# Four centuries of return predictability

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## Online Appendix

The first part of the Online Appendix provides the sources for the underlying data. The second part reports supporting evidence for the results reported in the main paper. We first report the sensitivity analysis of our main results based on annual real data from Table 2. Table OA.1 uses nominal data. In Table OA.2, we extend the UK period until 1900, and we use the broad-based CRSP index rather than the S&P 500 from 1925 onward. In Table OA.3, we add lagged returns and dividend growth rates as additional predictors. In Table OA.4, we smooth the dividend-to-price ratio by taking a trailing two-year rolling average. In Table OA.5, we report the sensitivity of longer horizon predictability results from Table 6. Instead of predicting simple sum of future returns and dividend growth rates, we weigh them by "rho." Finally, in Figure OA.1, we plot annual real dividends along with the smoothed dividends for the Netherlands/UK period.

## A. Data sources

This section provides details on all the data sources used in the paper. Sections A.1 through A.3 describe the main data for the different periods. Section A.4 provides details on the dating of recessions.

### A.1 Amsterdam and London 1629-1812

The data for the period 1629-1812 cover all actively traded securities in Amsterdam and London for which the necessary data are available. Our dataset covers (at most) nine securities, two of which are Dutch, seven English. Table A.1 gives an overview of the securities we use and the years they are in our dataset. Below we discuss the individual securities and the different sources we use to construct the data. Index returns are value-weighted.

#### *A.1.1 Amsterdam*

There were two widely traded Dutch stocks in the 17th and 18th centuries: the Dutch East India (VOC) and West Indies (WIC) companies. Shares of both companies were freely tradable, and shareholders enjoyed limited liability. The VOC was the world's first publicly traded corporation. It was founded in 1602, and its capital became permanent in 1613 (Gelderblom, De Jong and Jonker, 2013). The company held the Dutch monopoly on trade with Asia, where it operated an extensive trade network. The Dutch government nationalized the company in 1796. The WIC was founded in 1675 and was involved in slave trade and the administration of colonies in Africa and the Caribbean. The company was nationalized in 1791.

From 1719 onwards, we obtain stock prices from the newspapers of the time. For 1719-1722, we follow Frehen, Goetzmann and Rouwenhorst (2013) and use information from the *Leydse Courant*. Starting in 1723, we rely on Van Dillen (1931) which reports price information from the

*Amsterdamsche Courant*. Coverage continues until 1791 and 1795 when the WIC and VOC were nationalized.

Before 1719, newspapers did not publish Amsterdam stock prices. For the VOC there are a number of alternative sources that we use to construct continuous end-of-year stock prices back to 1629. We start with Amsterdam notary records that often contain information about share transactions. Van Dillen (1931) and Petram (2011) provide two largely independent sets of share prices extracted from these records. In addition, the Amsterdam City Archives provide an (incomplete) index to the notary records that also contain price observations (City Archives Amsterdam 30452).

From 1629 to 1652 the end-of-year prices from the notary records are complete. Between 1653 and 1719 there are occasional gaps. We fill these gaps by reconstructing transaction prices from the VOC's dividend ledgers and the Bank of Amsterdam's account books. In the 17th and 18th centuries, the title to a share was formalized by an entry in the Company's dividend ledgers. These books keep track of changes in ownership but do not report the associated transaction price. We infer stock prices by comparing share transfers in the dividend books of the VOC chamber in Amsterdam (Dutch National Archives, 1.04.02) with payments in the Bank of Amsterdam (City Archives Amsterdam, 5077). During this time, all important economic agents had the equivalent of a checking account at this institution (Quinn and Roberds, 2014). Most of the Bank's ledgers have survived, and we can reconstruct individuals' bank transfers, including payments for shares.

For the WIC we were not able to reconstruct a continuous annual price before 1719 (at which point it accounted for 1.1% of total market capitalization). There are few notarized transactions, and the WIC's dividend ledgers have not survived.

Dividends are available for the entire period and come from two sources. For the VOC, we rely on Klerk de Reus (1894) which provides information on the exact dates dividends were payable to investors; for the WIC, we use Luzac (1780).

*A.1.2 London*

We have information available for seven English securities. The first group of securities includes the most important English companies of the time: the Bank of England (BoE), the English East India Company (EIC), and the South Sea Company (SSC). The BoE was founded in 1694 to help finance the English government debt. It held an effective monopoly on the issuance of banknotes and provided short-term credit to merchants and other financial intermediaries. It was an important lender to the EIC as well. The EIC started in 1657 and held the English monopoly on trade with Asia. Around 1700 the trade on Asia was opened up, and in 1708 the government allowed the "old" EIC to merge with its main competitor, the "new" EIC, to restore its monopoly. For the period before 1708 there is only information available for the old EIC. The SSC started in 1711 after receiving a monopoly on the trade with South America. These activities never materialized, and the Company was mainly a vehicle to finance the English government debt. It performed a number of debt-for-equity swaps; the final one resulted in the South Sea Bubble in 1720. In that year the company accounted for 61% of total market capitalization. After the bubble burst, the company was largely liquidated; in 1733, it constituted only 6% of our index. Remaining shares were largely backed by government debt.

The second group of stocks includes the London Assurance Company (LA), the Million Bank (MB), the Royal African Company (RAC), and the Royal Exchange Assurance Company (REA). These companies were substantially smaller, and their coverage is mostly limited to the first few decades of the 18th century. Both LA and the REA were set up as insurance companies

in the run-up to the South Sea Bubble. They mainly dealt in marine insurance, but also set up ventures in fire and life insurance. Similar to the SSC, the MB was a vehicle to help fund the government debt. Finally, the RAC was set up as an English equivalent to the WIC and was mainly active in the slave trade between Africa and the Caribbean (Scott, 1912).

Data coverage for the first group of securities is relatively complete. Starting in 1698, Neal (1990) provides detailed price data collected from the *Course of the Exchange*. For earlier years, we rely on Thorold Rogers (1902) and Scott (1912) who report prices from a series of English newspapers. For the BoE and SSC, available stock prices go back to their inception; 1696 and 1711, respectively. For the EIC, prices are only available from 1692 onwards. Between 1657 and 1692 price observations are too infrequent to construct an annual series (Scott 1912, II, p. 178-9). We take prices for the old EIC until its merger with the new EIC in 1708, using prices for the newly formed United EIC thereafter. For all three companies, stock prices are available up to 1812. Information on dividends and stocks outstanding was kindly provided by Gary Shea (*in preparation*).

Data coverage is more limited for the second group of companies. In general, prices go back to the initial issuance of each security, but coverage ends in 1734 when the *Course of Exchange* stops reporting their prices (Neal 1990). Early prices come from Scott (1912); information after 1698 is from Neal (1990), where necessary supplemented with information from Frehen, Goetzmann and Rouwenhorst (2013). We collected information on dividends and stocks outstanding from a host of sources. Table A.1 gives and overview. This information is complete for all companies, with the exception of the REA, for which dividend information is only available for 1718-1720 as the company's financial records were almost entirely destroyed in a fire in 1838

(Supple, 1970). For all four securities we have full data coverage in 1720, the year of the South Sea Bubble when these securities appreciated substantially in value.

The English companies have a complicated history of capital calls, rights issues, repurchases, stock dividends and share splits ("capital events"). We use the sources listed in Table A.1 to adjust stock prices where necessary. In particular, we define dividends as regular dividends only. This approach closely follows Acheson et al. (2009), Cowles (1939) and S&P (the sources that we use for the 19th and early 20th century). To ensure that total returns capture actual outcomes to investors, price appreciation is adjusted for other payments such as rights issues, repurchases at non-market values and capital calls. For example, if a company is trading at 100 and has a rights issue at a price of 98 at a one-to-one basis, we add two percentage points to the capital appreciation in that year.

Table A.1 Overview of securities, 1629-1812

| Security | Home market | Years with available data | Sources: Prices | Sources: Dividends and shares outstanding |
|---|---|---|---|---|
| Dutch East India Co. (VOC) | Amsterdam | 1629 – 1794 | Van Dillen (1931), Petram (2011), *Leydse Courant*, City Archives Amsterdam (5077, 30452) and Dutch National Archives (1.04.02) | Klerk de Reus (1894) |
| Dutch West Indies Co. (WIC) | Amsterdam | 1719 – 1791 | Van Dillen (1931), *Leydse Courant* | Luzac (1780) |
| Bank of England (BoE) | London | 1696 – 1813 | Rogers (1902), Neal (1990) | Shea (*in preparation*) |
| English East India Co. (EIC) | London | 1692 – 1813 | Rogers (1902), Neal (1990) | Shea (*in preparation*) |
| London Assurance Co. (LA) | London | 1719 – 1734 | Neal (1990), Frehen et al (2013) | Scott (1912), Guildhall Library |

| | | | | |
|---|---|---|---|---|
| | | | | (0074 CLC/B/192-26)[1] |
| Million Bank (MB) | London | 1700 – 1734 | Neal (1990), Frehen et al (2013) | Scott (1912) |
| Royal African Co. (RAC) | London | 1691 – 1734 | Scott (1912), Neal (1990) | Scott (1912), Anonymous (1749), House of Commons (1803) |
| Royal Exchange Assurance Co. (REA) | London | 1718 – 1721 | Neal (1990), Frehen et al (2013) | Scott (1912), Supple (1970) |
| South Sea Company (SSC) | London | 1711 – 1813 | Neal (1990) | Shea (*in preparation*) |

*A.1.3 Exchange rates*

For most of the period, the English securities were also traded in the Amsterdam market (but not the other way around). We take the perspective of a Dutch investor and convert all price and dividend data into Dutch guilders. Exchange rate information comes from Posthumus (1946), where necessary supplemented with information from Frehen, Goetzmann and Rouwenhorst (2013).

*A.1.4 Risk-free rate*

Our estimates of the risk rate are based on returns on Dutch and English government bonds that are available from 1650 onwards. Between 1650 and 1720 we use returns on Dutch (redeemable) annuities. This was the most liquid form of Dutch government debt of the time. Data come from Gelderblom and Jonker (2011). There is a gap in our data between 1720 and 1727. Starting in 1727 we use returns on the English 3% Annuities reported in Neal (1990).

[1] We thank Rik Frehen for sharing his scans of the London Assurance dividend books with us.

*A.1.5 Earnings*

We are able to (partially) reconstruct earnings for the VOC, EIC and BoE. Data for the VOC are available in De Korte (1984) and start in 1651. Information for the EIC comes from Chaudhuri (1978) for 1710 – 1745 and Bowen (2006) for 1757 – 1812. For the BoE, we obtain data from Clapham (1945) for 1721 – 1797 and *Report on the Bank Charter* (1832) for 1798 – 1812.

## A.2 England 1813-1870

*A.2.1 Stock market data*

Starting in 1825, we use the value-weighted return and dividend series from Acheson, Hickson, Turner, and Ye (2009), hereafter AHTY. Their data are based on all frequently traded domestic equities in London. Returns and dividends are constructed in the standard way with two exceptions. First, they omit all securities that were traded for less than 12 months. There were many new issuances in this period, and investors were allowed to spread IPO payments over an extended period of time. This gave investors the option to withdraw if they thought the company would not survive. Many firms failed to raise the required capital, and the 12 month cut-off is meant to exclude such cases. Second, there were many capital calls, rights issues, and other capital events. It is often unclear what the impact of these events was on investors' returns. AHTY therefore omit individual security returns for the months in which these events took place. AHTY and Hickson, Turner and Ye (2011) have more details.

AHTY try to correct their stock market index for survivorship bias arising from delistings. They propose a number of alternatives. We use the index constructed using "definition 2 (upper bound)." This series adjusts for survivorship bias in a simple way that we can easily replicate when we extend the data back to 1813. In particular, AHTY set returns on securities that disappear to -

100%, but only if they were listed for at least 36 months. The underlying assumption is that such securities "were never fully established in the market." "Upper bound" means that delisted securities disappear from the sample afterwards, as opposed to the "lower bound" strategy where delisted securities are retained in the index, setting subsequent returns to 0. In untabulated results we find that using alternative series from AHTY that adjust for survivorship bias in slightly different ways affects the level of the risk premium, but does not materially impact the predictability results.

We extend AHTY's series back to 1813 using the same source material and methodology. In particular, for each individual security, we construct monthly price and dividend payments using information from Wetenhall's *Course of the Exchange* (available on microfilm at the University of Illinois, Urbana-Champaign) using the last available observation within each month. We then follow the same approach as AHTY to construct annual returns and dividends.

*A.2.2 Risk free rate*

For the risk free rate between 1813 and 1870, we use returns on 3% Consols from Homer and Sylla (2005, Table 19). This was the most liquid form of government debt at the time (Grossman 2002, AHTY).

### A.3 US 1871-2015

To facilitate comparison with the existing literature, we rely on the US stock market data starting in 1871, using data from Amit Goyal's website. For the period between 1871 and 1925, these data come from Cowles (1939), covering between 50 (1871) and 258 (1925) securities. For 1926-2015, the data are based on the S&P 500 index provided by CRSP. Before 1957, this was actually the S&P 90. Both Cowles (1939) and S&P only report ordinary dividends. Prices are

adjusted for non-regular payouts to investors. We also obtain aggregate earnings data from Amit Goyal's webpage.

*A.3.2 Risk free rate*

Rates on US Treasury bills are only available from 1920 onwards; for 1920-1945, we use Homer and Sylla (2005, Table 49); for the 1945-2015 period, we rely on the dataset on Amit Goyal's website. Before 1920, there are two interest rates that we use to estimate the risk free rate: the rate on so-called call loans and yields on long term government debt. Call loans were the most important short term debt instruments of the time. They were collateralized with liquid securities and could be called in by the lender at any point in time. For the period between 1920 and 1945, the different interest rate series overlap, and we predict the T-bill rate with the call loan rate and the government bond yield. We use the resulting coefficient estimates to construct a hypothetical T-bill rate for 1871-1919. Call loan rates and yields on government securities come from Homer and Sylla (2005), tables 44, and 49, and 42, 43, 46 and 48, respectively.

## A.4 Recession dates

As is standard, we classify a recession as the period between a peak and a trough in the economic cycle. We collect peak and trough dates from the secondary literature. All sources use the NBER definition that identifies a peak or trough when a large number of macro-economic variables have a turning point in their time series (Diebold and Rudebusch, 1996). This approach goes back to the seminal work of Burns and Mitchell (1946) who describe this approach as follows:

> "A [business] cycle consists of expansions **occurring at about the same time in many economic activities**, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle." (Burns and Mitchell 1946, p.3)

Which specific macro-variables to look at is at the discretion of the NBER's committee members and can vary over time. In the committee's own words, "the committee does not have a fixed definition of economic activity."[2]

For the period 1870-2015, we rely on information from the NBER website that lists the months the US economy was at a peak or trough.[3] Before 1945, the data come from Burns and Mitchell (1946); from 1946 onwards, the data come directly from the NBER. We classify a year as a recession if at least six months in that year feature a contraction.

For the period before 1870, we rely on recessions in the UK A number of publications reconstruct British peak and trough dates using the same methodology as Burns and Mitchell. For 1700-1802 we rely on the work of Ashton (1959), and for 1803-1870 we use the dates from Rostow (1972), who incorporates the earlier work by Gayer, Rostow and Schwartz (1953) for 1803-1850. These dates are considered the best available estimates in the literature (Broadberry and Van Leeuwen, 2010). The identification of peaks and troughs is primarily based on cyclical fluctuations in exports, investment (particularly in buildings and ships) and textile production. All three contributions use qualitative evidence from contemporary sources to help identify the exact timing of the economy's turning points (Gayer, Rostow and Schwartz, 1953, p. 342-53 and 532; Ashton 1959, p.138-40). The early data are annual. We let recessions start in the year following a peak and end in the year of a trough. For the period before 1700, we are not aware of any data on peak and trough dates.

[2] http://www.nber.org/cycles/recessions.html, retrieved August 1, 2016

[3] http://www.nber.org/cycles/cyclesmain.html, retrieved August 1, 2016

**Additional References**

Anonymous, 1749. An antidote to expel the poison. Contained in an anonymous pamphlet: later published in: A Detection of the Proceedings and Practices of the Directors of the Royal African Company of England, J. Roberts, London, UK.

Bowen, H. V., 2006. The Business of Empire: The East India Company and Imperial Britain, 1756 – 1833. Cambridge University Press, Cambridge, UK.

British House of Commons, 1803. Journals of the House of Commons, January 17, 1750 to April 6, 1754. Vol. 26. London, UK.

British House of Commons, 1832. Report from the Committee of Secrecy on the Bank of England Charter, with the minutes of evidence, apx. and index… Hansard, London, UK.

Broadberry, S., van Leeuwen, B., 2010. British economic growth and the business cycle, 1700 – 1870: annual estimates. Unpublished working paper. University of Warwick, Coventry, UK.

Burns, A. F., Mitchell., W. C., 1946. Measuring business cycles. Studies in Business Cycles. National Bureau of Economic Research.

Chaudhuri, K. N., 1978. The Trading World of Asia and the English East India Company, 1660 – 1760. Cambridge University Press, Cambridge, UK.

City Archives Amsterdam, 30452. Archief van S. Hart: (gedeeltelijke) toegang op de notariële archieven.

City Archives Amsterdam, 5077. Archief van de Wisselbank, 1609 – 1820.

Clapham, J., 1945. The Bank of England: A History. Cambridge University Press, Cambridge, UK.

De Korte, J. P., 1984. De jaarlijkse financiële verantwoording in de VOC. Verenigde Oostindische Compagnie. M. Nijhoff, Den Haag, The Netherlands.

Diebold, F. X., Rudebusch, G., 1996. Measuring business cycles: a modern perspective. Review of Economics and Statistics 78, 67 – 77.

Dutch National Archives, 1.04.02. Archief van de Verenigde Oost-Indische Compagnie (VOC), 1602-1795 (1811).

Gelderblom, O., De Jong, A., Jonker, J., 2013. The formative years of the modern corporation: the Dutch East India Company VOC, 1602 – 1623. Journal of Economic History 73, 1050 – 1076.

Gelderblom, O., Jonker, J., 2011. Public finance and economic growth: the case of Holland in the 17th century. Journal of Economic History 71-1, 1 – 39.

Homer, S., Sylla, R., 2005. A History of Interest Rates. John Wiley and Sons, Hoboken, NJ.

Klerk de Reus, G. C., 1894. Geschichtlicher Überblick der administrativen, rechtlichen und finanziellen Entwicklung der Niederländischen-Ostindischen Compagnie, M. Nijhoff, The Hague, The Netherlands.

Luzac, E., 1780. Hollands Rijkdom. Luzac en van Damme, Leiden, The Netherlands.

Petram, L., 2011. The world's first stock exchange: how the Amsterdam market for Dutch East India Company shares became a modern securities market, 1602-1700. Ph.D. dissertation. University of Amsterdam, Amsterdam, The Netherlands.

Posthumus, N. W., 1946. Inquiry into the history of prices in Holland, Volume 1. E. J. Brill, Leiden, The Netherlands.

Quinn, S., Roberds, W., 2014. How Amsterdam got fiat money. Journal of Monetary Economics 66, 1–12.

Rogers, J. E. T., 1902. A History of Agriculture and Prices in England, Volumes 6 and 7 – 2, Clarendon Press, Oxford, UK.

Scott, W. R., 1912. The Constitution and Finance of English, Scottish, and Irish Joint-Stock Companies to 1720. Volumes I – III. Cambridge University Press, Cambridge, UK.

Shea, G. Handbook of 18th and early 19th century British corporate finance. In preparation.

Supple, B., 1970. The Royal Exchange Assurance: a History of British Insurance, 1720 – 1970. Cambridge University Press, Cambridge, UK.

Van Dillen, J. G., 1931. Effectenkoersen aan de Amsterdamsche Beurs 1723 – 1794, Economisch Historisch Jaarboek 17, 1 – 34.

## B. Additional Tables

This section reports supporting evidence for the results reported in the main paper.

### Nominal data (Table OA.1)

Our main analysis is based on real data. Here, we repeat the analysis using nominal prices and dividends. As reported in Table OA.1, results are qualitatively similar. The only important difference is that returns are less predictable, and the dividend growth is more predictable in the U.K period. The full sample results remain qualitatively the same.

### Extended UK period and CRSP index (Table OA.2)

In the main text, we switch from UK to US data in 1871 (for better comparability with recent studies). One can argue that it was not until the beginning of the 20th century that that the US became the world's largest economy. Also, the Cowles (1939) data, which we use between 1871 and 1925, includes only 50 companies in 1871 (258 in 1925). Many more companies were traded in the UK at the end of the 19th century. Moreover, after 1925 we use the S&P 500 in the main analysis, which was effectively the S&P 90 till March 1957. Again, one may wonder if results change by using an index with a broader coverage.

Here, we present results where we switch from the UK to the US market in 1900. The UK data for the period 1870-1900 come from Grossman (2002). These data include 520 companies in 1870 and around 1,000 companies in 1900. We also use the CRSP value-weighted index from 1925 onward rather than the S&P 500. The CRSP index includes 533 companies in January 1926 (rather than 90) and 7,178 in December 2015 (rather than 500). As before, end-of-year dividends are simple sums of within-year dividends.

Results are reported in Table OA.2 and are qualitatively similar to the baseline results reported in Table 2. There is some more evidence for dividend growth predictability in the extended UK period as the estimated parameter is now significant. Results for the US period, however, are unchanged. The same is true for the full sample results.

### Lagged returns and dividend growth rates as additional predictors (Table OA.3)

In the main analysis, we predict returns and dividend growth rates using the lagged dividend-to-price ratio only. Here, we add lagged returns and lagged dividend growth rates as additional predictors. Lagged variables occasionally strengthen the overall evidence for return or

dividend growth predictability (for example, in the recent period dividend growth is persistent and predicts itself), but they do not importantly affect the coefficients on the dividend-to-price ratio. If anything, return predictability from dividend yields becomes somewhat stronger, especially in the early US period 1871-1945, although the coefficient remains insignificant.

**Two-year trailing average of dividend-to-price ratio (Table OA.4)**

To address the concern that our results are influenced by measurement error, we redo Table 2 using a smoothed version of dividend-to-price ratio. That is, we predict returns and dividend growth rates by the lagged two-year trailing average of dividend-to-price ratio. Under this specification, the evidence for dividend growth predictability in the earliest period (1629-1812) becomes weaker. Using the raw data, the predictive coefficient on the dividend-to-price ratio goes down from -2.25 to -1.32 and becomes insignificant (*t*-statistic of -1.57). In log terms, it falls from -0.12 to -0.08 and remains significant (*t*-statistic of -1.91). The evidence for the predictability of returns is largely unchanged. The only exception is the early US period (1871-1945), where the evidence for dividend yields predicting returns becomes stronger and significant. Thus, using the smoothed dividend-to-price ratio, annual returns are predictable in all the subperiods and in the full period. Dividend growth remains predictable in the full sample.

**Long-horizon predictability: Weighted returns and dividend growth rates (Table OA.5)**

In Table 4, we consider predicting 1-, 3-, and 5- year returns and dividend growth rates. That is, we predict simple sum of log returns over subsequent years. Now, we consider weighting future returns and dividend growth rates by the linearization constant $\rho$. This is motivated by the present value model linking the dividend-to-price ratio to the discounted sum of future returns and dividend growth rates (Eq. 8 in the main paper). Results are reported in Table OA. 5. Weighting only has a marginal effect on our estimates, and all the main results are qualitatively similar to Table 4.

## Table OA.1: Nominal data

This table reports OLS estimates of regressing annual nominal returns and dividend growth rates on the lagged dividend-to-price ratio. Lower case letters are logs of corresponding capital letters. All regressions include a constant (not reported). Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with one lag.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Neth./UK | UK | US | US | Full period | Full period |
| | 1629-1812 | 1813-1870 | 1871-1945 | 1945-2015 | 1700-2015 | 1629-2015 |
| Dependent variable: $RET_{t+1}$ | | | | | | |
| $DP_t$ | 3.11 | 2.42 | 1.11 | 3.86 | 1.60 | 1.70 |
| *t*-stat. | (4.23) | (1.56) | (0.75) | (2.93) | (2.16) | (2.70) |
| R2 | 0.11 | 0.05 | 0.01 | 0.10 | 0.02 | 0.03 |
| Dependent variable: $DG_{t+1}$ | | | | | | |
| $DP_t$ | -1.89 | -5.62 | -7.45 | 0.49 | -3.21 | -2.93 |
| *t*-stat. | (-1.90) | (-2.76) | (-7.09) | (0.55) | (-5.26) | (-5.27) |
| R2 | 0.04 | 0.15 | 0.49 | 0.01 | 0.14 | 0.12 |
| Dependent variable: $ret_{t+1}$ | | | | | | |
| $dp_t$ | 0.14 | 0.13 | 0.06 | 0.11 | 0.06 | 0.06 |
| *t*-stat. | (4.16) | (1.89) | (0.67) | (2.59) | (1.86) | (2.22) |
| R2 | 0.10 | 0.07 | 0.01 | 0.10 | 0.02 | 0.02 |
| Dependent variable: $dg_{t+1}$ | | | | | | |
| $dp_t$ | -0.11 | -0.25 | -0.45 | 0.01 | -0.12 | -0.12 |
| *t*-stat. | (-2.32) | (-2.46) | (-6.83) | (0.43) | (-4.05) | (-4.55) |
| R2 | 0.05 | 0.15 | 0.51 | 0.00 | 0.11 | 0.10 |

## Table OA.2: Extended UK period and CRSP index

This table reports OLS estimates of regressing annual real returns and dividend growth rates on the lagged dividend-to-price ratio. Lower case letters are logs of corresponding capital letters. All regressions include a constant (not reported). Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with one lag.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Neth./UK | UK | US | US | Full period | Full period |
| | 1629-1812 | 1813-1900 | 1900-1945 | 1945-2015 | 1700-2015 | 1629-2015 |
| Dependent variable: $RET_{t+1}$ | | | | | | |
| $DP_t$ | 2.72 | 3.50 | 1.86 | 3.47 | 2.04 | 1.94 |
| *t*-stat. | (3.13) | (2.72) | (0.98) | (2.36) | (2.61) | (3.10) |
| R2 | 0.06 | 0.08 | 0.02 | 0.07 | 0.03 | 0.03 |
| Dependent variable: $DG_{t+1}$ | | | | | | |
| $DP_t$ | -2.25 | -5.60 | -8.00 | -0.25 | -3.17 | -2.84 |
| *t*-stat. | (-2.36) | (-2.32) | (-7.70) | (-0.30) | (-4.64) | (-4.88) |
| R2 | 0.05 | 0.08 | 0.61 | 0.00 | 0.09 | 0.09 |
| Dependent variable: $ret_{t+1}$ | | | | | | |
| $dp_t$ | 0.12 | 0.14 | 0.11 | 0.10 | 0.07 | 0.07 |
| *t*-stat. | (2.97) | (2.84) | (1.03) | (2.09) | (2.36) | (2.72) |
| R2 | 0.06 | 0.07 | 0.02 | 0.06 | 0.03 | 0.03 |
| Dependent variable: $dg_{t+1}$ | | | | | | |
| $dp_t$ | -0.12 | -0.24 | -0.48 | -0.01 | -0.11 | -0.11 |
| *t*-stat. | (-2.73) | (-2.47) | (-7.44) | (-0.45) | (-3.67) | (-4.29) |
| R2 | 0.06 | 0.09 | 0.64 | 0.00 | 0.07 | 0.08 |

## Table OA.3: Lagged returns and dividend growth rates as additional predictors

This table reports OLS estimates of regressing annual real returns and dividend growth rates on the lagged dividend-to-price ratio, lagged returns, and lagged dividend growth rates. Lower case letters are logs of corresponding capital letters. All regressions include a constant (not reported). Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with one lag.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Neth./UK | UK | US | US | Full period | Full period |
| | 1629-1812 | 1813-1870 | 1871-1945 | 1945-2015 | 1700-2015 | 1629-2015 |
| Dependent variable: $RET_{t+1}$ | | | | | | |
| $DP_t$ | 3.04 | 4.12 | 2.28 | 3.18 | 2.35 | 2.18 |
| *t*-stat. | (3.47) | (1.97) | (1.47) | (2.35) | (3.22) | (3.55) |
| $RET_t$ | -0.07 | 0.12 | 0.13 | 0.03 | 0.09 | 0.03 |
| *t*-stat. | (-0.94) | (1.29) | (0.80) | (0.31) | (1.38) | (0.55) |
| $DG_t$ | -0.06 | 0.15 | -0.29 | 0.20 | -0.04 | -0.05 |
| *t*-stat. | (-0.70) | (1.67) | (-1.86) | (0.94) | (-0.48) | (-0.81) |
| R2 | 0.09 | 0.14 | 0.08 | 0.08 | 0.04 | 0.04 |
| Dependent variable: $DG_{t+1}$ | | | | | | |
| $DP_t$ | -1.67 | -4.02 | -5.64 | -0.12 | -2.22 | -2.13 |
| *t*-stat. | (-1.89) | (-1.51) | (-4.15) | (-0.15) | (-3.97) | (-4.33) |
| $RET_t$ | 0.10 | -0.09 | 0.17 | 0.09 | 0.18 | 0.15 |
| *t*-stat. | (1.24) | (-0.50) | (1.51) | (1.51) | (3.24) | (3.06) |
| $DG_t$ | -0.09 | 0.03 | 0.01 | 0.39 | -0.01 | -0.02 |
| *t*-stat. | (-0.89) | (0.15) | (0.08) | (2.81) | (-0.16) | (-0.34) |
| R2 | 0.05 | 0.05 | 0.48 | 0.24 | 0.13 | 0.11 |
| Dependent variable: $ret_{t+1}$ | | | | | | |
| $dp_t$ | 0.13 | 0.22 | 0.13 | 0.10 | 0.09 | 0.08 |
| *t*-stat. | (3.23) | (2.28) | (1.47) | (2.30) | (2.81) | (3.02) |
| $ret_t$ | -0.07 | 0.12 | 0.13 | 0.04 | 0.07 | 0.02 |
| *t*-stat. | (-0.88) | (1.30) | (0.77) | (0.41) | (1.16) | (0.43) |
| $dg_t$ | -0.06 | 0.11 | -0.29 | 0.21 | -0.05 | -0.06 |
| *t*-stat. | (-0.76) | (1.34) | (-1.86) | (0.95) | (-0.58) | (-0.89) |
| R2 | 0.08 | 0.15 | 0.08 | 0.08 | 0.04 | 0.03 |
| Dependent variable: $dg_{t+1}$ | | | | | | |
| $dp_t$ | -0.09 | -0.18 | -0.30 | -0.00 | -0.07 | -0.08 |
| *t*-stat. | (-2.16) | (-1.43) | (-3.88) | (-0.21) | (-3.13) | (-3.71) |
| $ret_t$ | 0.10 | -0.11 | 0.24 | 0.12 | 0.23 | 0.18 |
| *t*-stat. | (1.21) | (-0.64) | (2.36) | (1.63) | (3.87) | (3.56) |
| $dg_t$ | -0.11 | 0.06 | 0.03 | 0.34 | -0.02 | -0.04 |
| *t*-stat. | (-1.16) | (0.31) | (0.39) | (2.45) | (-0.35) | (-0.64) |
| R2 | 0.06 | 0.05 | 0.53 | 0.25 | 0.14 | 0.11 |

## Table OA.4: Two-year trailing average of dividend-to-price ratio

This table reports OLS estimates of regressing annual real returns and dividend growth rates on the lagged two-year trailing average of dividend-to-price ratio. Lower case letters are logs of corresponding capital letters. All regressions include a constant (not reported). Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with one lag.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Neth./UK | UK | US | US | Full period | Full period |
| | 1629-1812 | 1813-1870 | 1871-1945 | 1945-2015 | 1700-2015 | 1629-2015 |
| Dependent variable: $RET_{t+1}$ | | | | | | |
| $(DP_t + DP_{t-1})/2$ | 2.96 | 4.69 | 3.28 | 3.16 | 2.45 | 2.30 |
| *t*-stat. | (3.63) | (2.16) | (1.92) | (2.28) | (3.18) | (3.64) |
| R2 | 0.07 | 0.08 | 0.05 | 0.07 | 0.04 | 0.04 |
| Dependent variable: $DG_{t+1}$ | | | | | | |
| $(DP_t + DP_{t-1})/2$ | -1.32 | -4.63 | -6.49 | 0.03 | -2.17 | -2.00 |
| *t*-stat. | (-1.57) | (-1.85) | (-6.06) | (0.03) | (-3.50) | (-3.87) |
| R2 | 0.02 | 0.06 | 0.29 | 0.00 | 0.05 | 0.05 |
| Dependent variable: $ret_{t+1}$ | | | | | | |
| $(dp_t + dp_{t-1})/2$ | 0.13 | 0.23 | 0.19 | 0.10 | 0.09 | 0.08 |
| *t*-stat. | (3.35) | (2.29) | (2.10) | (2.21) | (2.76) | (3.11) |
| R2 | 0.06 | 0.09 | 0.05 | 0.07 | 0.04 | 0.03 |
| Dependent variable: $dg_{t+1}$ | | | | | | |
| $(dp_t + dp_{t-1})/2$ | -0.08 | -0.19 | -0.37 | 0.00 | -0.08 | -0.08 |
| *t*-stat. | (-1.91) | (-1.51) | (-5.55) | (-0.10) | (-2.90) | (-3.42) |
| R2 | 0.02 | 0.05 | 0.29 | 0.00 | 0.04 | 0.04 |

## Table OA.5: Long-horizon predictability: Weighted returns and dividend growth rates

This table reports OLS estimates of regressing the weighted sum of annual real returns $\left(\sum_{j=1}^{h}\rho^{j-1}ret_{t+j}\right)$ or dividend growth rates $\left(\sum_{j=1}^{h}\rho^{j-1}dg_{t+j}\right)$ on the dividend-to-price ratio. All variables are in logs. Horizon *h* is either 1, 3, or 5 years. Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with the number of lags equal to the length of the horizon. In brackets are *t*-statistics based on non-overlapping observations, calculated as the mean across alternative non-overlapping samples (e.g. in case of 5-year predictions, we report the mean across five different non-overlapping samples starting in years 1 through 5). The *p*-values '(Sim., Direct)' are based on Monte Carlo simulations. The 'implied coefficient' for longer horizon predictions is based on the 1-year coefficient and calculated using $\beta_{x,h} = \beta_x\left(1-\rho^h\beta_{dp,1}^h\right)/(1-\rho\beta_{dp,1})$. All regressions include a constant (not reported).

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | 1629-1945 | 1945-2015 | 1700-2015 | 1629-2015 |
| Dependent variable: 1-year ret | | | | |
| $dp_t$ | 0.11 | 0.09 | 0.08 | 0.07 |
| *t*-stat. | (3.22) | (2.03) | (2.47) | (2.81) |
| *p*-value (Sim., Direct) | 0.00 | 0.24 | 0.01 | 0.00 |
| R2 | 0.04 | 0.06 | 0.03 | 0.03 |
| Dependent variable: 3-year ret | | | | |
| $dp_t$ | 0.28 | 0.24 | 0.20 | 0.19 |
| *t*-stat. (Overlap.) | 4.45 | 2.85 | 3.13 | 3.43 |
| *t*-stat. (Non-overlap.) | 3.48 | 2.82 | 2.82 | 3.03 |
| *p*-value (Sim., Direct) | 0.00 | 0.25 | 0.01 | 0.00 |
| Implied coefficient | 0.23 | 0.25 | 0.19 | 0.19 |
| *p*-value (Sim., Direct) | 0.00 | 0.20 | 0.01 | 0.00 |
| R2 | 0.10 | 0.15 | 0.08 | 0.07 |
| Dependent variable: 5-year ret | | | | |
| $dp_t$ | 0.41 | 0.42 | 0.32 | 0.30 |
| *t*-stat. (Overlap.) | 4.57 | 5.24 | 4.04 | 4.32 |
| *t*-stat. (Non-overlap.) | 3.50 | 3.67 | 3.00 | 3.18 |
| *p*-value (Sim., Direct) | 0.00 | 0.20 | 0.00 | 0.00 |
| Implied coefficient | 0.29 | 0.37 | 0.27 | 0.26 |
| *p*-value (Sim., Direct) | 0.00 | 0.16 | 0.00 | 0.00 |
| R2 | 0.15 | 0.28 | 0.14 | 0.13 |
| | | | | |
| Dependent variable: 1-year dg | | | | |
| $dp_t$ | -0.20 | -0.01 | -0.10 | -0.10 |
| *t*-stat. | (-5.30) | (-0.40) | (-3.45) | (-4.09) |
| *p*-value (Sim., Direct) | 0.00 | 0.40 | 0.00 | 0.00 |
| R2 | 0.14 | 0.00 | 0.07 | 0.07 |
| Dependent variable: 3-year dg | | | | |
| $dp_t$ | -0.32 | 0.01 | -0.15 | -0.17 |
| *t*-stat. (Overlap.) | -4.88 | 0.09 | -2.61 | -3.31 |
| *t*-stat. (Non-overlap.) | -3.83 | 0.10 | -2.21 | -2.76 |
| *p*-value (Sim., Direct) | 0.00 | 0.61 | 0.01 | 0.00 |
| Implied coefficient | -0.43 | -0.03 | -0.24 | -0.25 |
| *p*-value (Sim., Direct) | 0.00 | 0.39 | 0.00 | 0.00 |
| R2 | 0.15 | 0.00 | 0.06 | 0.08 |
| Dependent variable: 5-year dg | | | | |
| $dp_t$ | -0.34 | 0.00 | -0.15 | -0.19 |
| *t*-stat. (Overlap.) | -3.77 | -0.01 | -2.54 | -3.17 |
| *t*-stat. (Non-overlap.) | -2.73 | -0.02 | -1.68 | -2.27 |
| *p*-value (Sim., Direct) | 0.00 | 0.58 | 0.07 | 0.02 |
| Implied coefficient | -0.53 | -0.04 | -0.34 | -0.35 |
| *p*-value (Sim., Direct) | 0.00 | 0.38 | 0.00 | 0.00 |
| R2 | 0.13 | 0.00 | 0.05 | 0.08 |

## Figure OA.1: Actual and smoothed dividends: Netherlands/UK (1629-1812)

This figure plots annual real dividends along with the smoothed dividends for the Netherlands/UK period. Smoothed dividends are based on a 10-year moving average of real annual dividends until 1700 and annual real dividends thereafter.