DANMARKS NATIONALBANK

Do equity prices reflect the ultra-low interest rate environment?

Søren Lejsgaard Autrup
Principal Economist
ECONOMICS AND
MONETARY POLICY

sla@nationalbanken.dk

Jonas Ladegaard Hensch
Economist
ECONOMICS AND
MONETARY POLICY

jlh@nationalbanken.dk

Do equity prices reflect the ultra-low interest rate environment?

- The equity risk premium has about doubled after the financial crisis, amid a sharp decline in interest rates and an unchanged required return on equities.

- The increase in the premium entailed a lower pass-through of monetary policy rates to the total financing costs of corporations. That may help to explain why corporate investments have not rebounded faster and stronger after the financial crisis.

- We do not find a major role for a higher underlying earnings risk or a higher price of risk in explaining the higher premium. Changed financial structures and behaviour may instead appear potentially relevant. In case of the latter, equity prices may not fully reflect the current low level of interest rates.

Investors face a choice when deciding where to invest today: Get a certain return on bonds offering very low or negative returns, or buy a risky equity and expect to get around 7 per cent per annum, but with downside and upside risks. Before the financial crisis of 2007-08, the trade-off looked different: The expected return on equities was at the same level, but the alternative looked much more favorable with bond yields around 4 per cent. In other words, the equity risk premium, defined as the additional return required as compensation for investing in equities rather than risk-free assets (bonds), has about doubled to around 7 per cent. Still, bonds are in high demand and no major, global rotation between asset classes has taken place so far.

The increased equity risk premium has exhibited persistency despite a very long and stable, although modest, economic upswing since the aftermath of the financial crisis. A higher equity risk premium entails a higher cost of equity for corporations. This means that, during the years of accommodative monetary policy by global central banks, firms' overall average financing costs have declined much less than monetary policy interest rates. The lower pass-through of monetary policy interest rates to actual financing conditions for corporations may contribute to shedding light on the fairly sluggish recovery of business investments after the financial crisis.

The main contribution of this Economic Memo is to analyse the increase in the equity risk premium in light of recent, observed developments in the macro economy and financial markets, and that we assess whether or not the increase is explained by economic developments, and finally discuss what the implications for monetary policy are. We are not aware of other studies doing that thoroughly.

There are strands of literature on topics related to ours. For example, there is a very large literature on the so-called equity premium puzzle, termed by Mehra and Prescott (1985), showing that equities historically have provided a much higher realised return than bonds. The puzzle is that the return difference cannot be explained by realistic risk aversion parameters in standard macroeconomic models, cf., for example, Jorda, Schularick and Taylor (2019). With this memo, we argue that equity returns going forward may also be significantly larger than bond returns. We do so by applying a forward-looking measure of the equity risk premium. Companies' investment decisions take the forward-looking costs into account. Therefore, our measure is more relevant for financing conditions in the economy and the transmission of monetary policy than measures based on realised returns.

Duarte and Rosa (2015) analyse several models to derive forward-looking estimates of the equity risk premium for the US. They observe an increase after the financial crisis and conclude that the equity risk premium rose because interest rates declined. In a comprehensive review of equity risk premia and their behaviour, Damodaran (2019) notes that equity risk premia until 2008 were positively correlated with the level of interest rates, but vice versa afterwards. Without analysing it in greater detail, Damodaran comments that this change may have had negative implications for the

Federal Reserve's monetary policy after the financial crisis.

In this memo, we confirm on Danish data that the equity risk premium has increased following the financial crisis, using a standard dividend discount model.[1] The increase in Denmark is also coincident with a sharp decline in interest rates such that the sum of the two, the total expected return on equities, is unchanged. We aim to assess if a high premium is an inherent feature of low interest rates, or whether the two phenomena are coinciding by coincidence.

In order to do so, we identify the risks and price of risk changes that could constitute fundamental explanations of the increase in the equity risk premium. We analyse each explanation in turn, where possible using data and including available findings in the literature.[2] To identify the relevant equity risks, we link them with the risk on companies' real capital, using the fact that equities are claims on residual income of companies' real capital. We show that the increase in the equity risk premium coincides with a comparable development in the excess return on real capital. Therefore, we analyse whether the higher return on real capital is a compensation for higher risk. We do not find evidence that the earnings risk for corporations has been increasing sufficiently to account for the developments in the excess return on real capital.

We then turn to developments in the price of risk. Perceptions of equity risk may have changed as a result of the financial crisis. Nonetheless, it is difficult to reconcile that a large increase in the price of risk has caused the higher equity risk premium with the more benign developments in risk compensations in

---

[1] This memo uses Danish data where it is available, because the aim is to analyse the financing conditions for companies in Denmark. However, our findings generally apply to the euro area.

[2] It is out of the scope of this memo to formally test and prove whether each of the potential risk or price of risk explanations – alone or in combination with others – can explain the higher equity risk premium.

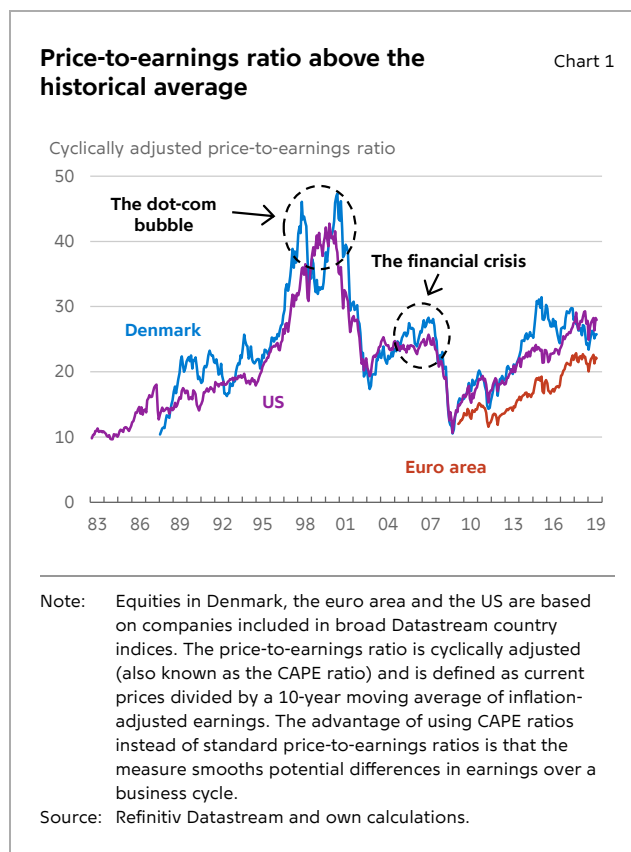corporate bond markets and equity options markets.

We argue that there is no strong evidence that the proposed fundamental explanations of risk and price of risk have the power to explain the increase in the risk premium. Therefore, we also review explanations grounded in financial frictions and financial behaviour that can potentially explain the higher equity risk premium. Among the explanations proposed are excess global savings in a world with financial segmentations, stickiness in investors' way of deciding on their required returns and hesitation to evaluate the profitability of investments relative to the low interest rates currently prevailing in bond markets. Discussions with market participants and use of survey results tentatively support a role for these alternative explanations.

The role of risk premia in monetary policy and macroeconomics is a very important topic and still understudied. Many unanswered questions remain. There are a number of issues to look into, both in Denmark and internationally. One avenue of further research would be to supplement the analysis by a more formal survey of corporations and investors regarding their view on required returns on capital and equity investments, respectively.
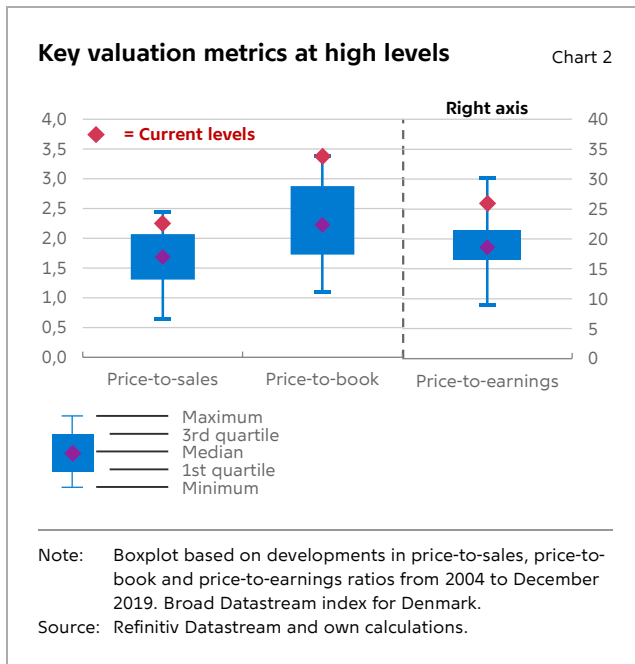
Equity valuation after the financial crisis

Equity prices globally have increased strongly since the trough in March 2009 after the financial crisis. As a result, investors relying on simple valuation metrics, e.g. price/earnings, price/book or price/sales ratios, may easily reach the conclusion that equity valuation today is high and stretched.

In Denmark, the price-to-earnings ratio is, for example, more or less on the same level as right before the financial crisis, and higher than the historical average, cf. Chart 1.

Price-to-earnings ratio above the historical average — Chart 1

Note: Equities in Denmark, the euro area and the US are based on companies included in broad Datastream country indices. The price-to-earnings ratio is cyclically adjusted (also known as the CAPE ratio) and is defined as current prices divided by a 10-year moving average of inflation-adjusted earnings. The advantage of using CAPE ratios instead of standard price-to-earnings ratios is that the measure smooths potential differences in earnings over a business cycle.

Source: Refinitiv Datastream and own calculations.

Price-to-sales and price-to-book ratios have broadly evolved in the same manner and are close to the highest levels since the mid-2000s, cf. Chart 2.

Key valuation metrics at high levels   Chart 2

Note: Boxplot based on developments in price-to-sales, price-to-book and price-to-earnings ratios from 2004 to December 2019. Broad Datastream index for Denmark.
Source: Refinitiv Datastream and own calculations.

The equity risk premium increased after the financial crisis and remains high

There is an important caveat regarding the valuation measures mentioned above: They may be relevant for comparing valuations across equities, but they are not relevant for assessing valuation relative to other assets.

Equities are claims to streams of future, unknown dividends. To properly value equity, an investor therefore needs an opinion on the development of the dividends, the alternative return she could get on a close-to-risk-free (henceforth risk-free) asset and how much compensation she needs for the risk of holding the equity over the risk-free return.
The compensation for the risk is termed the equity risk premium, and the entire required return on equities is the sum of the risk-free return and the equity risk premium.

An estimate of the equity risk premium can be derived using a dividend discount model, cf. Box 1. The estimate indicates that investors since the financial crisis required a by and large unchanged return on equities despite the sharp decline in risk-free interest rates, cf. Chart 3. Consequently, the equity risk premium has

The concept and derivation of required returns and the equity risk premium   Box 1

Our measure of the required return on equities is a forward-looking implied measure of the expected average return over an infinite time horizon. It is implied because it is the return that justifies the equity price today for a given future earnings path for the companies in the Danish stock index. It is also investors' required return for investing in equities. If investors would require a smaller return than the one we derive, they would be willing to pay a higher price for the equities, and the price would go up until the implied required return would equal their actual required return. And vice versa.

The dividend discount model

Theoretically, the fundamental value of equities equals the present value of future dividends, appropriately discounted by the required return on equities. The required return on equities is identical to the discount factor, ρ, which ensures that the value of all expected dividends reflects the current equity price, P_t:

$$P_t = \frac{D_{t+1}}{(1+\rho)^1} + \frac{D_{t+2}}{(1+\rho)^2} + \frac{D_{t+3}}{(1+\rho)^3} + \ldots + \frac{D_\infty}{(1+\rho)^\infty}$$
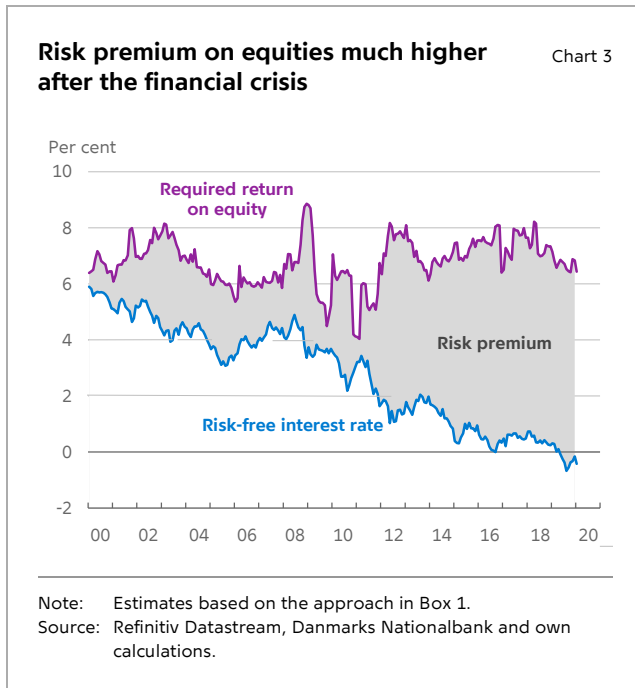
The required return can be divided into a risk-free rate, r^f, and a risk premium, ε: $\rho = r^f + \varepsilon$.

The risk-free interest rate is approximated by the yield on a 10-year Danish government bond. A 10-year bond is used in order to capture expectations for risk-free rates when discounting future dividends.

The required return on equities is derived from an approximation to a three-stage dividend discount model, cf. Fuller and Hsia (1984). Refinitiv I/B/E/S earnings expectations collected from stock market analysts have been applied as expectations of growth in earnings in the medium run, combined with long-term nominal growth that is a 4-year moving average of potential growth in real terms based on Danielsen, Mose and Nguyen (2017) plus expected inflation for the euro area 5 years ahead from the ECB's SPF.

We apply a dividend discount model because it is intuitive and consistent with models used by central banks, practitioners and corporate treasuries. The dividend discount model is derived in real time, i.e. all the inputs to the model are available at the point in time to which the estimate applies, and it uses data for that time period only. Thus, it is not sensitive to the choice of time sample. Furthermore, Duarte and Rosa (2015) show in a comparison of 20 different models that there is considerable heterogeneity across model types, but that the dividend discount models most closely follow the first principal component of the model results, meaning that the dividend discount models may be the best at capturing the collective result of the spectrum of models.
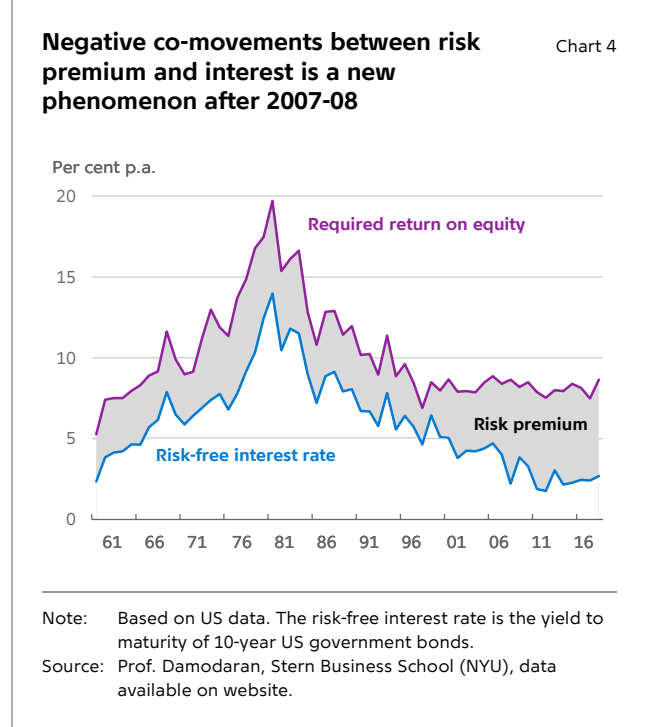
broadly doubled since the years before the financial crisis to a range of 6-8 per cent after 2012. The increasing equity risk premium is also documented by other central banks, practitioners and academics.[3]

Risk premium on equities much higher after the financial crisis   Chart 3

Note: Estimates based on the approach in Box 1.
Source: Refinitiv Datastream, Danmarks Nationalbank and own calculations.

To establish whether interest rates and risk premia are systematically correlated, we would need a longer sample of risk premia estimates, but it is not possible to derive an equity risk premium on Danish data before 2000 due to data unavailability. Based on available US data, between 1961 and 1999, there was a positive correlation between (yearly) changes in US Treasury bond yields and the implied equity risk premium, cf. Chart 4. The increasing implied risk premium and declining interest rates since the financial crisis is thus not a regular pattern.[4]

Negative co-movements between risk premium and interest is a new phenomenon after 2007-08   Chart 4

Note: Based on US data. The risk-free interest rate is the yield to maturity of 10-year US government bonds.
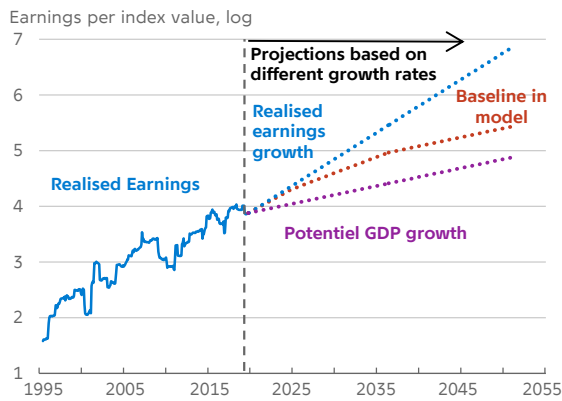Source: Prof. Damodaran, Stern Business School (NYU), data available on website.

The finding of a widened equity risk premium is robust to the specification of the dividend discount model and the inputs. The most uncertain inputs are the analysts' earnings expectations and the length of the period with growth in earnings following analysts' expectations. While the level of the premium is subject to considerable uncertainty, the finding of a higher premium is robust to these inputs, cf. Appendix 1.

The baseline path for expected earnings used for the estimate of the risk premium assumes a continued increase in nominal earnings, cf. Chart 5. The growth path is lower than the growth path based on realised growth in earnings since 1995. Were expected earnings to evolve slower than the baseline and, for example, according to the potential GDP, the equity risk premium still increases after the financial crisis.[5]

---

[3] See, for example, ECB (2018), Daly (Goldman Sachs) (2016) and Damodaran (NYU) (2019).

[4] There are many estimates of realised equity premia based on actual stock market returns for longer time spans. However, we are interested in the co-movement of forward-looking implied premia and risk-free rates. There is too much noise in realised returns to use those as estimates of implied returns.
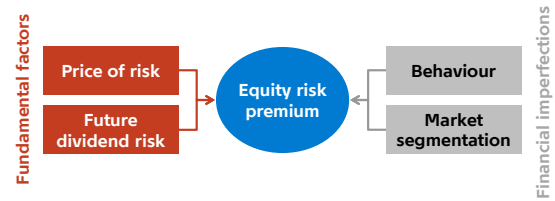
[5] The equity risk premium estimate could be too high if earnings were to decline structurally going forward. That could be the case if, for example, remuneration shifts back from capital to labour after many years of sluggish wage growth despite growth in output and employment, and/or the world economy experiences a downturn that is more protracted and severe than after the financial crisis.

Growth path based on analysts' expectations imply lower growth than realised over the last 25 years Chart 5

Note: The baseline in the model is based on the expected earnings path described in Box 1 and used for the derivation of the equity risk premium in Chart 3. 'Earnings' are the earnings accruing to one unit of OMXC20.
Source: Refinitiv Datastream and own calculations.

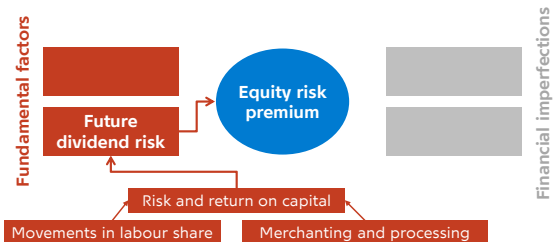## Risk and price of risk are fundamental drivers of equity risk premia

Risk to dividends and the price of risk are key to explain developments in the risk premium. The breakdown of the risk premium on an earnings risk and a price of risk leads to two fundamental factors to potentially explain the increase in the equity risk premium:

  i. Riskiness of earnings to the equity owner has increased
  ii. The price of risk has increased.

In the next two sections, we first look at explanations related to the riskiness of earnings and then to the price of risk, cf. the fundamental factors in the red boxes in Chart 6. Afterwards, we propose some financial market imperfections that can also lead to a higher risk premium on equities without directly being related to risk or the price of risk, cf. the grey boxes in Chart 6.

Main channels of drivers of the equity risk premium Chart 6

Earnings risk and the equity risk premium

We will start by analysing whether new macroeconomic tendencies may have changed the risk and return on capital and under which circumstances this may have contributed to a larger equity risk premium through higher risks on the future earnings, cf. Chart 7.

Channel via dividend risk Chart 7

First, it is necessary to understand where the risks to the future dividends of equities come from, cf. Chart 8: An equity is a right to any residual income from the firm's real capital (henceforth capital) once wages, other
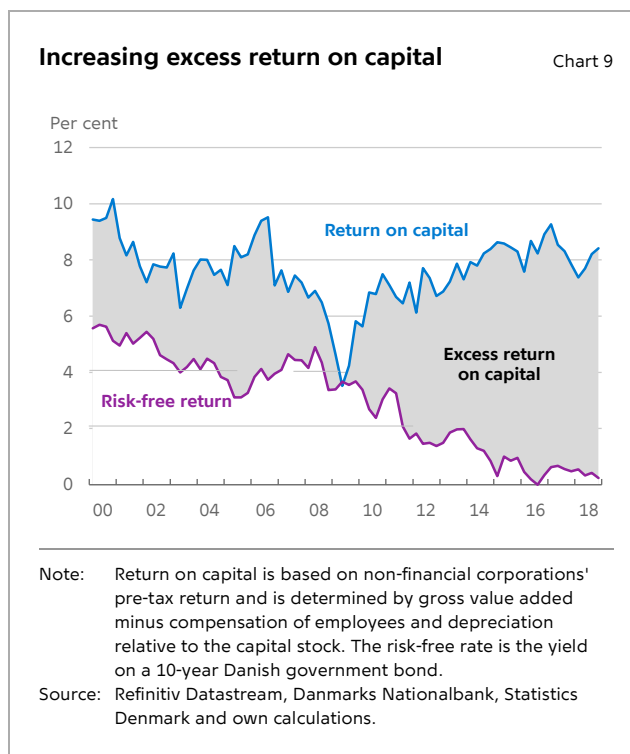
6

production inputs, taxes and interest on debt have been paid. Therefore, the dividend risks derive from the corporate earnings, which again derive from risks to the return on capital.
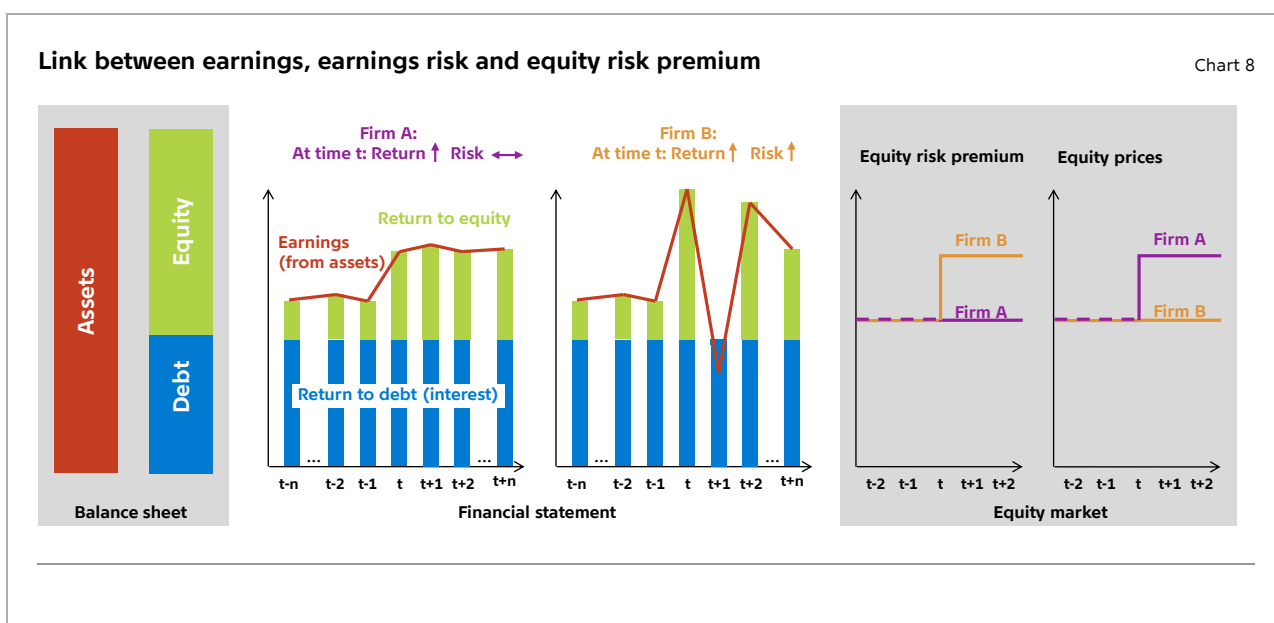
As an illustration, if the return on a company's capital increases at time t and the riskiness of the return does not (**firm A**), the earnings accruing to the equity owner will increase with no additional risk. In that case, the equity risk premium should stay the same and the price of the equity increase. If the return on capital goes up, but hand in hand with more risk (**firm B**), the higher earnings will also be more risky and the equity risk premium should increase. The equity price should therefore not increase as much – if at all.[6]

The return on corporations' capital measured on their balance sheets has increased in the wake of the financial crisis, cf. Chart 9. As a result, the excess return on capital, defined as the difference between the return on capital and the risk-free interest rate, has evolved comparably to the development in the equity risk premium. Therefore, it may be obvious to

suspect a link between the two phenomena.

Increasing excess return on capital Chart 9

Note: Return on capital is based on non-financial corporations' pre-tax return and is determined by gross value added minus compensation of employees and depreciation relative to the capital stock. The risk-free rate is the yield on a 10-year Danish government bond.
Source: Refinitiv Datastream, Danmarks Nationalbank, Statistics Denmark and own calculations.

Below, we propose macroeconomic trends that – separately or jointly – may contribute to explaining the increased excess return on capital in Denmark. Thereafter, in order to draw conclusions on the impact on the equity risk

Link between earnings, earnings risk and equity risk premium Chart 8

---

[6] Changes in leverage can affect the riskiness of equities for an unchanged risk on assets. However, Danish corporations have been deleveraging since the financial crisis, cf. Danmarks Nationalbank (2019a). All else equal, the deleveraging trend lowers equity risks.

premium, we turn to assessing the impact on the risk to capital returns:

Movements in the labour share: The increasing excess return on capital has to some extent happened at the expense of a lower return on the remaining production input, namely labour. The decline in the labour share in many advanced countries after the financial crisis of 2007-08 could, for example, be related to a new wave of automation or changes in product market competition conditions. Automation increases the productivity of capital and can lead to capital replacing tasks that were previously performed by labour.[7] A decline in competition (higher mark-ups) will reduce the wage share and raise the excess return on capital.

Merchanting and processing:[8] Danish corporations increasingly sell goods that are not produced domestically. Although the production takes place abroad and the goods do not cross the Danish borders, it still enters the national accounts and the financial statements of Danish companies. As a consequence, merchanting and processing raise profits relative to domestic inputs of labour and capital. Thereby, the return on capital is pressed up. Although no official statistics exist for other countries, merchanting and

processing are likely more important for Danish economy than for many other advanced economies.[9]

Higher excess return partly explained by macroeconomic trends

We use a framework developed by Caballero et al (2017) to identify if and to what extent macroeconomic trends have been driving the increase in the excess return on capital. Their framework incorporates developments in key economic determinants: expected capital losses, product market competition (mark-ups) and automation, where the latter two are related to changes in labour share developments, cf. Box 2. The framework does not incorporate merchanting and processing. Finally, their model contains a residual if the modelled factors fail to explain the increase in the return. The residual is labelled a 'risk premium', although it could also result from a possible misspecification of the model or mismeasurement of capital returns, e.g. from challenges to account for intangible assets.

---

[7] However, automation can also contribute to the creation of new tasks, which has also been the case in previous waves of technical change. Creation of new tasks will separately contribute to an increase in the wage share. Therefore, the effect is ambivalent: In case of a low rental rate of capital relative to wages, tasks will gradually be technologically automated, leading to an increase in return on capital and vice versa, cf. Acemoglu and Restrepo (2018).

[8] Merchanting is defined as follows: A Danish parent company buys final goods produced by a foreign factory. The finished goods are resold to consumers abroad from the factory. The Danish parent company receives payment from the consumers abroad. The margins are registered as value added.

Processing is defined as: Intermediary goods owned by a Danish parent company are sent from Denmark or another country for processing at a foreign factory. The Danish parent company pays for the processing service. The final goods are sent directly to consumers abroad, who remit payment to the Danish parent company. This activity is classified in the manufacturing industry since both the intermediary and the final goods are owned by the Danish parent company throughout the process. The value of the final goods is registered as exports, but processing services are registered as imports.

[9] Pedersen, Schmith, Sørensen and Rold (2019).

Drivers of excess return on capital — Box 2

Caballero et al (2017) propose a simple macroeconomic accounting framework for examining the drivers of the increasing wedge between return on capital and the risk-free return. The framework builds on a no-arbitrage condition stating that the wedge between the average product of capital, APK^e, and a risk-free return, r^s, equals the capital risk premium, ε^K, the effect of imperfect competition and the expected capital loss, $(1-\delta)g_\xi^e$:

$$\underbrace{APK^e - r^s}_{Excess\,return} = \underbrace{\varepsilon^K}_{Risk\,premium} + \underbrace{\frac{Y}{\zeta K}\left(1 - \frac{1}{\mu}\right)}_{Mark-up} - \underbrace{(1-\delta)g_\xi^e}_{Expected\,capital\,loss},$$

where $\frac{Y}{\zeta K}$ is the output-capital ratio (net of depreciation) and μ is the mark-up. The challenge in terms of identifying the drivers of the excess return is that neither the risk premium nor the mark-up can be observed. To deal with that, we use a Cobb-Douglas production function, such that the labour share, s_N, is given by the mark-up and the share of automated tasks, α_K, cf., for example, Acemoglu (2018): $s_N = (1 - \alpha_K)/\mu$.[1] As both α_K and μ are unobservable, we solve the system under two scenarios: (i) Assuming that the mark-up follows the estimated mark-up on manufacturing firms in the euro area[2] and (ii) letting α_K be unchanged such that μ follows the labour share in Denmark. We have reported scenario (ii), but scenario (i) delivers similar results.

Introducing merchanting and processing

In order to incorporate merchanting and processing, we split gross value added (GVA) into a part that only comprises production abroad (GVA^{MP}) and a part that captures domestic production (GVA^{DK}): $GVA = GVA^{MP} + GVA^{DK}$. Subsequently, the net income originating from merchanting and processing (NI^{MP}) is assumed to be equal to total net income (NI) minus gross value added from merchanting and processing: $NI^{MP} = NI - GVA^{MP}$. This correction imposes an assumption that there are no labour costs associated with the extra value added. As the return on capital is defined as net income relative to the capital stock, APK^e can then be expressed as:

$$\underbrace{APK^e - r^s}_{Excess\,return} = \underbrace{APK^{MP\,e}}_{\substack{Merchanting\,and\\processing}} + \underbrace{\varepsilon^K}_{\substack{Risk\\premium}} + \underbrace{\frac{Y}{\zeta K}\left(1 - \frac{1}{\mu}\right)}_{Mark-up} - \underbrace{(1-\delta)g_\xi^e}_{\substack{Expected\\capital\,loss}},$$

where APK^{MP} is the return on capital that is related to merchanting and processing.

---

[1]. Our results are robust to alternatively using a CES production function.
[2]. Cf. Cavalleri et al (2019).

In Denmark, pharmaceutical and other R&D intensive companies, for which patents play a large role in the generation of profits, make up a large share of value added, and mismeasurement of intangible assets is a potential issue. Firstly, we note that we include intangible assets in our measure of capital. Secondly, we argue why mismeasurements should not play a major role in explaining either the widening excess return on capital or the widening equity risk premium, cf. Box 3.

Mismeasurement of intangible assets — Box 3

Intangible assets increased from 14 per cent of Danish listed companies' assets in 2005-07 to 18 per cent in 2016-18. The economic importance of intangible assets may still be understated. We present two arguments for why it is unlikely that developments in intangible assets are behind the increase in the equity risk premium:
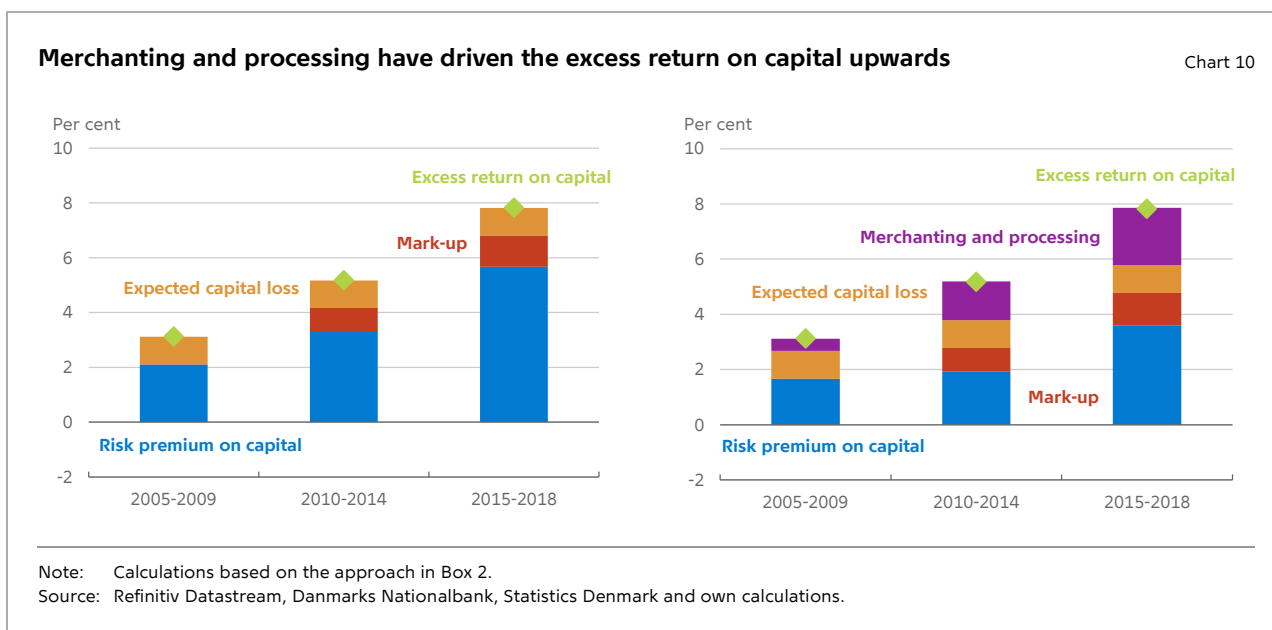
Firstly, it does not seem plausible from a timing perspective that the effect of intangible assets should have become particularly pronounced over the few years where the widening of the excess return on capital happened. Companies have been investing in R&D and creating patents for much longer, and the possible effect on the return on capital should be much more gradual. In a similar vein, Karabarbounis and Neiman (2018) investigate on US data what drives the increase in factorless income by analysing the consistency of macroeconomic dynamics over a long time period. Factorless income is the residual income after paying capital an imputed return. In other words, our finding of an increased excess return on capital would be labelled factorless income in their setting. They consider it more plausible that, for example, time-varying risk premia are behind the increase in factorless income rather than the mismeasurement of intangible capital.

Secondly, even if the importance of intangible assets is understated, it is unlikely that it would have implications for equity risk premia. If intangible assets were better captured in the balance sheet, corporations' book equity would also be higher. The equity owner would therefore have a claim on more assets and equity. Although the investor would will receive a lower return per unit of assets, the return in monetary units would be unchanged because of more assets. The risk would also be unchanged. Therefore, the market value of the equity would be unchanged. The only equity market change would be a lower price-to-book ratio.

The widening of the excess return on capital is a well-known phenomenon in other advanced economies as well. In the US, a decline in competition conditions appears to be an important potential driver of the large return on capital.[10] In the euro area, the modelled factors fail to explain the majority of the widening. Therefore, the risk premium is picking up the increase in the excess return on capital as the residual, cf. Hutchinson and Saint-Guilhem (2019). Using Danish data, the decomposition directly based on the Caballero et al (2017) framework is also not particularly successful in explaining the large increase in the excess return on capital, cf. Chart 10 (left).

disruption from ICT services has been a factor at least since the IT revolution starting in the late 1990s, the realised depreciation should to some extent reflect risks of depreciation due to the continued wave of digitalisation etc.

A potential caveat of applying the framework on Danish data is that merchanting and processing are not modelled. These production forms are increasingly used by large Danish companies. The increased importance for the Danish economy coincides closely with the increase in the excess return on capital. To address this shortcoming, we adjust the gross value added used as input for the

Merchanting and processing have driven the excess return on capital upwards

Chart 10

Note: Calculations based on the approach in Box 2.
Source: Refinitiv Datastream, Danmarks Nationalbank, Statistics Denmark and own calculations.

Larger mark-ups can explain some of the larger excess return according to the model. The larger contribution from the mark-ups after the financial crisis does not reflect a general shift in the competition conditions after the crisis, but more a substantial drop in the mark-ups around 2008-2009. We also find a small contribution from higher expected capital losses. A risk of disruption from new technologies should enter the model via the expected capital loss. We use a time-varying realised depreciation rate to capture expectations. Since technological

decomposition for the contribution from merchanting and processing (see also Box 2). Merchanting and processing are able to account for a considerable part of the increase in the excess return. This suggests that they probably have been key drivers of the increasing excess return on capital in Denmark after the financial crisis, cf. Chart 10 (right). Merchanting and processing can potentially affect both the level of returns and the risks associated with returns. For instance, they could imply a larger risk premium on capital if the production abroad implies higher business

---

[10] Cf. Autor, Dorn, Katz, Patterson and Reenen (forthcoming).

risks on production, sales and price, among others. On the other hand, merchanting and processing could also entail that business risks are transferred to other entities or, for example, entail a lower risk of disrupted supply chains or trade restrictions. We are not aware of studies highlighting additional risks to these production structures. The time span of data on merchanting and processing is too short to draw a firm conclusion on their risk and return effects. Still, we note that the economic contribution from them have been increasing steadily over the last ten years without major volatility between years, supporting a conjecture that merchanting and processing do not lead to higher business risks than normal production structures.[11] To that extent, the higher return leads to higher equity prices.

No visible increase in capital risk based on individual company returns
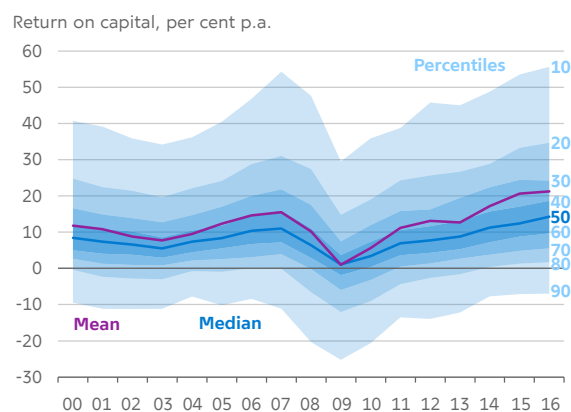
We use developments in capital returns of individual firms to further analyse if risks have increased amid the higher returns. We use all Danish corporations in the manufacturing sector with assets above DKK 5 million (approximately EUR 0.7 million) from the registry of individual companies by Statistics Denmark. This gives us around 2,500-3,000 companies in any year. Higher risk to the capital return could show up as 1) a higher variation in return on capital for the individual firm over time and 2) a higher dispersion in return on capital across companies as more corporations are likely to experience negative returns while others will have very high returns. Regarding (1), we note that the mean standard deviation

of companies' return on assets is roughly unchanged in a pre-crisis sample from 2000-2006 compared to a post-crisis sample from 2010-2016: The standard deviation increases from 19 per cent to 20 per cent.[12] Regarding (2), the cross-company distribution of returns also does not show a large difference when comparing the period before the financial crisis to the period after the crisis, cf. Chart 11. The increase in the median is consistent with the increase in the average return based on national accounts (shown in Chart 9). Even more strikingly, returns on capital increased across the distribution of returns and thus also for the least profitable companies.[13]

To sum up, neither the time-series volatility nor the cross-sectional dispersion indicates a higher riskiness of realised capital returns for the post-financial crisis period where the capital risk and equity risk premia are high.

Unchanged risk to capital returns across firms Chart 11

Return on capital, per cent p.a.

Note: Firms in manufacturing sectors with assets (tangible and intangible) above DKK 5 million.
Source: Statistics Denmark, own calculations.

---

[11] To the extent that merchanting and processing play a role, it also has implications whether a high return from merchanting or processing is a temporary or persistent phenomenon. If it would be purely temporary, the return on capital would drop to a normal level and that would negatively affect the dividends to shareholders. In the framework of the equity risk premium, that could translate into earnings expectations being too optimistic and the equity risk premium estimate too high. We consider it likely that the high return will be persistent: It takes time for potential new entrants to develop technology and brands and organisations and there are risks associated with it. Therefore, capital accumulation to take advantage of the excess return will be a slow process and leave the excess return high in the medium term.

[12] The latest observation available is 2016.
[13] The return on capital was higher for all deciles of companies in 2015 or 2016 than in any year since 2000 and before the financial crisis.

Capital risk unlikely to play a major role in explaining the higher equity risk premium
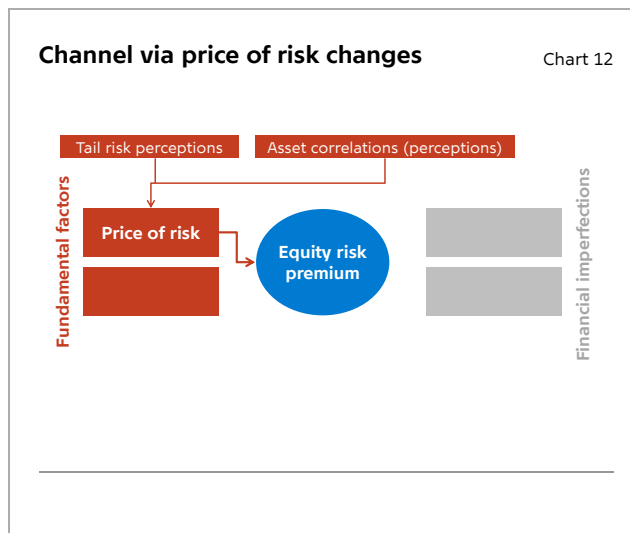
As shown, the Caballero et al (2017) framework adjusted for merchanting and processing can explain a part of the increase in the excess return. Still, the risk premium in the framework increases over time and accounts for almost half of the excess return in 2015-2018. Therefore, the large excess return could partly result from an increase in capital risk premia demanded by corporations to invest. Like for the equity risk premium, the capital risk premium may be caused by either higher actual capital risks or a higher compensation for a given risk.

The increase in the equity risk premium that we are trying to explain is of a large magnitude. Therefore, for the capital risk to explain the increase in the equity risk premium, we would expect to see clear evidence in the data or studies clearly confirming that risks have changed significantly compared to before the financial crisis.

On the contrary, the identified macroeconomic trends (and especially merchanting and processing) are associated with the increase in the excess return on capital after the financial crisis, and the higher return took place amid unchanged realised risks. Therefore, we do not find support that a higher capital risk, and thus earnings risk for the equity holder, is a main explanation of the increase in the equity risk premium.
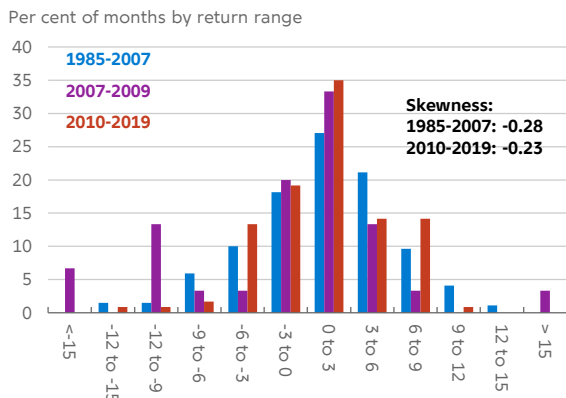
Price of risk and the equity risk premium

We next address the price of risk, cf. Chart 12.

Channel via price of risk changes — Chart 12

In retrospect, the tail risks to equity investments were probably misjudged before the financial crisis. Equity owners lost more than 50 per cent in 2008-09. Such a large decline had not been observed for more than 50 years. The occurrence of extreme negative returns is a measure of realised tail risk outcomes. In the period 1985-2007, the distribution of monthly returns was lightly skewed towards negative outcomes, cf. Chart 13. In the period including and after the financial crisis from mid-2007 to end-2009, the distribution of returns was much more skewed towards negative returns, indicating a higher realised equity risk. However, the distribution of returns after 2010 exhibits a smaller degree of skew than in the pre-crisis period. This reflects fewer realisations of negative tail risk outcomes during the period of the high equity risk premium, whether by coincidence or not.

Fewer tail risk outcomes during period of higher equity risk premium   Chart 13

Per cent of months by return range

1985-2007
2007-2009
2010-2019

Skewness:
1985-2007: -0.28
2010-2019: -0.23

Note: Broad Datastream index of Danish equities. 2007 split by
         first half and second half to account for the first concrete
         signs of the financial crisis of 2008-09.
Source: Refinitiv Datastream and own calculations.

Investors may also have underestimated the correlation between equity returns and returns on additional assets (e.g. housing wealth) and income (e.g. received wages). A reassessment of the perception and correlation of risks may have contributed to an increase in the equity risk premium required by investors.
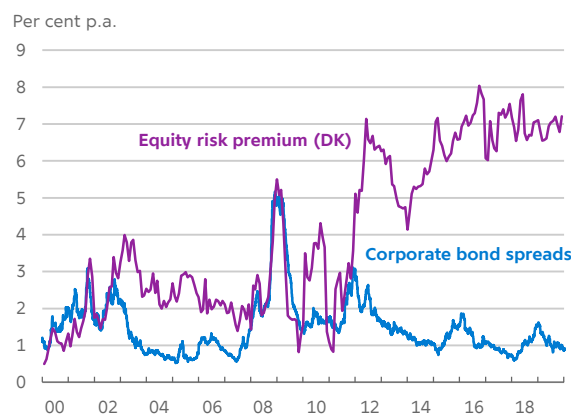
However, if the price of risk has changed to an extent that it can explain the increase in the equity risk premium, it should also be visible in related asset markets or in markets actively used for hedging equity risks:

Not consistent with premia on other asset classes: The market pricing of other risk premia does not show the same pattern of a persistent increase after the financial crisis. In general, risk premia have been compressing at a time of low returns, cf., for example, the search for yield behaviour often mentioned by central banks and official institutions.[14] Why should investors behave much differently for equities than for other asset classes? Strikingly, corporate bond spreads of fairly low-rated issuers have

developed very differently from the estimated equity risk premium since 2012, cf. Chart 14. Corporate bond spread developments are relevant because the underlying risk of default is based on the same risk process as for equities, namely the risk associated with companies' assets, particularly for tail risk events affecting both bond and equity owners.

Diversion in price of risk across corporate risk markets   Chart 14

Per cent p.a.

Equity risk premium (DK)

Corporate bond spreads

Note: 'Corporate bond spread' is the yield to redemption on the
         IBOXX euro non-financial BBB-rated 7 to 10-year maturity
         minus the 8-year euro swap rate.
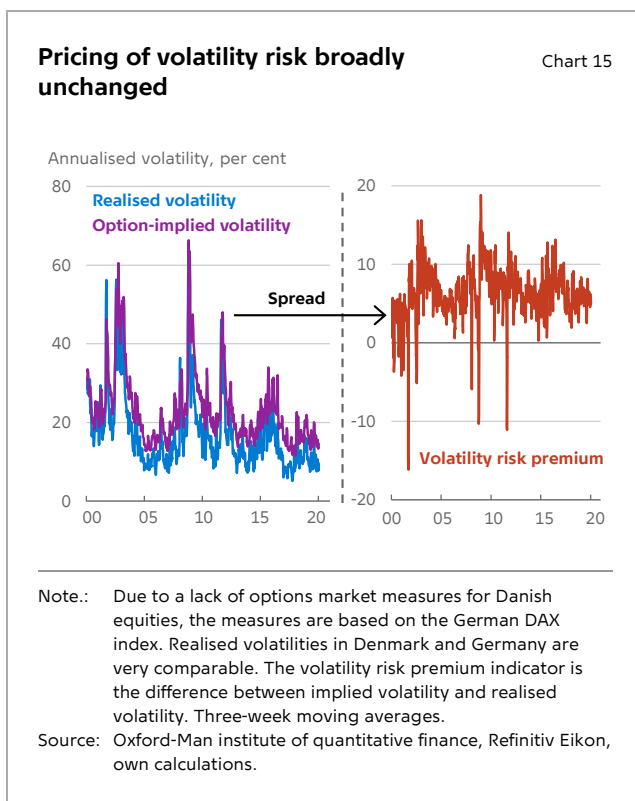Source: Refinitiv Datastream, own calculations.

No signs of higher price of risk in equity options measures:[15] Equity investors can use options markets to hedge against certain outcomes, e.g. large equity price declines. The VIX is an indicator of the price of buying protection against large moves, i.e. an option-implied volatility. Both the realised volatility of stock prices and the option-implied future volatility are generally lower than in the 2000s. A simple indicator of a market premium for volatility risk is the spread between the option-implied volatility and the actual realised volatility (as a proxy of the true, current volatility). The measure of volatility risk increased during the financial crisis, and the

---

[14] See, for example, IMF (2019).

[15] A higher price of risk is when the price that investors are willing to pay for protection is high relative to what the protection is actually worth using the real, unobserved probabilities of outcomes.

elevated level may seem to have persisted for a few years, cf. Chart 15.[16] However, from 2012 and onwards, i.e. during the period where the equity risk premium remained elevated, the volatility risk indicator is no longer elevated compared to the early 2000s.[17] The options market therefore also does not lend support to the hypothesis that the price of risk should be significantly higher today than before the financial crisis.

Pricing of volatility risk broadly unchanged   Chart 15

Note.:   Due to a lack of options market measures for Danish equities, the measures are based on the German DAX index. Realised volatilities in Denmark and Germany are very comparable. The volatility risk premium indicator is the difference between implied volatility and realised volatility. Three-week moving averages.

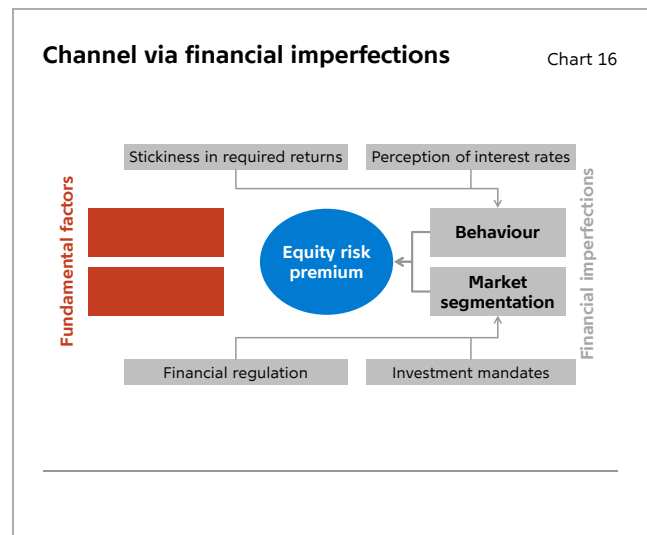Source: Oxford-Man institute of quantitative finance, Refinitiv Eikon, own calculations.

Financial market changes may have contributed to increasing risk premia

The analysis of the data suggests that the higher equity risk premium cannot be explained fully by larger risks on capital returns or a changed fundamental price of risk. Below, we propose potential explanations for a higher equity risk premium which are grounded in financial frictions and financial behaviour, cf. Chart 16. We find tentative support for some alternative explanations from discussions with market participants and the use of surveys.

Channel via financial imperfections   Chart 16

Global savings glut and market segmentation: Demographic trends in Denmark and abroad have contributed to a higher demand for savings. Together with increased risk aversion due to the financial crisis, this has led to an increase in demand for safe assets, such as low-risk bonds. The higher demand entails a lower interest rate on safe bonds, often labelled as low natural rates.[18] Furthermore, central banks' quantitative easing policies have contributed to an increased demand for low-risk bonds and declining interest rates.

Portfolio rebalancing theory would suggest that an efficient financial market would be able to restore the 'true' risk/return trade-off, as investors would move from bonds to equities. However, financial markets are segmented and regulated. A large share of the additional savings is managed by agents who are not able or willing to buy equities, e.g. due to specialisation in specific asset classes, inflexible

---

[16] Based on the German equity market due to lack of data for the Danish market.

[17] The variance risk premium applied here is one of the simplest in the class of variance risk premia, as the expected conditional variance is proxied by the high-frequency realised variance. Bekaert and Hoerova (2014) confirm on US data (until end-2016, available online) that more sophisticated variance risk premia provide qualitatively similar results.

[18] The natural interest rate has declined strongly since the financial crisis, cf. Adolfsen and Pedersen (2019).

investment mandates or regulation. Greenwood, Hanson and Liao (forthcoming) argue that segmentation within bond markets entails slow-moving capital and creates persistent price impacts. Segmentation between equity markets and bond markets is likely to be at least as pronounced as segmentations within bond markets. Investors with the capability and willingness to swiftly switch between equities and bonds may already hold a large share of equities. Increasing that share would create risks by reducing the diversification of their portfolios. Instead, until the slow-moving rebalancing takes place, the savings may increase demand for savings deposits or bonds and contribute to a persistent high return differential between bonds and equities, i.e. the equity risk premium. Hall (2017) presents evidence that growth in wealth of risk-averse investors relative to the wealth of risk-tolerant investors is a source of the downward trend in the worldwide real interest rate. If that is also the case for Danish and European economic conditions, it can help explain why risk premia and the return on capital are high while the natural rates are low.

Perception of low interest rates: A simple hypothesis of why investors have not adjusted their required return on equities downwards is that they have been hesitant to adapt to the current ultra-low interest rate environment. For instance, some investors may have underestimated the length of the period with negative and falling interest rates and believed it to be a short post-crisis phenonomen. Investors may instead have discounted future cash flows using subjective risk-free rates that are higher than those implied by bond markets, leaving the equity risk premium calculated with market interest rates high. The low natural rate hypothesis would imply that the current low levels of risk-free rates is more than just a short-term phenomenon. Investors should therefore take the low rates into account when pricing

other investments. If investors deem the current interest rates to be unsustainably or unrealistically low, they would profit by locking in the low interest rates using, for example, the interest rate swap market and benefit if interest rates increase.

The increase in equity market valuation in the latter part of 2019 took place against slightly declining long-term earnings expectations and broadly unchanged interest rates.[19] As a result, the increase in equity prices was casued by a contraction in the equity risk premium. It remains to be seen whether the 2019 equity price increases represented the beginning of a gradual, downwards adjustment of the equity risk premium, or merely was a run-up in equity prices caused by other factors.

Stickiness in required return: An even simpler interpretation is that investors require the same return on equities independently of the levels of the risk-free rates, cf. the striking constancy of the required return around 7 per cent. A small survey of market professionals in Denmark confirms that the equity risk premium used by practitioners has been increasing almost in line with the decline in risk-free rates, thereby leaving the required return broadly constant, cf. PWC (2016).

Important implications of the increase in the equity risk premium

Weaker transmission of monetary policy
Non-financial corporations rely on equity financing for about half of their liabilities on their balance sheet. Corporations tend to keep the mix between debt and equity roughly constant over time.[20] For corporations' decisions to invest, the relevant long-term,

---

[19] Based on the euro area and the US. Earnings expectations increased in Denmark, but we consider this to be due to idiosyncratic factors.
[20] After the financial crisis, there has been a movement towards increasing the share of equity, i.e. debt deleveraging.
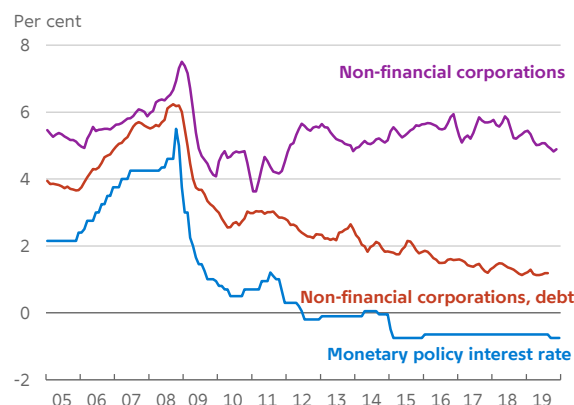
macroeconomic marginal cost of financing is therefore a weighted average of the prices of debt and equity financing (henceforth composite cost of financing), cf. Danmarks Nationalbank (2019b).

The stickiness in the cost of equity after the financial crisis entails that the composite cost of financing has not declined in line with monetary policy rates, cf. Chart 17.[21] This has important insights for how the monetary policy response after the financial crisis has been transmitted to the real economy. Whereas monetary policy rates, and to a large extent bank and market-based interest rates, have declined by around 5 percentage points, the composite cost of financing has only declined by about 2 percentage points. The magnitudes of declines are confirmed by a survey of German, Austrian and Swiss companies. The survey finds that the cost of equity has only declined marginally since before the financial crisis and is in the order of 8-9 per cent. The weighted average cost of capital (WACC), which is economically similar to our composite cost of financing, has only declined from around 8 per cent before the financial crisis to 7 per cent today.[22]

The implication for monetary policy of the increase and subsequent persistency in the equity risk premium is potentially large: In the absence of a widening of the risk premia, a much smaller rate cut could have achieved the same accommodation for corporations' financing costs as the actually implemented policies have.

Low pass-through from monetary policy to firms' financing costs Chart 17

Per cent

Note: The series 'non-financial corporations, debt' shows costs excluding equity financing. The monetary policy rate indicates the rate of interest on certificates of deposit.

Source: Refinitiv Datastream, Danmarks Nationalbank, Statistics Denmark and own calculations.

The increase in the equity risk premium may have dampened business investments
A higher composite cost of financing owing to a higher equity risk premium means that fewer investments are profitable and, consequently, firms invest less. Over time, this can lead to a lower stock of capital, and ultimately to a higher marginal capital product.[23]
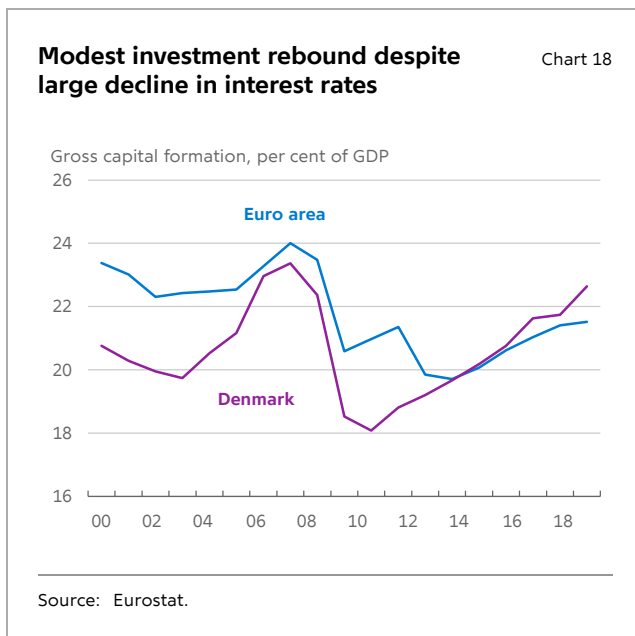
Sharpe and Suarez (2014) show, based on a survey and by reviewing literature of old surveys, that US companies' required return ('hurdle rate') to undertake investments remained broadly unchanged around 15 per cent from 1985 until 2013, despite a drop in interest rates from above 10 per cent to around 2 per cent. They argue that investments are not nearly as tightly linked to interest rates as most economists think. They mention the role of the cost of equity as one potential reason for the higher wedge. Hall (2014) argues that, in the US, a rise in the equity premium is in fact an essential part of the wider financial wedge between the return on capital and the interest

[21] Blundell-Wignall and Roulet (2013) confirm that companies invest less when the cost of equity increases.
[22] KPMG (2019).

[23] In this way, the causality could go from a high equity risk premium to a high return on capital instead of the other way around as analysed earlier in this memo.

rate after the financial crisis, and thus an important factor behind the collapse of investment after the crisis.
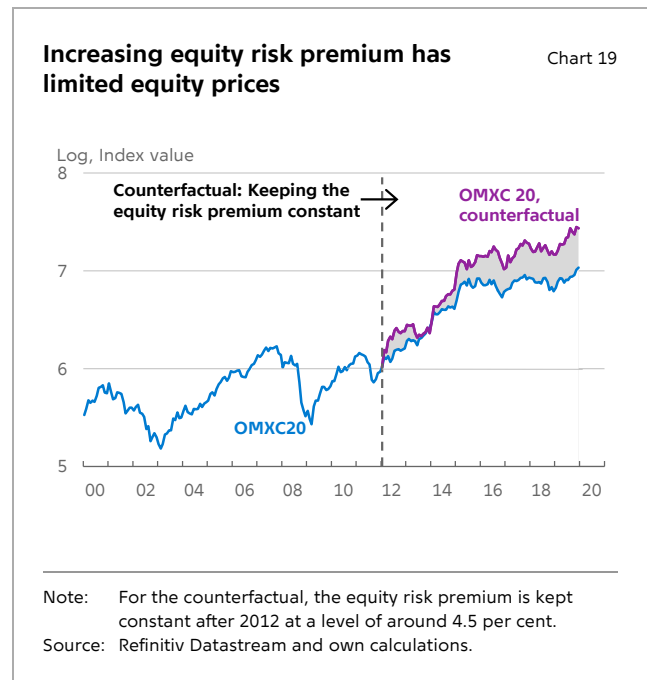
On the aggregate, business investments in Denmark and the euro area have increased since the financial crisis, cf. Chart 18. However, as a share of GDP, investments in Denmark and the euro area are not significant different today compared to during the 2000s, even though interest rates have declined by around 4 percentage points and the return on capital is broadly unchanged.

Modest investment rebound despite large decline in interest rates Chart 18

Gross capital formation, per cent of GDP

Source: Eurostat.

Equity prices would have been higher if the premium had not increased
Equity prices are higher for a lower equity risk premium, keeping everything else unchanged, cf. Box 1. Therefore, if the equity risk premium had stayed unchanged, reflecting the broadly unchanged earnings risks for equities, equity prices would have increased more than they did as interest rates fell. For instance, if the risk premium had remained on the level of the post-financial crisis years (i.e. before the large increase in the premia after 2012, cf. Chart 3), equity prices should be around 40-45 per cent higher today to fully reflect the very low level of

interest rates, cf. Chart 19. If, however, business investments had reacted stronger to the decline in monetary policy interest rates, and the interest rates therefore would have been lowered less, equity prices would not necessarily have increased beyond what they actually have.

Increasing equity risk premium has limited equity prices Chart 19

Log, Index value

Note: For the counterfactual, the equity risk premium is kept constant after 2012 at a level of around 4.5 per cent.
Source: Refinitiv Datastream and own calculations.

Concluding remarks

We find evidence of a larger equity risk premium in Denmark today than before the financial crisis. Our result coincides with findings in the euro area and several other advanced economies. The increase in the premium is economically significant. Furthermore, the magnitude of the increase means that some underlying economic or financial factors must have changed considerably to explain the higher equity risk premium. As a novel feature, we provide an encompassing overview and data evidence where possible of the explanations that we are able to identify as candidates. We group them in two categories, namely fundamental factors such as earnings

risks and price of risks, and financial imperfection factors.

Earnings risks boil down to developments in the risk to the return on capital. Realised excess returns on corporations' capital have increased strongly compared to before the financial crisis, but risks to returns from capital are broadly unchanged. Therefore, we do not see a major role for higher underlying capital risk. Furthermore, we find an association between macroeconomic trends, such as an increased use of merchanting and processing production structures in production and increasing excess return on capital.

We also do not find strong support for a higher price of risk. Asset and derivatives markets that are directly or closely related to the equity market exhibit very different evolutions compared to the equity market in terms of pricing of risks.

Explanations based on financial frictions and imperfections may instead appear potentially relevant to explain the developments in the equity risk premium. Increased savings combined with financial market segmentations can provide an explanation that is consistent with – and complements – the literature on low natural real rates. Finally, it may be of relevance that investors in equities have a persistent return requirement independently of the level of interest rates or, somewhat related, that investors simply do not use the prevailing very low interest rates in the valuation of equities.

The financial frictions and imperfections offer an explanation of how the low level of interest rates has played a role in increasing the equity risk premium. However, there are no arguments why the high equity risk premium should necessarily persist if rates remain low for long.

Based on the analysis, it is not possible – and also not the aim – to prove whether equities are too expensive or too cheap. But the rise in equity prices after the financial crisis would have been larger if the equity risk premium had only reflected movements in the underlying equity risk, according to our findings.

Likewise, we argue that the increasing equity risk premium has lowered the pass-through of monetary policy rates to the total financing costs of corporations. The lower pass-through to firm's financing costs could explain why corporate investments have not rebounded faster and stronger in reaction to the accommodative monetary policy.

The effect on the monetary policy transmission and business investments is the same no matter the reason for the higher equity risk premium. But the implications are not. If the higher premium is caused and explained by fundamental factors such as a higher risk on earnings for equities or price of risk, corporations' incentives to invest and the resulting investment level would reflect fundamental economic conditions. So would equity prices.

On the other hand, to the extent that the risk premium is higher because of financial frictions, which may be the case according to our findings, there is an additional and non-fundamentally driven wedge between corporations' costs of investing and the level of monetary policy rates. For a given interest rate level, that can lead to a lower level of investments and a lower capital stock than what would have been the outcome without the financial friction. Equity prices would be too low for the level of interest rates. The implications for the real economy are large, and we hope this memo can stimulate further research on the topics.

Literature

Acemoglu, Daron and Pascual Restrepo (2018), The race between man and machine: Implications of technology for growth, factor shares and employment, *American Economic Review*, Vol. 108, No. 6.

Adolfsen, Jakob and Jesper Pedersen (2019), The natural real interest rate in Denmark has declined, *Danmarks Nationalbank Analysis*, No. 13, June.

Autor D, Dorn D, Katz LF, Patterson C, Reenen JV (forthcoming), The Fall of the Labor Share and the Rise of Superstar Firms, *Quarterly Journal of Economics,* Vol. 135 (2).

Bekaert, Geert and Marie Hoerova (2014), The VIX, the variance premium and stock market volatility, *Journal of Econometrics,* Vol. 183, pp. 181-192.

Blundell-Wignall, Adrian and Caroline Roulet (2013), Long-term investment, the cost of capital and the dividend and buyback puzzle', *OECD Financial Market Trends*, Vol. 2013, Issue 1.

Caballero, Ricardo J., Emmanuel Farhi and Pierre-Olivier Gourinchas (2017), Rents, technical change, and risk premia accounting for secular trends in interest rates, returns on capital, earnings yields, and factor shares, *American Economic Review: Papers and Proceedings 2017*, Vol. 107(5), pp. 614-620.

Daly, Kevin (2016), A Secular Increase in the Equity Risk Premium, *International Finance*, Vol. 19:2, pp. 179-200.

Damodaran, Aswath (2019), Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2019 Edition, *SSRN.*

Danielsen, Troels, Rasmus Mose and Casper Winter Nguyen (2017), Revisiting potential output in Denmark, *Danmarks Nationalbank Working Paper*, No. 111, February.

Danmarks Nationalbank (2019a), Monetary and Financial Trends, *Danmarks Nationalbank Analysis*, March 2019.

Danmarks Nationalbank (2019b), Monetary and Financial Trends, *Danmarks Nationalbank Analysis*, September 2019.

Duarte, Fernando M. and Carlo Rosa (2015), The Equity Risk Premium: A Review of Models, *Economic Policy Review*, Vol. 21, No. 2, December.

ECB (2018), Measuring and interpreting the cost of equity in the euro area, *Economic Bulletin,* June.

Fuller, Russell J., and Chi-Cheng Hsia (1984), A simplified Common Stock Valuation Model, *Financial Analysts Journal*, Vol. 40, No. 5, pp. 49-56.

Greenwood, Hanson and Liao (forthcoming), Asset Price Dynamics in Partially Segmented Markets, *Review of Financial Studies*.

Hall, Robert E. (2013), The routes into and out of the zero lower bound, *Proceedings – Economic Policy Symposium – Jackson Hole, Federal Reserve Bank of Kansas City*, pages 1-35.

Hall, Robert E. (2017), The Role of the Growth of Risk-Averse Wealth in the Decline of the Safe Real Interest Rate, *Working Paper*.

Hutchinson, John and Saint-Guilhem, Arthur (2019), The wedge between the return on capital and risk-free rates', *Bank de France Billet*, no. 104.

IMF (2019), Global Financial Stability Report, October.

Jorda, Oscar, Moritz Schularick and Alan M. Taylor (2019), The total risk premium puzzle, *Federal Reserve Bank of San Francisco Working Paper*, 2019-10.

KPMG (2019), Cost of capital study 2019, *available online*.

Mehra, Rajnish and Edward C. Prescott (1985), The equity premium: A puzzle, *Journal of Monetary Economics*, Vol. 15, No. 2, pp. 145-161.

Karabarbounis, Loukas and Brent Neiman (2018), Accounting for factorless income, *NBER Working Paper*, No. 24404.

Pedersen, Erik Haller; Adrian Michael Bay Schmith and Rasmus Rold Sørensen (2019): Globalisation affects measures of wage competitiveness, *Danmarks Nationalbank Analysis*, December.

PWC (2016), Værdiansættelse af virksomheder: Sådan fastlægges afkastkravet i praksis, in Danish, *available online*.

Sharpe, Steve and Gustavo A. Suarez (2014), Why isn't investment more sensitive to interest rates: Evidence from surveys, *FEDS Working Paper,* No. 2014-2.

The increasing equity risk premium is robust to earnings expectations and other model assumptions

<div align="right">Appendix 1</div>

The size of the estimate of the equity risk premium depends on the model specification and its inputs to and expectations for the companies' earnings per share. Below, we describe the sensitivity of the derived premium to the inputs and the model.

Robust to the choice of earnings expectations
We use equity analysts' earnings expectations (cf. Chart 3). Overall, the development in equity risk premium is very robust to the choice of expectations for earnings, cf. chart to the left. The equity risk premium is increasing when expected earnings per share growth in the medium run is assumed to reflect the realised growth in earnings per share, and also when growth in earnings per share is equal to the expectations for long-run potential growth.

Robust to the choice of the length of the periods with excess growth
The three-stage dividend discount model assumes that expected earnings growth is divided into three stages: In the first stage (short run), earnings growth is assumed to follow equity analysts' earnings expectations; in the second stage (medium run), earnings growth is an average of analysts' expectations and expectations for potential GDP growth; and in the third stage (long run), the expected earnings growth equals potential GDP growth. One crucial parameter in the model is the H parameter that captures the length of period with the different stages. More specifically, the H parameter equals the half-life period with 'excess' growth (i.e. growth higher than the potential). The choice of the H parameter does not seem to affect movements in the equity risk premium significantly after the financial crisis, cf. chart to the right.
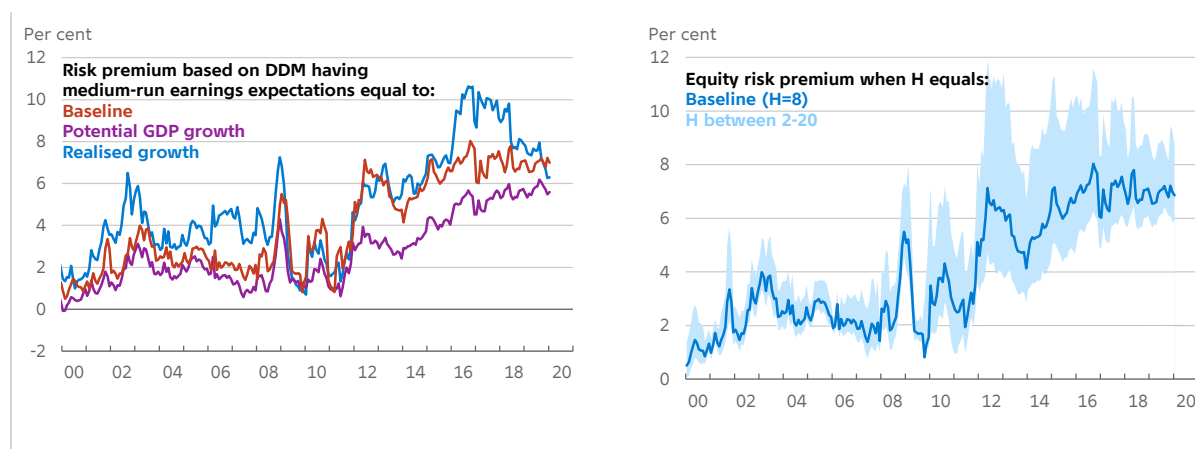
Changed industry composition does not explain the increase of the equity risk premium
The industry composition of Danish companies has been changing towards more advanced medical and biotech companies over the last decade. In general, these types of businesses are risky when it comes to the success of developing new products. A shift in the composition of companies towards riskier industries would explain a larger equity risk premium. However, the developments in the Danish equity risk premium cohere with the findings in the euro area and several other countries where the compositions of industries are completely different.

The equity risk premium is also robust to model approach and time-varying risk-free rates
We check whether the three-stage approximation of the dividend discount model leads to considerably different estimates of the equity risk premium due to asymptotic behaviour of the discount factor. However, estimating the implied equity risk premium by using the full earnings profile does not influence the results.[1] Another issue in the H model is that expected future dividends are not discounted along the yield curve. If we instead discount each of the first 10 years' expected dividends with 1 to 10-year overnight index swap rates, expected dividends 11-15 years ahead with 15-year swap rates and the remaining dividends with 20-year swap rates, we get a similar result.

Equity risk premium robust to earnings expectations (left) and length of excess growth period (right)

Note: 'DDM-model' = dividend discount model. The red line ('Baseline') is the one in Chart 3.
Source: Refinitiv Datastream, Danmarks Nationalbank and own calculations.

[1.] See also ECB (2018).

PUBLICATIONS

NEWS

News offers a quick and accessible insight into an Analysis, an Economic Memo, a Working Paper or a Report from Danmarks Nationalbank. News is published continuously.

ANALYSIS

Analysis from Danmarks Nationalbank focuses on economic and financial matter. Some of the analyses are published with a regular frequency e.g. *Outlook for the Danish economy and Financial stability*. Other analyses are published continuously.

REPORT

Report comprises recurring reports and reviews of the functioning of Danmarks Nationalbank. For instance Report includes the *Annual report* and the annual publication *Danish government borrowing and debt*.

ECONOMIC MEMO

Economic Memo is a cross between Analysis and Working Paper and it often shows the ongoing study of the authors. The publication series is primarily targeted at professionals and is solely available in English. Economic Memo is published continuously.

WORKING PAPER

Working Paper presents research projects by economists in Danmarks Nationalbank and their associates. The series is primarily targeted at professionals and people with an interest for academia. Working Paper is published continuously.