs
			N	ulti-As	set In-Sa	mple Resu	Its					
Australia	1990	9.19	9.19	12.78	104.03	1932.09	-26.85	1951-10	39.66	8 74	19.15	959
Australia	1970	4.50	4.50	5.51	22.80	1990:01	-9.75	1975:03	20.51	5.70	7.11	473
Hong Kong	1990	0.00					- 21112	1010101		0.10		41.4
Hong Kong	1970	4.50	4.50	8.61	30.62	2000-02	-20.73	2009-02	30.87	7.50	9 71	473
India	1930	0.55	0.55	12.02	60.20	1933-02	-51.94	1943-04	52.68	8 20	12.03	959
India	1970	4.50	4.50	6.49	24.11	1992:03	-13.42	1975:02	23.68	6.32	7.89	473
Japan	1930	1.66	1.66	72.84	181.49	1949:09	-679.37	1946:07	41.03	30.75	72.82	953
Japan	1970	4.50	4.50	5.89	20.84	2000:02	-12.41	1974:11	20.08	6.06	7.41	473
Singapore	1930	0.00										
Singapore	1970	4.50	4.50	7.38	25.80	2000:02	-22.22	2008:12	18.60	6.93	8.63	473
South Korea	1930	0.00										
South Korea	1970	4.50	4.50	4.67	16.62	1997:12	-12.93	1975:10	13.32	5.41	6.48	473
			Mul	ti-Assot	t Out-of-	Sample Re	sults					
Australia	1980	3.00	-113	12.88	18 20	1971.12	-44 29	1987-10	40.65	2.07	3.72	893
Australia	1970	4.50	5.02	7.62	21.80	1976:11	-7.05	1976:10	38.50	1.49	2.24	413
Hong Kong	1930											
Hong Kong	1970	4.50	4.43	7.97	9.92	1999:03	-10.89	2008:10	42.13	1.75	2 33	413
India	1930	1.79	-1.03	7.27	15.34	2008:12	-11.15	1998:01	52.41	1.37	2.10	893
India	1970	4.50	4.18	5.46	10.43	1991:07	-5.21	2008:10	41.65	1.22	1.61	413
Ianan	1980	5.28	3.06	26.06	63.48	1949:01	-93.24	1945:12	48.15	4.46	7.52	893
Japan	1970	4.50	4.43	7.07	7.91	1999:03	-7.79	2008:10	39.95	1.60	2.07	413
Singapore	1930											
Singapore	1970	4.50	3.74	6.69	9.52	1999:03	-10.23	2008:10	42.62	1.45	1.95	413
South Korea	1930											
South Korea	1970	4.50	4.21	3.99	6.91	1997:12	-3.32	2008:12	31,96	0.90	1.20	413
		Static Po	rtfollos a	nd Opt	inized w	th Equitie	s, Bonds,	and Bills				
Australia	100% Equity		2.15	22.06	72.51	1987:07	-59.27	1974:09	42.71	17.37	22.14	473
Australia	50/50 Equity/Bill		2.38	11.79	40.20	1987:07	-33.11	1974:09	36.58	17.37	12.01	473
Australia	100% BIII		2.61	4.22	11.33	1990:07	-8.41	1973:10	21.78	4.17	4.96	473
Australia	IS Equity/Bill/Bond	3.90	3.90	11.48	36.59	1991:10	-26.10	1974:07	37.21	9.74	12.11	473
Australia	OS Equity/Bill/Bond	2.75	3.54	10.89	13.30	1987:07	-44.29	1987:10	37.05	1.71	3.15	413
Hong Kong	100% Bill		-0.66	4.82	11.89	1999:08	-21.00	1973:09	56.87	3.66	4.86	473
India	100% Bill		1.75	6.04	22.09	1976:02	-20.79	1974:09	29.60	4.48	6.28	473
India	IS Equity/Bill/Bond†	1.75	1.75	6.04	22.09	1976:02	-20.79	1974:09	29.60	4.48	6.28	473
India	OS Equity/Bill/Bond†	1.26	2.62	3.27	3.86	1975:12	-3.25	1998:01	40.92	0.74	0.97	413
Japan	100% Equity		5.60	25.01	102.36	1972:11	-48.40	1974:10	41.44	19.61	25.61	473
Japan	50/50 Equity/Bill		2.92	13.15	50.90	1972:11	-33.04	1974:10	41.44	19.61	13.45	473
Japan	100% Bill		0.23	3.77	6.01	1987:01	-19.14	1974:02	33.40	2.38	3.78	473
Japan	IS Equity/Bill/Bond	4.50	4.50	14.58	56.91	1972:11	-38.57	1974:10	38.05	11.65	15.25	473
Japan	OS Equity/Bill/Bond	4.50	4.64	7.76	10.23	1986:03	-8.24	1990:09	43.34	1.69	2.27	413
Singapore	100% Equity		8.72	32.85	146.91	1999:08	-80.07	1974:01	43.55	25.21	33.95	473
Singapore	50/50 Equity/Bill	-	4.67	17.37	74.10	1999:08	-54.79	1974:01	42.28	25.21	17.96	473
Singapore	100% Bill	-	0.61	5.23	8.05	1976:09	-30.51	1974:03	32.77	3.05	5.26	473
Singapore	IS Equity/Bill/Bond ^{††}	4.50	4.50	16.74	71.08	1999:08	-53.74	1974:01	42.07	12.64	17.31	473
Singapore	OS Equity/Bill/Bond ^{††}	4.49	6.83	12.69	30.65	1975:01	-12.06	1987:10	43.10	2.41	3.70	413
South Korea	100% Bill	-	5.11	5.52	13.65	1972:01	-14.46	1975:10	10.99	6.46	7.52	473
South Korea	IS Equity/Bill/Bond†	4.50	5.11	5.52	13.65	1972:01	-14.46	1975:10	10.99	6.46	7.52	473
South Korea	OS Equity/Bill/Bond†	5.21	5.18	2.82	4.81	1977:11	-2.74	1980:01	23.73	0.71	0.92	413