Online Appendix for:

Long-Run Productivity Risk

A New Hope for Production-Based Asset Pricing?

by
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A.1 Data

Consumption (C_t). Per capita consumption data are from the National Income and Product Accounts (NIPA) annual data reported by the Bureau of Economic Analysis (BEA). The data are constructed as the sum of consumption expenditures on nondurable goods and services (table 1.1.5, lines 5 and 6) deflated by corresponding price deflators (table 1.1.9, lines 5 and 6).

Physical Investment (I_t). Per-capita Physical investment data are also from the NIPA tables. We measure physical investment by fixed investment (table 1.1.5, line 8) minus information processing equipment and software (table 5.5.5, line 3) deflated by its price deflator (table 1.1.9, line 8). Information processing equipment and software is interpreted as investment in intangible capital and is therefore subtracted from fixed investment.

Output (Y_t). It is the sum of total consumption and investment, that is, $C_t + I_t$. We exclude government expenditure and net export because not explicitly modelled in our economy.

Labor (N_t). It is measured as the total number of full-time and part-time employees as reported in the NIPA table 6.4. Data are annual.

Physical Capital (K_t). We follow Hall (2001) and construct capital according to the following recursion: $K_t = (1 - \delta_K)K_{t-1} + I_t$. This recursion is initialized in 1929 by imposing $K_{1929} = I_{1929}/\delta_K$.

Productivity measures (A_t). The BLS productivity measure is available over the sample 1949–2008 at: ftp://ftp.bls.gov/pub/special.requests/opt/mp/prod3.mfptablehis.zip

The utilization-adjusted productivity measure denoted as Basu et al. is available over the same sample at:

http://www.frbsf.org/economic-research/total-factor-productivity-tfp/

The Solow residuals are constructed as follows:

$$\ln A_t = \ln Y_t - \alpha \ln K_t - (1-\alpha) \ln N_t,$$

where the parameter $\alpha = 0.3$ measures the share of capital income.

Asset returns (r_t^{LEV}). The market returns are from the Fama-French dataset available online on K. French's webpage: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/ftp/F-F_Research_Data_Factors.zip.

Risk-free rate (r_t^f). The nominal risk-free rate is measured by the annual 3-month T-bill return. The real risk-free rate is computed by subtracting realized inflation from the nominal risk-free rate.

Price-dividends (pd_t) ratio and Tobin's Q (Q_t). Data on annual price-dividend ratio, and dividends are obtained from CRSP. Annual dividends are obtained by time-aggregating monthly dividends. Nominal dividends are turned into real dividends using the CPI index. Data on Tobin's Q are from the Flow of Funds (FoF) and are obtained directly from the St. Louis Fed by dividing the variable *MVEONWMVBSNNCB* (line 35 of Table B.102 in the FoF report) by *TNWMVBSNNCB* (line 32 of table B.102 in the FoF report).

A.2 Calibration of the ARMA(1,1) process

As shown in Hamilton (1994), when the long-run component x_t in equation (1) is assumed to be latent, the Wold representation of productivity growth is an ARMA(1,1),

$$\Delta a_{t+1} = \mu(1-\rho) + \rho \Delta a_t - b\widehat{\epsilon}_{a,t} + \widehat{\epsilon}_{a,t+1},$$

with the following restrictions:

$$\begin{aligned} Var(\widehat{\epsilon}_a) &= \frac{\sigma_x^2 + (1+\rho^2)\sigma^2 + \sqrt{(\sigma_x^2 + (1+\rho^2)\sigma^2)^2 - 4\rho^2(\sigma^2)^2}}{2}, \\ b &= \rho \cdot \frac{\sigma^2}{Var(\widehat{\epsilon}_a)}. \end{aligned}$$

References

Epstein, L., Zin, S. E., July 1989. Substitution, risk aversion, and the temporal behavior of consumption and asset returns: A theoretical framework. Econometrica 57 (4), 937–969.

Hall, R., December 2001. The stock market and capital accumulation. American Economic Review 91 (5), 1185–1202.

Hamilton, J. D., 1994. Time series analysis. Princeton University Press, Princeton, NJ.