INTERNATIONAL MONETARY FUND

DENMARK

SELECTED ISSUES

June 2017

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June 2, 2017

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CONTENTS

TABLES

MIGRANT INTEGRATION IN DENMARK AND EUROPE: EVIDENCE USING MICRO DATA 18

FIGURES

TABLES

APPENDIX

DYNAMICS OF FIRM INVESTMENT IN DENMARK: ROLE OF LEVERAGE, DEMAND, AND KNOWLEDGE INTENSITY _____ 33

HOUSEHOLD BALANCE SHEET STRUCTURE IN DENMARK AND SENSITIVITY TO RISING RATES[1]

Households in Denmark have gotten considerably wealthier in recent decades. High household assets, in particular in the mandatory pension system and housing, provide stability by funding future consumption and protecting against shocks. The high, but mostly illiquid, assets have a counterpart, however, in the high household debt, as households often need to borrow to consume or buy property. The resulting combination of large assets and liabilities on household balance sheets make the Danish economy sensitive to interest-rate changes. Sudden increases in interest rates can create macroeconomic instability via their impact on the debt service of households and knock-on effects on consumption. Analysis of Danish microdata on household balance sheets shows a modest impact on consumption overall from a small rise in interest rates, but vulnerabilities are considerably larger for at-risk groups, such as households with high debt and adjustable-rate mortgages.

A.   The Assets and Wealth of Households in Denmark

1.   **Danish households have amassed considerable wealth in past decades, and fare favorably among advanced economies.** Having recovered from a temporary dip during the global financial crisis (when households had to use accumulated buffers to support consumption in the face of declining incomes), the net wealth of Danish households reaches close to 600 percent of gross disposable income (or about 300 percent of GDP) as of 2015, well above many other advanced economies (Figures 1 and 2).[2] This is partly the result of sound long-term macroeconomic policies aiming at promoting greater pension coverage while increases in the prices of houses and other assets also play a role.

Figure 1. Household Net Wealth in Denmark and Elsewhere[1]
(Percent of gross disposable income)
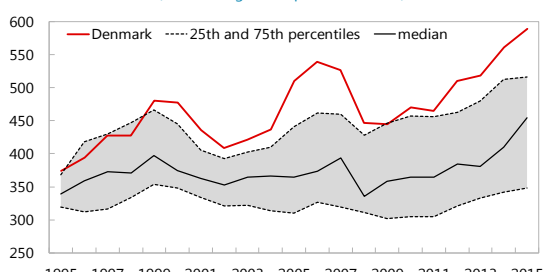
Source: OECD.
1. Countries comprise Austria, Belgium, Czech Republic, Estonia, Finland, France, Germany, Hungary, Italy, Korea, Latvia, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Sweden, UK, and US.

Figure 2. Danish Household Assets and Net Wealth
(Percent of gross disposable income)
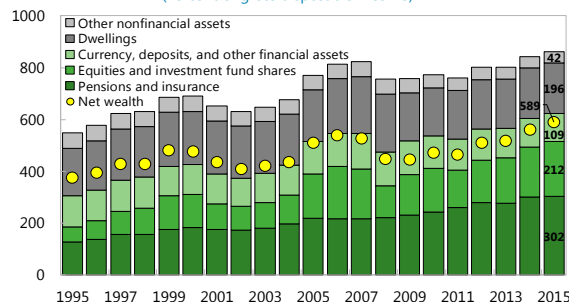
Source: OECD.
Note: Green bars are financial assets, and gray bars are nonfinancial assets. Net wealth is assets minus liabilities (not shown).

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[2] Throughout this paper, households refer to the national accounts sectors households and non-profit institutions serving households.

2.   Danish household assets are concentrated in pensions and nonfinancial assets, in particular real estate. As collective pension schemes took shape (Box 1), the pension and insurance savings of Danish households have been increasing steadily in recent decades. They amounted to almost 300 percent of disposable income in 2015 and make up half of households' financial assets and over a third of their total assets (Figure 2). Real estate property assets are another substantial component of wealth for households at nearly 200 percent of gross disposable income in 2015 (nearly 100 percent of GDP).

3.   While Danish households have built large assets, this contrasts with a low measured household savings rate. Indeed, while household's accumulated savings and assets in Denmark are large, the gross household savings rate has historically been low compared to peer economies. Box 2 discusses this discrepancy. The measurement issues and possible identification challenges relating to the savings of the nonfinancial corporate sector may be contributing to the discrepancies between the flow and stock indicators. Valuation effects may also play a role.

Figure 3. Financial Assets and Financial Net Wealth
(Percent of gross disposable income, latest available annual data)

Source: OECD.

Figure 4. Household Debt
(Percent, latest available annual data)

Source: OECD.
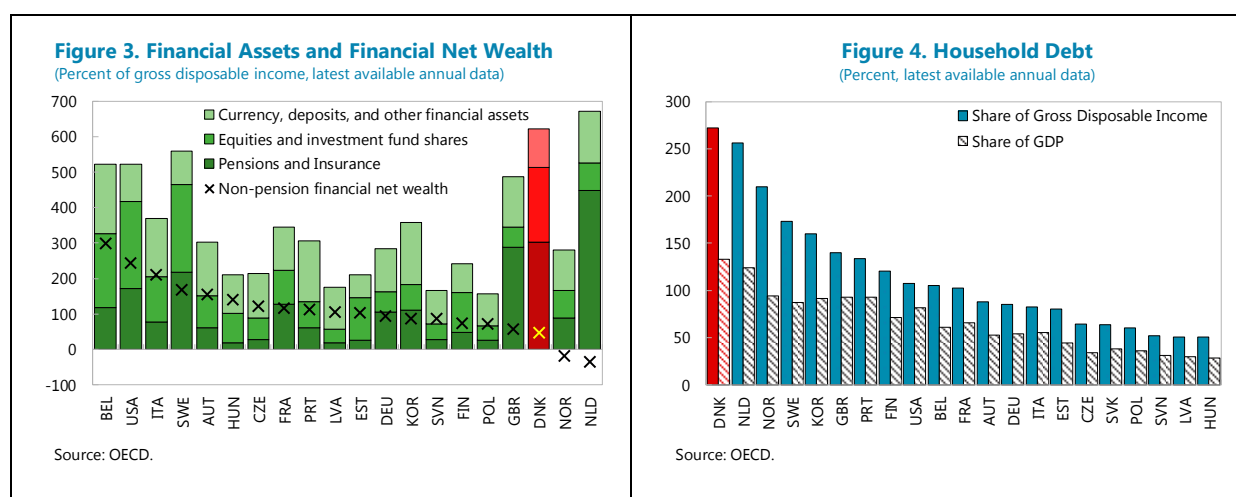
4.   High household assets in Denmark have a counterpart in high household debt. Households in Denmark, and other northern European economies, tend to have a low share of their wealth in liquid instruments, such as deposits and portfolio investments (Figure 3). An unintended consequence of having a large share of illiquid assets is that it leads households to borrow more than they would otherwise to consume or acquire assets (such as property). The result is high household debt and balance sheet leverage (Figure 4). This is consistent with the *life cycle hypothesis*, which posits that household income and consumption patterns differ over the life cycle. Households raise debt early in their lives to finance consumption, then they accumulate net savings by paying down debt and paying into pensions, and finally they reduce their net wealth by drawing on their pension savings. Isaksen et. al. (2011a and 2011b) estimate that for every 100 kroner increase of pension wealth, household debt rises by 30–40 kroner.

Box 1. The Pension System in Denmark

Denmark, as many other European countries, has adopted a three-pillar pension system. The first pillar—which is mandatory—is tax-funded and includes the basic state retirement scheme. The second, and biggest, pillar comprises collective occupational pension schemes (also mandatory for most labor-market plans), and the labor market supplementary pension (ATP).[1] The third pillar comprises voluntary, private, savings-based pensions, typically managed by private insurance companies and banks. For more information, see Kramp et. al. (2012), and IMF (2014).

Figure 1.1. Pension Contributions and Payouts
(Percent of GDP)

Sources: ADAM; and Statistics Denmark.
Note: Net contributions are adjusted for the early taxation of capital pensions after 2013.

Contributions to labor market pensions outpace payouts consistently. During the catch-up phase of savings contributions were on a steady increasing path, climbing up to 6.7 percent of GDP before the financial crisis. Net contributions have been tempered somewhat in recent years due to technical reasons, such as early taxation incentives introduced in 2013, but are expected to resume and remain high for the next few decades (see Autrup et. al., 2015).

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[1] There is some debate as to whether the ATP pension fund should be classified under pillar I or II, or be given its own classification, given its hybrid nature. Here we follow the designation of Kramp et. al. (2012).

Box 2. The Puzzle of High Household Assets Accumulation and the Low Savings Rate

The gross household savings rate in Denmark, as measured in the national accounts, is low compared to other advanced economies (Figure 2.1). Yet Danish households have amassed high pension wealth at almost 150 percent of GDP (or 300 percent of gross disposable income; see Figure 2) as well as large housing and equity wealth.[1] There are several potential explanations for the apparent discrepancy both between countries, and between the flow and stock indicators.

Figure 2.1. Gross Household Savings Rate
Percent; average 2007-2015

Source: OECD.
Note: Gross household savings rate = gross savings/(gross disposable income + change in net equity of pension fund reserves).

Cross-country comparisons of household savings rates are not straightforward. Even when the underlying consumption and saving behaviors of households are similar, various factors may affect the direct comparison of savings rates (see for example Rocher and Stierle, 2015). For instance, differences between tax systems can affect the comparability of household disposable incomes, and hence their savings.

_____

[1] Household savings are a flow indicator from the national accounts, while pension wealth is a composite stock indicator constructed from the financial (flow of funds) accounts.

Box 2. The Puzzle of High Household Assets Accumulation and the Low Savings Rate
(concluded)

Similarly, the recordation of pension savings and social security contributions in the national accounts can differ from country to country and affect the comparability of disposable incomes and savings. Recent research by Statistics Denmark staff (Osterwald-Lenum, 2017) argues that the actual household savings rate could be as much as eight percentage points higher when adjustments are made for Denmark-specific effects related to pension contributions, taxes, and imputed rents in the calculation of household consumption.

In Denmark, it is also difficult to draw a clear line between household and corporate savings. There is evidence that part of the very high corporate savings (Figure 2.2) in Denmark may effectively reflect household savings (Autrup et al., 2015). Several of the biggest firms in Denmark are owned by households, often via foundations, which are classified as nonfinancial corporations for the purposes of national

accounting. In addition, sole proprietorships and owners of small and medium enterprises, tend to invest their savings in their businesses. For tax reasons, owners of firms often opt to retain the firms' profits as retained earnings, rather than distribute them as dividends. In other cases, firms can buy back their own stock which also has the effect of increasing the value of the firm, and creating capital gains to their owners. The Danish central bank estimated that on a national level the effect of capital gains for households, possibly reflecting such operations, reached over DKK 3 trillion through 2014.

Figure 2.2. Savings of Household and Nonfinancial Corporate Sectors in Denmark
Percent of GDP

Source: Statistics Denmark.

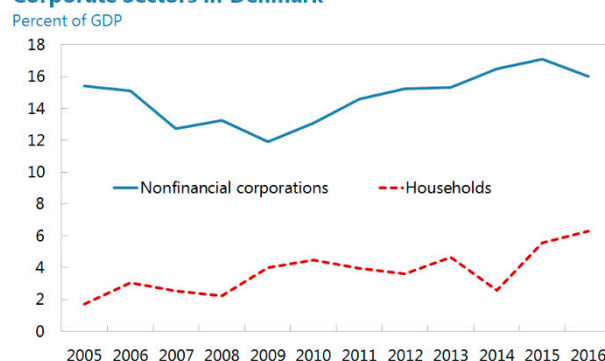**The treatment of pension capital gains and tax incentives can also affect the savings rate.** Capital gains on pension wealth are not included in the calculation of disposable income in Denmark, but pension-yield tax is (via current taxes). An additional complication is that Danish households were given the option in 2013 to pay taxes early on their future pension payouts and at a discount, which affected the measurement of net contributions.

Valuation effects may also be at play. The role of valuations can also make the comparison between household financial assets (stocks), and savings rate (flows) difficult.

5.   **From the perspective of pension funds, household debt serves as an important component of their investment portfolio.** Household's pension contributions and insurance premiums are invested in mortgage-related debt. Pension funds and insurance firms held DKK 747 billion of covered mortgage-credit bonds in 2016 (about a quarter of the outstanding stock), equivalent to 13 percent of monetary financial institution (MFI) assets (Figure 5), from DKK 240 billion (ten percent of the outstanding stock) in 2010.

6.   **The large supply of savings and high demand for household credit is mirrored in the size of Denmark's financial sector.** Banks and mortgage credit institutions utilize the covered bond market to fund their assets. As there are no options to offload housing loans from their balance sheet, their assets have grown substantially to reach 380 percent of GDP in 2015 (Figure 6).

Figure 5. Holdings of Mortgage-Covered Bonds Issued by MFIs
(Percent of monetary financial institution (MFI) assets)
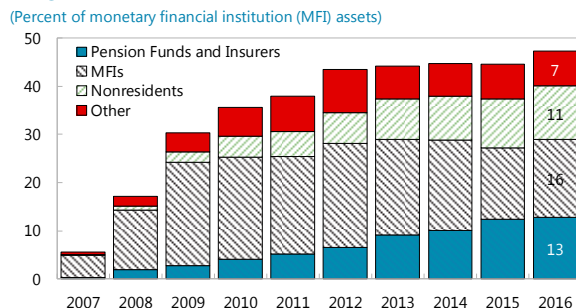
Source: Statistics Denmark.
Note: Pension fund and insurers' holdings include indirect holdings through investment funds.

Figure 6. Unconsolidated Bank Assets
(Percent of GDP, 2015)
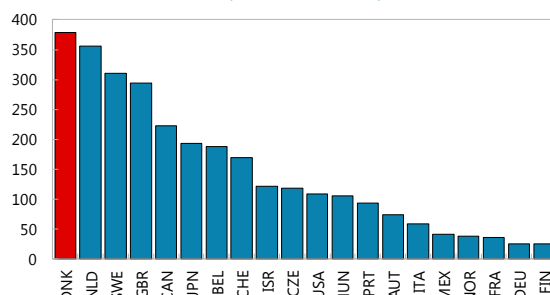
Sources: Danmarks Nationalbank; OECD; IMF International Financial Statistics; and IMF staff calculations.
Note: The figure for Denmark includes banks and mortgage credit institutions.

B.   Large Assets and Liabilities: Benefits and Drawbacks

7.   On a national level, high household savings reduce fiscal and macroeconomic risks. Pension savings provide stability by funding future consumption, and buffer against shocks. Moreover, large household wealth contributes to fiscal sustainability by reducing the burden on the public sector, and lessen the need to borrow to fund future liabilities. In addition, because households fund future expenditures with current savings, there is less need for higher taxes in the future, which improves business confidence. Unlike in many other countries, on current projections, Danish public finances are robust to aging and it is expected that no major fiscal adjustment will be needed when aging peaks.

8.   Investment can boost financial wealth. Borrowing to invest or purchase property can accelerate wealth creation, if the relative return on the debt-funded investment to the cost of borrowing is positive (such as during housing price rises). This is contingent on an eventual reduction of the debt load, which is important for Denmark because of the relatively low amortization rates of housing debt.

9.   More types of assets can diversify household balance sheets. Holding various diverse types assets, such as real estate, equity, and pension claims, diversifies the net wealth of households, and reduces volatility of their balance sheets. Relative price stability of real estate properties over time, and their low long-term correlation to financial assets have been shown to reduce volatility of the financial wealth of households (see for example Table 3.1 of Chapter 3 of the Global Financial Stability Report (IMF, 2005)).

10.   But the large financial assets and liabilities of households also make the economy more sensitive to interest-rate changes and can pose macroeconomic risks. High household leverage can amplify vulnerabilities in case of shocks. Shocks to household consumption may for instance arise from declines in property prices (which reduce wealth) and/or increases in interest rates (which raise debt servicing costs). During the global financial crisis, house prices in Denmark fell by more than 20 percent in aggregate real terms, and contributed to the significant hit to

domestic demand and household consumption (Figure 7). Confidence effects can also become a drag on growth as investment is held back during deleveraging.

11.   High household debt can also pose risks to the financial sector, although at present banks are sound and have considerable buffers. Danish financial institutions are liquid, well-capitalized, with regulatory capital amounting to nearly 20 percent of risk-weighted assets, and have set aside adequate buffers to withstand reasonable increases in nonperforming loans to the household sector. In recent stress tests, the Danish central bank concluded that risks to the financial system were small from even a severe recession, owing their large excess capital, and the households' strong repayment capacity due to the generous social safety net (see Danmarks Nationalbank, 2016). Nevertheless, there are concerns about funding risk, particularly for financial institutions funded by short-term mortgage bonds that then finance adjustable-rate mortgages.

Figure 7. Household Leverage and Consumption
(Percent)

Source: Riksbank Financial Stability Report (H1 2015).
Note: Consumption is real private consumption per working-age capita.
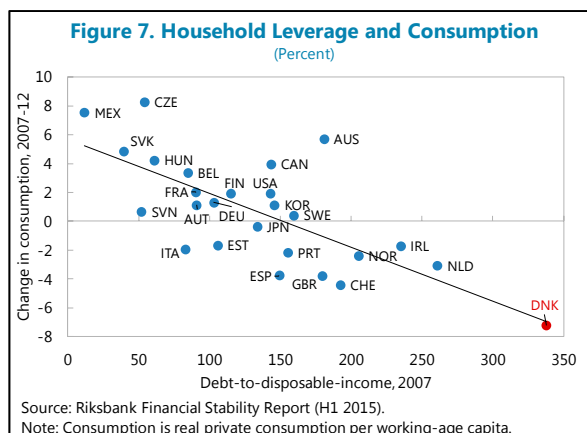
C.   The Effect of Higher Rates on Household Consumption

12.   A sustained rise in interest rates could have a significant impact on consumption. Rising interest rates are expected to have an immediate increase of the interest expense of households, as currently 60 percent of outstanding mortgages in Denmark are adjustable-rate (Figure 8). Mortgage payments could rise rapidly, as some floating-rate mortgages reset every three or six months, which has the potential to chip away a large portion of households' disposable income and reduce consumption. This is particularly important in the current period of low interest rates that has afforded households the lowest debt-service ratio in the last two decades, and large purchasing power (Figure 9).

13.   We evaluate these risks with a rich household-level database containing detailed balance sheet information. The microdata gathered by Statistics Denmark include income, debt, and wealth information on individuals residing in Denmark, which are aggregated to the family level akin to Andersen (2016), and they allow for tracking individuals over time. Information on their age and geographic region of residence is also provided.

14.   Vulnerabilities are not evenly distributed across households. The median net-debt-to-income level for households in the first 5 income deciles is around zero—a positive attribute. The households with higher debt relative to their income are generally wealthier, with the median debt-to-income ratio of the tenth income-decile households (that is, households with the highest 10 percent of incomes) at 256 percent (Figure 10). Of households in the first 3 deciles of income, that is, households with 30 percent of the lowest incomes, about half have no debt. The tail of

households with high debt-to-income (75th to 90th percentiles) generally increases with the higher income

Figure 8. Stock of Residential Mortgages by Type
(Billions of Danish kroner)
Source: Danish Financial Supervisory Authority.
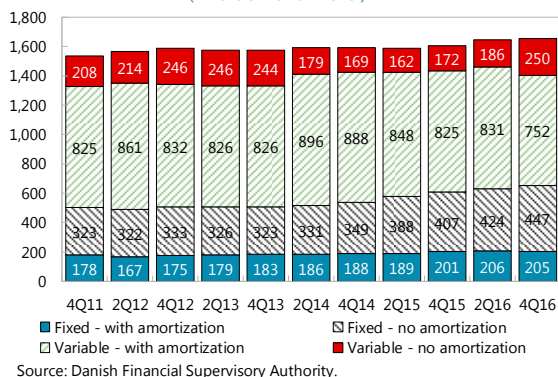
Figure 9. Household Interest Paid
(Percent of gross disposable income)
Source: Statistics Denmark.
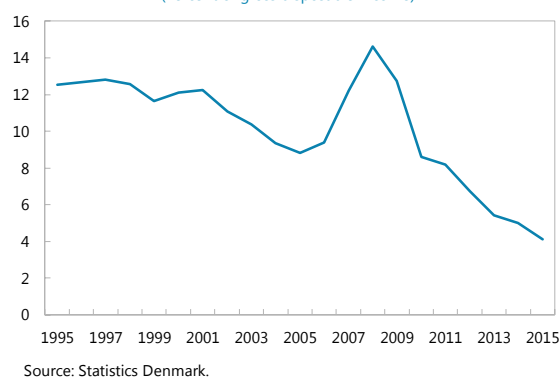
cohorts, however there is a notable outlier in the households of the second decile with debt-to-income reaching 430 percent for the most indebted households in this income group. Netting financial assets from debt (Figure 11), reduces this outlier somewhat, but it continues to suggest a pocket of vulnerability. This may reflect proportionally larger borrowing by young households (first-time homebuyers), in anticipation of higher future income. Households with larger debt relative to the value of their home also have higher net debt-to-income (Figure 12). For instance, the median net debt of highly leveraged households (loan-to-value above 80 percent) is over 320 percent of their income, making them particularly vulnerable to house price declines.

Figure 10. Household Debt Distribution[1]
Percent of income after tax
Source: Danmarks Nationalbank using registry data from Statistics Denmark.
[1] Over approximately 2.2 million household observations.
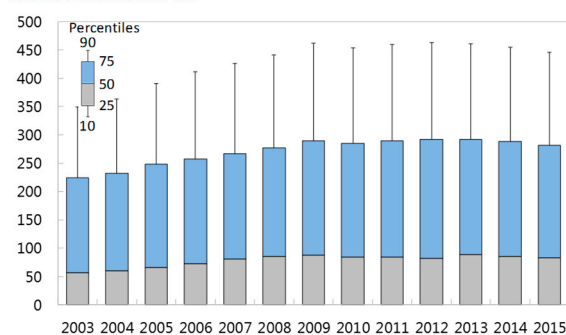
Figure 11. Household Net Debt per Income Decile[1]
(Percent of income after tax, 2015)
Source: Danmarks Nationalbank using registry data from Statistics Denmark.
[1] Net debt is debt minus financial assets plus pension savings.

Figure 12. Household Net Debt per LTV Group[1]
(Percent of income after tax, 2014)

Figure 13. Household Net Debt per Mortgage Type[1]
(Percent of income after tax, 2014)

Source: Danmarks Nationalbank using registry data from Statistics Denmark.
[1] Net debt is debt minus financial assets plus pension savings.

Source: Danmarks Nationalbank using registry data from Statistics Denmark.
[1] Net debt is debt minus financial assets plus pension savings.

15.   Households with adjustable-rate mortgages also have more debt. Within households that have outstanding mortgages, the debt-to-income of households with adjustable-rate mortgages is considerably higher than the ones with fixed-rate mortgages with median levels of 225 and 290 percent respectively, for the most recent year reported (Figure 13). This creates a particular vulnerability to rising rates. In addition, Kuchler (2015) also reports a higher share of interest-only loans held by families with high loan-to-value ratios.

Model Formulation

16.   The effect of higher rates on household consumption is modeled at the individual household level. Following Andersen (2016), we estimate the annual consumption c for each household for a given year from the equation

$$c = y - s,$$

where y is the observable annual disposable income, and s are the unobservable savings. The savings variable s is approximated by the annual changes of the values of the household's holdings of assets (such as deposits, investments, pensions, and housing properties), and liabilities (such as mortgage loans).[3] The simulation of the impact of higher rates on consumption is performed on both assets and liabilities, as well as on the disposable income to account for the difference in taxes (on the individual level before being aggregated to the household level). The DKK 50,000 threshold for interest-rate deductibility (DKK 100,000 for couples) is also applied on the household level to calculate the effect on disposable income.

17.   The simple assumptions for the repricing of liabilities and interest income are meant to provide a range of possible outcomes for the period of higher rates. Since the individual

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[3] Special considerations are given to households with real estate transactions, which are excluded for the year of the purchase or sale, but are included in the sample again the following year. For more information on the methodology and measurement issues we refer to Andersen (2016).

household mortgage information is available, we calculate the change in mortgage payments, from the increase in the borrowing rate on the debt service as

$$\text{payment}_{new} - \text{payment}_{old} = \text{principal}_{ARM} * \Delta r^{new, ARM} + \alpha * \text{principal}_{FRM} * \Delta r^{new, FRM},$$

where principal_{ARM} and principal_{FRM} are the outstanding principal of any adjustable- and fixed-rate mortgages of the household on the given year, respectively; $r^{new, ARM}$, $r^{new, FRM}$ are the new effective interest rates on any adjustable- and fixed-rate mortgages, respectively; and α (α in [0, 1]) is the coefficient to model the effect of the higher borrowing rates on future refinancings into fixed-rate mortgages and new fixed-rate mortgages. The α coefficient models the effect of higher borrowing rates on the stock of fixed-rate mortgages, and can be thought of as a passthrough indicator. Reasonable values for α can vary considerably, depending on the time horizon of the analysis, and the longer the sensitivity period, the higher the passthrough. In what follows, we assume that the increase of $r^{new, ARM}$ is equal to the increase of the overall borrowing rate (i.e., one-to-one effect), and the increase of $r^{new, FRM}$, α, is 0.25 times the increase of the overall borrowing rate, unless is otherwise noted. A 0.25 passthrough is admittedly a low figure for fixed-rate mortgages, and it offers a conservative estimate for the effects of higher rates. Interest income is also modeled via an increase to bank deposit rates.

18.   Banks may be slow to raise rates on their deposits following many years at zero interest-rate bound. It is reasonable to assume that interest-rate increases would not be mirrored on deposit rates one-to-one initially, especially after the many years of deposit rates being stuck at the zero lower bound, despite negative policy rates. An exception would be deposits that are linked to loan account which carry the same rate as the loan, but these cannot be identified by the microdata. As a result, the two sets of results presented below are meant to serve as range of estimates for the true impact of rising rates on consumption. In its current formulation, the effect of interest rates is reflected both via the cashflow channel, with the income effect being modeled only through the savings account.

19.   The effect of rising interest rates on consumption can be approximated via the reduction of the disposable income. It is straightforward to convert to consumption using one's estimate for the households' marginal propensity to consume. For example, a marginal propensity to consume equal to 1 would imply a one-to-one passthrough from disposable income to consumption, which would serve as an upper bound of the consumption response from changes in income. Reasonable estimates for the marginal propensity to consume range from 0.5 to 0.8, but given that the consumption data in the microdata refer to total consumption, which include autonomous consumption (such as fixed spending in utilities, housing expenditures, and more), higher values for the sensitivity of consumption to disposable income may be more realistic. For the sake of presentational simplicity, the results below are presented directly as the impact on consumption assuming 0.8 passthrough of income to consumption. Annual data end in 2014, and thus do not show the effect of the 7 Best Practices or the mortgage diamonds.

Results of Sensitivity Analysis

20.   The median sensitivity of household consumption to rising rates is modest. A 100 basis points (bps) increase of the borrowing rate decreases consumption by 0.71 percent for all households when allowing for interest income effects from bank deposits, and assuming 0.25 passthrough to fixed-rate mortgages (Table 1). This implies a hit to consumption that would detract 0.3 percentage points from annual GDP,[4] but when rates increase from the current very low rates, it is likely that banks will be slow to raise deposit rates given the long period of negative policy rates. In that case, ignoring interest income effects, the impact of the 100 bps increase of the borrowing rate decreases consumption by 1.03 percent (equivalent to 0.5 percentage points of GDP). When considering the effect of the rate rise only on households with debt, the sensitivity increases to 1 percent (including interest income effects) or 1.26 percent (excluding interest income effects; see Table 1). The mean reduction for all households is 0.62 percent (equivalent to 0.3 percentage points of GDP) factoring in the revaluation of bank deposits, and it increases to 0.98 percent when considering only households with outstanding debt. Similarly, when the effect of bank deposits is excluded, the mean decline of consumption for all households is 0.94 percent (thereby removing 0.4 percentage points of GDP), and 1.24 percent among households with debt. Given the large share of private sector consumption and investment in Denmark's economic output, sudden and prolonged shocks to interest rates can become macro-critical if they are not accompanied by offsetting increases to income such as via higher wages. In other words, the preconditions for the interest rate increase can mean very different outcomes for growth.

21.   The sensitivity of consumption to rate rises increases considerably for groups at risk. The simulation results presented in panels C–F of Figure 14 (which include the interest income channel and are therefore lower estimates for the impact on consumption) suggest that vulnerabilities are modest for most households, but substantial for specific groups. Higher leverage, as measured by loan-to-value (LTV) increases the sensitivity of consumption with respect to rates, with the median drop in consumption greater than 1 percent for households with LTV above 60 percent. While the majority of households has debt-to-income (DTI) below 100 percent, and thus smaller sensitivity of consumption to rising rates, the median consumption decline for households with debt-to-income (DTI) above 200 percent is over 1 percent, with the highly-indebted households (DTI greater than 400 percent). This makes highly-indebted households (accounting for 13 percent of households) very sensitive to rate increases with the median consumption drop over 2 percent. It is also worth noting the long right tail of households with a strong consumption response in the second decile of income in panel D, consistent with Figure 10 above. Households with their oldest family member in prime working age (30–59) display a higher sensitivity to interest rates, as expected, but older households (older than 65 years) have low sensitivity to rising rates, given their higher savings.

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[4] Assuming 47.5 percent private consumption as a share of GDP as in recent years.

D. Conclusions and Policy Implications

22.   Rising interest rates can impact consumption, especially of highly-indebted households. While the sensitivity of consumption to rising rates is modest for most households, there are pockets of vulnerability where the impact is substantial. The effect of rising rates is likely to affect liabilities faster than it will benefit households through returns on their savings, given the prolonged period of negative policy rates and banks' decision to hold a zero-lower bound on deposits. Even including the offsetting benefit of interest income from bank deposits, the hit on consumption from a rise in rates can become substantial for households with large debt stocks, like ones with loan-to-value above 60 percent, or debt-to-income ratios of 300 percent and higher.

Table 1. Denmark: Decline in Consumption from 100 bps Interest Rate Increase (Including Interest Income Effects, Unless Otherwise Noted)						
	No passthrough to Fixed-Rate Mortgages		0.25 passthrough to Fixed-Rate Mortgages		0.25 passthrough to Fixed-Rate Mortgages (no interest income)	
	Only households with debt	All households	Only households with debt	All households	Only households with debt	All households
Total	0.90	0.63	1.00	0.71	1.26	1.03
Mean	0.89	0.55	0.98	0.62	1.24	0.94
1st decile	-0.38	-0.66	-0.25	-0.59	0.01	0.00
1st quartile	-0.03	-0.18	0.01	-0.13	0.14	0.00
Median	0.30	0.06	0.40	0.12	0.59	0.26
3rd quartile	1.30	0.87	1.39	0.98	1.63	1.20
9th decile	2.70	2.30	2.79	2.38	3.04	2.60
Source: Authors' calculations.						

23.   The authorities have taken measures to keep housing prices and household debt in check. In particular, the authorities introduced a "supervisory diamond" for mortgage credit institutions in 2015, and lending guidance to institutions in areas with the fastest price growth via the Seven Best Practices. More recently, in line with staff advice, the DN and the Danish Financial Supervisory Authority (DFSA) have also begun examining additional macroprudential tools and the Systemic Risk Council (SRC) in April 2017, adopted a recommendation that the government caps variable-rate and interest-only loans in the Copenhagen and Aarhus areas to four times the borrowers' income.

24.   Additional measures could contain help debt accumulation and prepare households for rising interest rates. Given the configuration of household balance sheets, comprising large assets and large debt, policies need to manage the risks from asymmetric hits from higher rates and lower housing prices. Specific policies may include:

- **Macroprudential policies:** The proposed debt-to-income limit by the SRC is an important measure that can help provide a circuit breaker in case of unsustainable housing price increases and debt accumulation. However, a more general cap could apply to all loans, irrespective of the loan terms, possibly with tighter limits for interest only and variable rate instruments. Raising the recently introduced down payment requirement to at least ten percent, can help shield households from excessive indebtedness. Raising the recently introduced down payment

Figure 14. Distribution of the Decline in Consumption from 100 bps Interest Rate Increase
(Including Interest Income Effects, Unless Otherwise Noted)

A. Overall (Excluding Interest Income Effects)
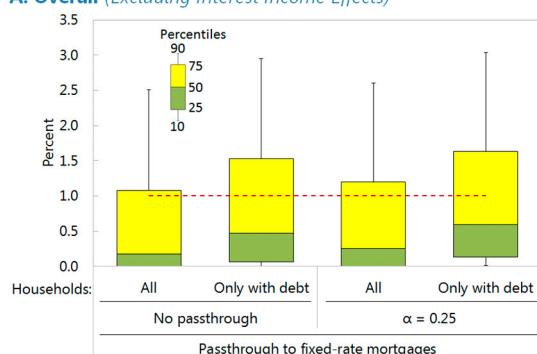
Source: Authors' calculations.

B. Overall (Including Interest Income Effects)
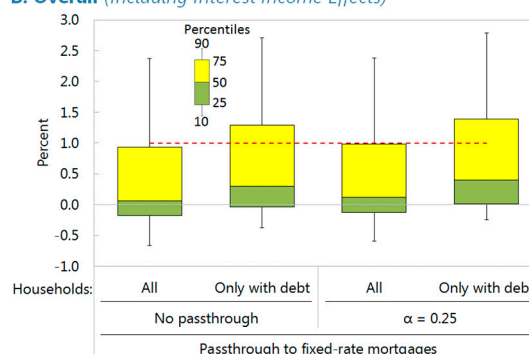
Source: Authors' calculations.

C. By Loan-to-Value Ratio[1]
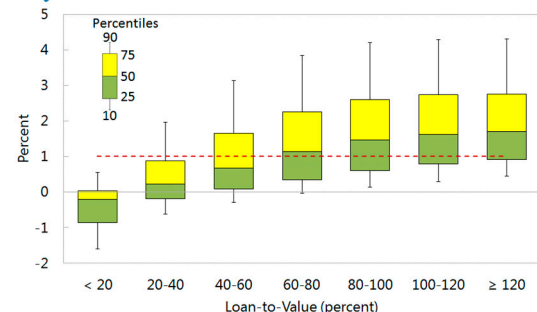
Source: Authors' calculations.
[1] Assuming α = 0.25 for the passthrough to fixed-rate mortgages. Only households that own homes and have debt are considered.

D. By Income Decile[2]
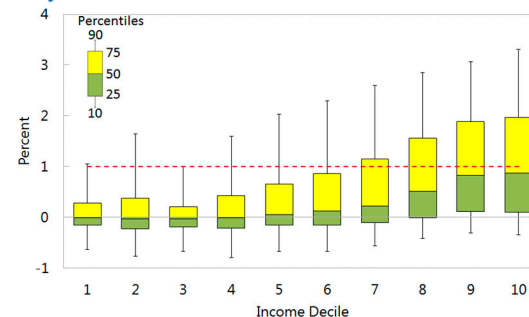
Source: Authors' calculations.
[2] Assuming α = 0.25 for the passthrough to fixed-rate mortgages. All households are considered.

E. By Debt-to-Income[3]
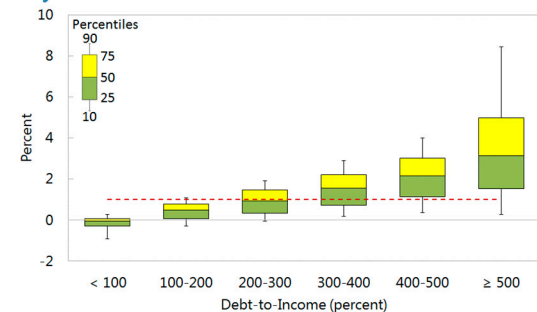
Source: Authors' calculations.
[3] Assuming α = 0.25 for the passthrough to fixed-rate mortgages. All households are considered.

F. By Age of the Household's Oldest Family Member[4]
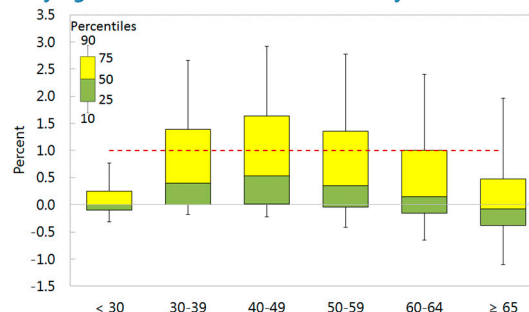
Source: Authors' calculations.
[4] Assuming α = 0.25 for the passthrough to fixed-rate mortgages. All households are considered.

The red dashed lines correspond to the level of 1 percent (100 bps) for ease of comparison with the size of the interest-rate increase.

requirement to at least ten percent, can help shield households from excessive indebtedness. Minimum amortization requirements could also be considered. For example, Sweden requires that borrowers make annual payments of at least 1 percent of the principal for mortgages with LTV over 50 percent and 2 percent for those with LTV above 70 percent. To further reduce risks from variable interest rates, the authorities should consider tightening the guidance in the mortgage diamond by further reducing the maximum share of such loans in banks' portfolios.

- **Tax policies: mortgage interest deductibility:** The broad housing recovery and current low interest rates provide an opportune moment for reducing the tax deductibility of mortgage interest expenses and for further lowering, beyond what is currently planned, the value of the deduction for interest expenses from income taxes. Homeowners in Denmark are already exempt from capital gains taxes on the sale of their primary residence, and further lowering mortgage interest deductibility—or phasing it out entirely as in Ireland and Spain—can help reduce the debt bias in the tax system.

Table 2. Denmark: Current Mortgage Interest Deductibility from Personal Income Taxes

	Denmark	Finland	Ireland	Netherlands
General rule	32.7 percent	45 percent capital income deduction in 2017; 35 percent in 2018; 25 percent in 2019 and thereafter	Until 2017: Up to 30 percent for first-time homebuyers, and up to 15 percent for others. 2018 and onward: 0 percent	100 percent for pre-2013 loans; 100 percent for post-2013 fully amortizing loans (within 30 years)
Caps/notes	Reduced to 27 percent in 2017 for annual mortgage interest expense over DKK 50,000; 26 percent in 2018; 25 percent in 2019 and thereafter	30 percent deduction of the excess interest expense over capital income against income tax, up to EUR 1,400 per year (32 percent for first-time homebuyers)	Deductibility varies by origination date (only 2004-12), and borrower's marital status	The maximum tax rate that mortgage interest can be deducted decreases by 0.5 points annualy from 52 percent in 2013, to 38 percent in 2042 (50 percent in 2017)

	Norway	Spain	Sweden	United Kingdom
General rule	100 percent (full deduction)	0 percent for properties purchased after Jan 1, 2013	30 percent	0 percent
Caps/notes		15 percent deduction up to EUR 9,040 per year, for properties purchased before Dec 31, 2012	Reduced to 21 percent for annual mortgage interest expense over SEK 100,000	Mortgage interest relief at source abolished in 2000

Sources: National tax and other authorities; Bourassa et al. (2013); Smidova (2016).

References

Andersen, A. L., Duus, C., and Jensen, T. L. (2016). "Household debt and spending during the financial crisis: Evidence from Danish micro data," *European Economic Review*, 89, issue C, 96–115.

Autrup, S. L., Kramp, P. L., Pedersen, E. H., and Spange, M. (2015). "Balance of Payments, Net Foreign Assets and Foreign Exchange Reserve," *Danmarks Nationalbank Monetary Review*, 4th quarter, 39– 54.

Bourassa, S. C., Haurin, D. R., Hendershott, P. H., and Hoesli, M. (2013). "Mortgage Interest Deductions and Homeownership: An International Survey," *Swiss Finance Institute Research Paper*, No. 12–06.

Danish Economic Councils (2008). "Danish Economy" (*in Danish)*, Chapter 2, Spring.

Danmarks Nationalbank (2016). *Financial Stability*, 2nd Half, December.

IMF (2005). *Global Financial Stability Report,* Spring (Washington)

———, (2014). *Denmark: Selected Issues,* IMF Country Report No 13/332 (Washington)

Isaksen, J., Kramp, P. L., Sorensen, L. F., and Sorensen, S. V. (2011a). "Household Balance Sheets and Debt—an International Country Study," *Danmarks Nationalbank Monetary Review*, 4th quarter, part 1, 47–58.

———, (2011b). "Household Balance Sheets and Debt—an International Country Study," *Danmarks Nationalbank Monetary Review*, 4th quarter, part 2, 39–81.

Kramp, P. L., Lohff, J. L., and Maltbaek, J. P. (2012), "Pension Savings," *Danmarks Nationalbank Monetary Review*, 1st quarter, part 1, 101–117.

Kuchler, A. (2015). "Loan types, leverage, and savings behavior of Danish households," *Danmarks Nationalbank Working Papers*, no. 97, September.

Osterwald-Lenum, M. (2017). "Households' disposable income, consumption and savings, and corresponding consumption rate and savings rate." (English translation of title of), Working paper in Danish (code: MOL07417; latest revision 12, as of May 8, 2017), Division of Economic Models, Statistics Denmark.

Smidova, Z. (2016). "Betting the house in Denmark," *OECD Economics Department Working Papers*, No. 1337, OECD Publishing, Paris.

MIGRANT INTEGRATION IN DENMARK AND EUROPE: EVIDENCE USING MICRO DATA[1]

This paper provides evidence on historical patterns of migrant integration in Denmark and Europe using a rich dataset and unified empirical framework. Employment gaps between natives and migrants in Denmark are persistent after many years of residence, in particular for nonwestern migrants, but their integration over time appears more effective in Europe. Upon arrival, female migrants exhibit wider initial employment gaps relative to natives compared with male migrants but they catch-up faster over time. Our findings also indicate that domestic education of migrants is important for successful integration. The extent of migrant education in Denmark is lagging the average for other European countries, suggesting room for improvement.

A. Introduction

1. **The refugee surge in Europe has subsided, but integrating the large stock of refugees and other immigrants remains challenging.** In Denmark, unemployment among the foreign-born is high and it is most pronounced for non-EU migrants. For integration policy to be most effective, it is important to understand historical patterns of integration in receiving countries.

Figure 1. Unemployment among the Foreign Born

Unemployment Rates of Foreign-Born Persons
(Percent of respective cohort)

Sources: Eurostat and Fund staff calculations.
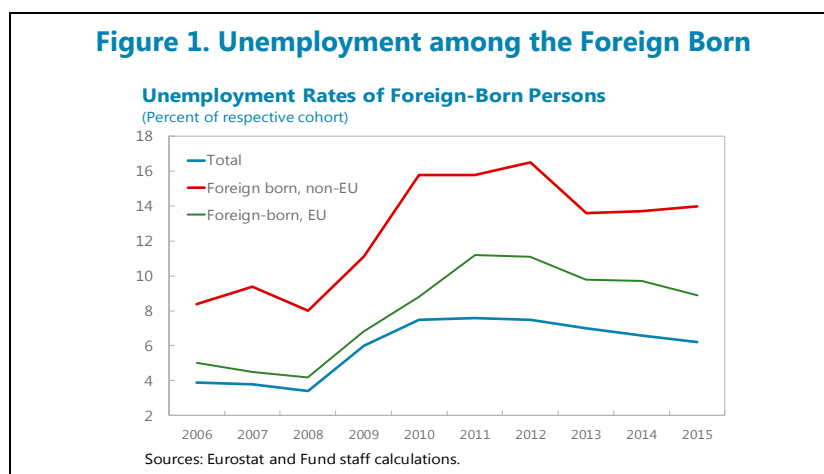
2. **This paper addresses three main research questions related to labor market outcomes for migrants in Denmark and Europe at large:**

- How successfully do migrants integrate in the labor market in Denmark and in Europe?

- How does integration speed in Denmark compare with other countries?
- What is the role of education in improving the probability of having a job?

3.   To answer these research questions, this paper first explores in section B the micro data from the Labor Force Survey (LFS) by Eurostat. Then, section C lays out the empirical framework and section D illustrates the baseline results for Denmark and Europe. Section E presents examines the role of foreign and domestic education in improving migrant employment probability. Section F concludes.

B.   A First Look at the Micro Data

4.   Eurostat's LFS is an extensive database with large coverage of European countries spanning all the way back to 1983, with rich information both at the individual and household levels.[2] Key variables of interest include country of birth, age, education, marital status, labor market status, employment characteristics, and survey year. For migrants—whom we identify by country of birth—the length of residency in the receiving country is also of prime relevance. The limitations of the dataset are that it does not allow tracking individuals over time; data on wages or income are missing; it lacks information on language skills; and data for Germany are not provided.

5.   In this section, we first provide descriptive statistics for the latest survey year (2014), followed by summary descriptive charts on labor integration outcomes based all survey years considered in the empirical section (2010–2014). For the last survey year (2014), the Denmark sample includes more than 44,000 individuals with a 12 percent share of foreign-born, 45 percent of whom are from a nonwestern origin (Table 1).

Table 1. Denmark: Distribution by Country of Birth, Eurostat's 2014 Labor Force Survey

| Country | Number of Individuals | Distribution by (in percent of working age population) | | | |
| | | Country of Birth | | Percent of Total* | |
		Natives	Foreigh-Born	Western	Nonwestern
Austria	86,348	81	19	86	14
Belgium	18,522	81	19	58	42
Denmark	44,084	88	12	55	45
Spain	59,705	91	9	35	65
Finland	27,261	94	6	73	27
France	110,619	86	14	29	71
Ireland	48,128	81	19	67	33
Italy	67,723	85	15	60	40
Netherlands	45,696	90	10	36	64
Norway	13,209	86	14	50	50
Portugal	36,901	91	9	35	65
Sweden	66,794	82	18	48	52
United Kingdom	43,751	83	17	32	68
Average	*51,442*	*86*	*14*	*51*	*49*

* Western refers to migrants from Europe, North America, and Oceania; Nonwestern refers to migrants from Asia, Latin America, and Middle-East and North Africa.
Source: Eurostat's Labor Force Survey and Fund staff calculations.

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[2] There are 13 countries included in the analysis: Austria, Belgium, Denmark, Finland, France, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, and the UK.

This sample is evenly split across male and female, with the majority being aged above 45 years of age and a small share of people with low level of education (Table 2).

Country	Distribution by (in percent of working age population)							
	Age			Gender		Educational Level		
	<30	30-45	>45	Male	Female	Low	Medium	High
Austria	15	33	52	49	51	16	56	28
Belgium	13	37	50	46	54	27	35	38
Denmark	9	31	59	48	52	17	43	40
Spain	9	38	54	49	51	46	21	34
Finland	9	33	57	49	51	13	44	42
France	10	36	54	48	52	26	43	30
Ireland	12	43	45	48	52	22	37	41
Italy	11	36	52	46	54	41	42	16
Netherlands	9	31	60	49	51	22	41	37
Norway	11	38	51	50	50	17	40	42
Portugal	9	37	55	48	52	62	20	19
Sweden	12	36	52	49	51	17	46	36
United Kingdom	11	37	52	47	53	24	38	38
Average	*11*	*36*	*53*	*48*	*52*	*27*	*39*	*34*

Table 2. Denmark: Distribution by Demographics, Eurostat's 2014 Labor Force Survey.

Source: Eurostat's Labor Force Survey and Fund staff calculations.

From Table 3, the probability of being employed in 2014 in Denmark is much lower for foreign-born persons (66 percent) than for natives (82 percent). In contrast, there is only a 9 percentage points gap between the employment probability of natives and migrants across all Europe, on average. In Denmark, unemployment among the foreign-born in the 2014 survey sample is twice as high as for natives (8 percent versus 4 percent), and inactivity is much higher among the foreign-born.
The micro data also allow us to examine employment rates of migrants after several years of residence in the receiving country. Considering the 2010–2014 surveys, we present summary charts in Figure 2 on the integration outcomes in some countries in Europe. For most countries, there are positive employment and participation gaps between natives and migrants, and these gaps are higher for immigrants born in nonwestern than in Western countries. In Denmark, employment and participation gaps between natives and migrant from nonwestern origin are quite pronounced. Further, for European countries, these employment and participation gaps generally decline after several years of residency in the country, whereas they are persistent in Denmark after 30 years (mostly for nonwestern migrants as the next section will show). These preliminary findings suggest that labor market prospects for migrants could be more favorable in other European countries than in Denmark.

Table 3. Denmark: Labor Market Outcomes, 2014 LFS						
Country	Distribution by (in percent of working age population)					
	Natives			Foreign-Born		
	Employed	Unemployed	Inactive	Employed	Unemployed	Inactive
Austria	76	3	21	67	7	26
Belgium	71	5	24	53	11	36
Denmark	82	4	14	66	8	25
Spain	62	16	22	57	26	17
Finland	78	4	18	68	9	22
France	71	7	22	56	12	32
Ireland	69	8	24	67	10	22
Italy	59	8	33	59	13	29
Netherlands	80	5	14	66	9	25
Norway	85	1	14	77	6	17
Portugal	67	11	22	70	15	15
Sweden	84	5	11	68	13	20
United Kingdom	77	3	20	72	5	23
Average	*74*	*6*	*20*	*65*	*11*	*24*

Source: Eurostat's Labor Force Survey and Fund staff calculations.

Figure 2. Integration Outcomes and Years of Residency

Employment and participation gaps between natives and migrants are higher for migrants from nonwestern than Western origin.

Employment Gaps (Percentage points)
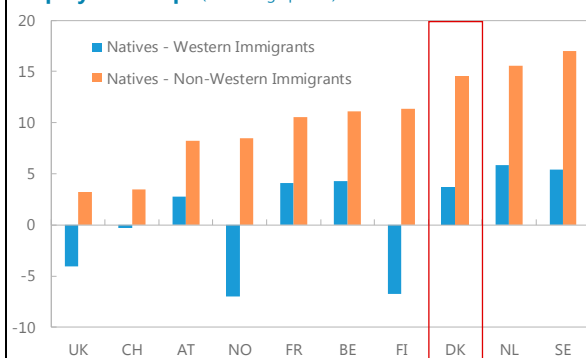
Participation Gaps (Percentage points)

Sources: Eurostat's Labor Force Survey and Fund staff calculations.
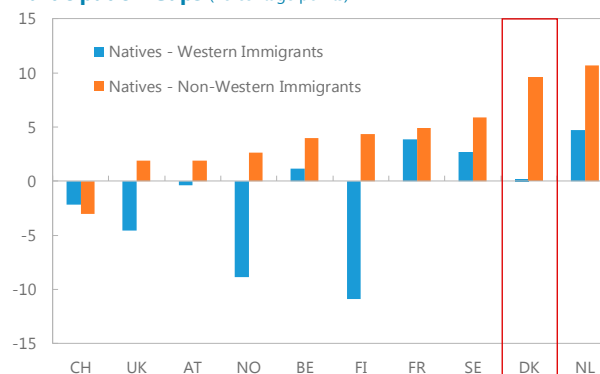
Sources: Eurostat's Labor Force Survey and Fund staff calculations.

These gaps generally decrease with greater years of residence in the country, but they remain open in Denmark after 30 years of residence.

Figure 2. Integration Outcomes and Years of Residency (concluded)

Sources: Eurostat's Labor Force Survey and Fund staff calculations.

Sources: Eurostat's Labor Force Survey and Fund staff calculations.
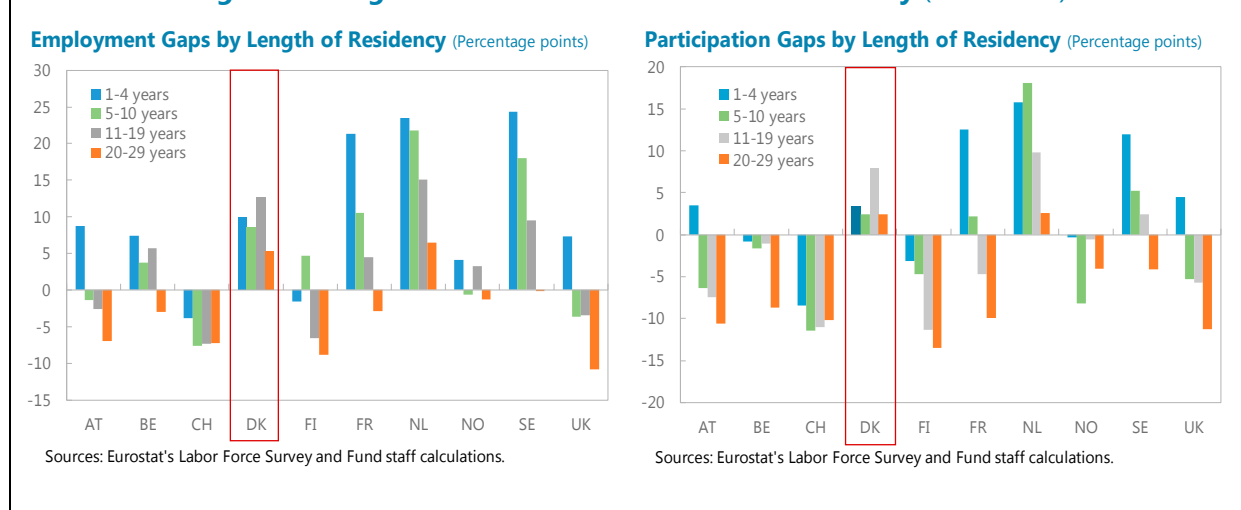
C. Empirical framework

6.   To investigate employment integration in Europe, we follow the established literature on earning assimilation of migrants (Chiswick, 1978; Borjas, 1985; Borjas, 2015; Frieberg, 2000) and estimate the following baseline probit regression specification:

$$\Pr(Employed) = \alpha_0 + \alpha_1 Mig + \alpha_2 Ysm + \alpha_3 Ysm^2 + \alpha_4 Age + \alpha_5 Age^2 + \alpha_6 Edu + \alpha_7 X + \varepsilon \qquad (1)$$

Where $\Pr(Employed)$ is the probability of having a job, which can assume either a value of 0 or 1; Mig is a dummy variable for migrants; Ysm refers to years since migration; Age and Edu are the age and education level of the person surveyed; and X includes other controls such as marital status, country, and survey year indicators. In equation (1), α_1 provides the initial migrant-native employment gap holding key person characteristics constant and α_2 proxies the catch-up integration speed of migrants (which could be non-linear).

7.   We allow for the integration profile of migrants to vary by origin and gender, and run the baseline specification in (1) for Denmark only and for all 13 European countries. We only consider the period 2010–2014 to avoid the crisis period and ensure a more balanced data coverage, as there is less coverage for surveys from earlier years. We also split the sample by Western and nonwestern origin of migrants to investigate differences in employment probabilities and integration speeds among the two categories of migrants.

8.   Further, we investigate an extension of the baseline specification to examine the role of education, both foreign and domestic, in shaping the probability of being employed. To do so, we decompose total education into that accumulated abroad in the foreign country (Edu_f) and in the receiving or domestic country (Edu_d), as in Friedberg (2000). We similarly decompose Ysm into Edu_d and work experience accumulated in the receiving country but, since information on the

latter is not available, we use Age as proxy. To impute the amount of foreign and domestic education in the micro data, we use information on year of migration and year of completion of education, assuming education (in years) is continuous. We obtain equation (2), in which coefficients of interest are β_2 and β_3:

$$\Pr(Employed) = \beta_0 + \beta_1 Mig + \beta_2 Edu_f + \beta_3 Edu_d + \beta_4 Age + \beta_5 Age^2 + \beta_6 X + \varepsilon \qquad (2)$$

We also explore the possibility of different returns to domestic education for natives and migrants. To that end, we incorporate an interaction term between Mig and Edu_d, allowing for the impact of domestic schooling to differ between natives and migrants. In equation (3) below, we are interested in the parameter estimate δ_4.

$$\Pr(Employed) = \delta_0 + \delta_1 Mig + \delta_2 Edu_f + \delta_3 Edu_d + \delta_4 Mig{\times}Edu_d + \delta_5 Age + \delta_6 Age^2 + \delta_7 X + \varepsilon \quad (3)$$

We use the above multivariate framework to estimate the (a) employment gap between natives and migrants by origin upon arrival, (b) integration speed of migrants, and (c) marginal effect of domestic education on natives and migrants.

D.   Analysis of Integration Speed

9.   Table A1 (see Appendix 1) presents summary statistics for key variables. Out of close to 3.5 million individuals aged between 22 and 62 years across Europe, the probability of having a job is 72 percent. Immigrants represent 13 percent of total people surveyed and they have been residing in the receiving country for an average of 19 years. A surveyed individual is on average 45 years old, has completed 12 years of education, and has a 60 percent probability of being married.

10.   Table A2 displays the estimation results of equation 1 for the Denmark and European samples, showing only the key variables of interest, Mig and Ysm. The estimated parameter α_1 from equation 1 is negative and significant indicating that, conditional on having the same age, education, and other key characteristics, a migrant upon arrival has a lower probability of being employed relative to a native. Considering all migrants together, the parameter estimate on Mig in the upper panel on Denmark is larger in absolute terms than for the average all European countries in the lower panel of Table A2. These results suggest wider initial employment gaps in Denmark relative to Europe for all migrants. However, the initial employment gap between nonwestern male migrants and natives is lower in Denmark ($\alpha_1 = -0.565$) than in Europe ($\alpha_1 = -0.842$). More broadly, initial employment gaps are wider for migrants from nonwestern origin than for migrants of western origin, and they are mostly pronounced among female.

Also from Table A2, the estimated parameter α_2 from equation 1 is positive and significant for the Europe sample, suggesting that spending more time in the receiving country improves the probability of migrants finding a job. However, in the case of Denmark, these results are only significant for female migrants, whether they have a Western or nonwestern origin.

11.   Using the results from equation 1, we calculate migrant employment probabilities upon arrival and after 10 years of residence in the country for Denmark and all Europe and illustrate the change in these probabilities in Figure 3. In both Denmark and Europe, female migrants are more likely to be employed after spending 10 years in the receiving country. However, for nonwestern female migrants, this probability is twice as high in Europe as in Denmark. For nonwestern male migrants, their employment probability in Europe increases by close to 9½ percentage points after 10 years, but it declines in Denmark by 10 percentage points.

Figure 3. Change in Employment Over Time

Change in Migrant Employment Probability after 10 Years
(in percentage points)

Sources: Eurostat's labor Force Survey and Fund staff estimates.
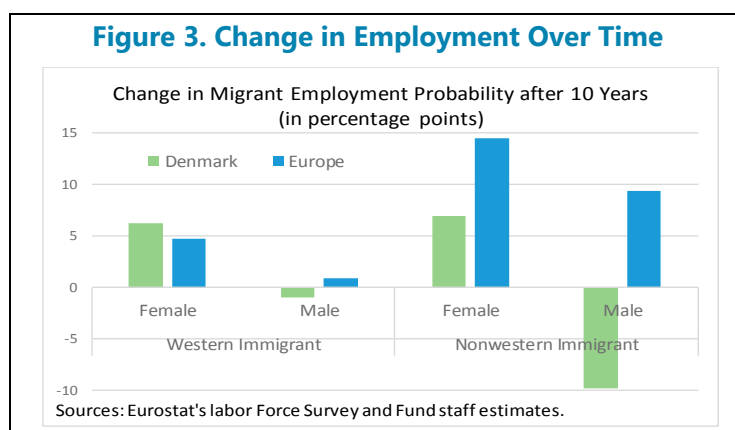
12.   We also use the results of the baseline regression from equation 1 to simulate the integration profile of a 30-year old migrant (of Western and nonwestern origin) in Denmark and all Europe, conditional on having the same age, education, and other key characteristics as the average representative individual in each sample. We illustrate the findings in Figure 4 and summarize them as follows. First, for both female and male in Denmark and Europe, the integration of migrants from nonwestern origin persistently lags that of migrants from western origin. Second, upon arrival to the receiving country, all female migrants exhibit a wider initial employment gap compared with male migrants and their catch-up speed is faster over time. Third, the employment probability of female nonwestern migrants after 20 years of residence in Denmark is close to the corresponding average for Europe (at about 60 percent). Fourth, whereas the employment probability of a nonwestern male migrant in Europe gradually catches up with that of other male migrants and natives, it gradually drops over time in Denmark, despite an initial employment gap upon arrival that is similar to that of western migrants.

13.   Next, we consider country-specific differences in initial employment gaps and integration speed, re-running equation 1 separately for each country. For each country, we calculate marginal effects for the conditional employment gap between natives and migrants upon arrival. The results (sorted for male migrants in Figure 5) confirm that the initial employment gap between natives and migrants in Denmark, both for female (about 25 percent) and male (about 10 percent), is not as pronounced as for other countries. Using the country-by-country results, we also calculate the marginal effects of the employment probability with respect to years since migration, showing the results sorted for male migrants in Figure 6. Each additional year of residence in Denmark increases the probability of employment for female by 1 percentage point,

which is larger than for many other countries in Europe. However, the employment probability of male migrants in Denmark declines by

Figure 4. Simulation of Integration Profile, 30-Year Old Migrant
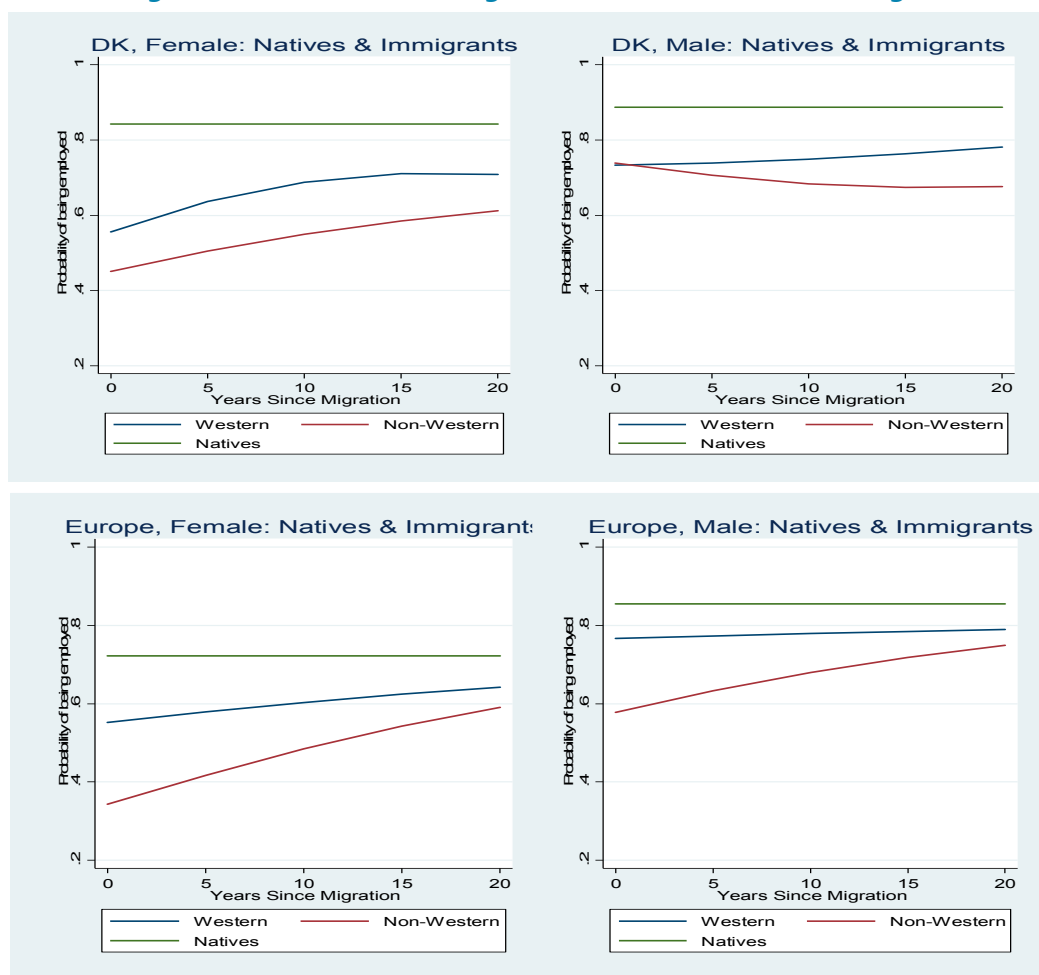
Figure 5. Initial Employment Gap between Migrants and Natives, By Country

1/ Gaps are measured as the percent difference in employment probability between natives and migrants upon arrival in each country. Source: Eurostat and Fund staff estimates.
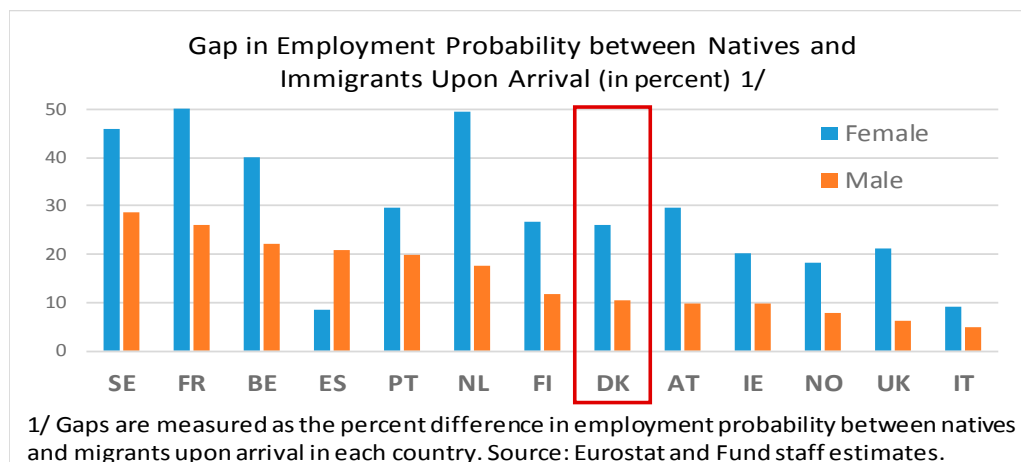
¼ percentage point with each additional year of residence in the country, although this finding is not statistically significant.

Figure 6. Estimated Integration Speed, By Country

Change in Immigrant Employment Probability with Years of Residence
(Percentage points)

Stripes indicate insignificance effect from years of residence in country.
Sources: Eurostat and Fund staff estimates.
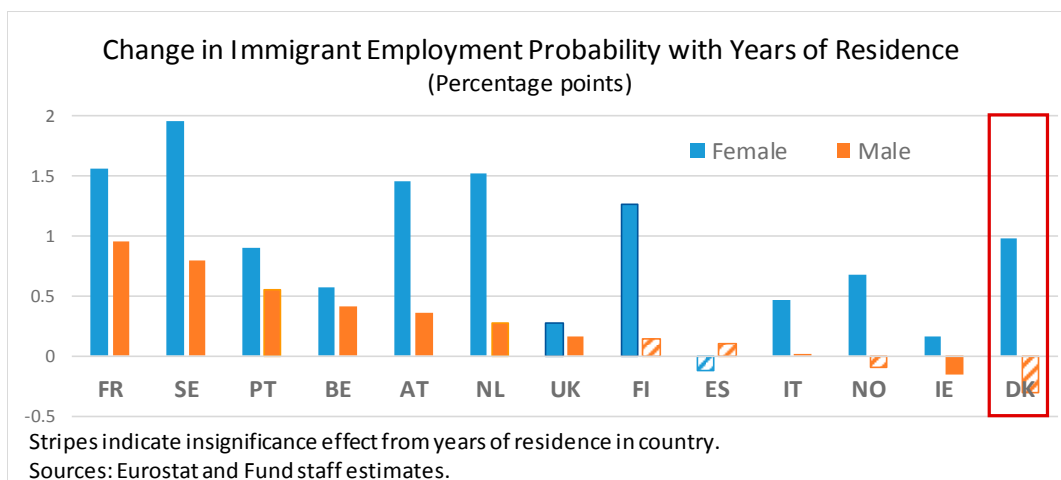
E. The Role of Education

14. **Studies by Borjas (1985, 2015) contend that the economic impact of immigration on a receiving country ultimately depends on the skills composition of the immigrant population.** In this section, we analyze the role of both foreign (acquired prior to migration) and domestic (acquired in the receiving country) education in improving migrant integration outcomes. Tables A3 and A4 present the estimation results of equations 2 and 3, respectively.[3]

15. **The positive and significant coefficients in Table A3 (β_1 and β_2 from equation 2)** indicate that both foreign and domestic education increase the probability of employment for all migrants, regardless of their country of origin. The size of the parameter estimate on domestic education is also greater than for foreign education, suggesting that the pay-off from domestic education—in terms of a higher employment probability—is greater than for foreign education. To assess the economic significance of differences in employment probabilities conditional on other individual characteristics, Figure 7 shows the marginal effect of having one more year of domestic and foreign education for female and male in Denmark and Europe, also broken down by migrant origin.

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[3] In this paper, foreign and domestic education are imputed from the Eurostat data, as they are not provided by the LFS. It is noteworthy, however, that Statistics Denmark is currently improving the definition of foreign education, which would help better understand the skills composition of migrants.

Figure 7. Foreign vs. Domestic Education
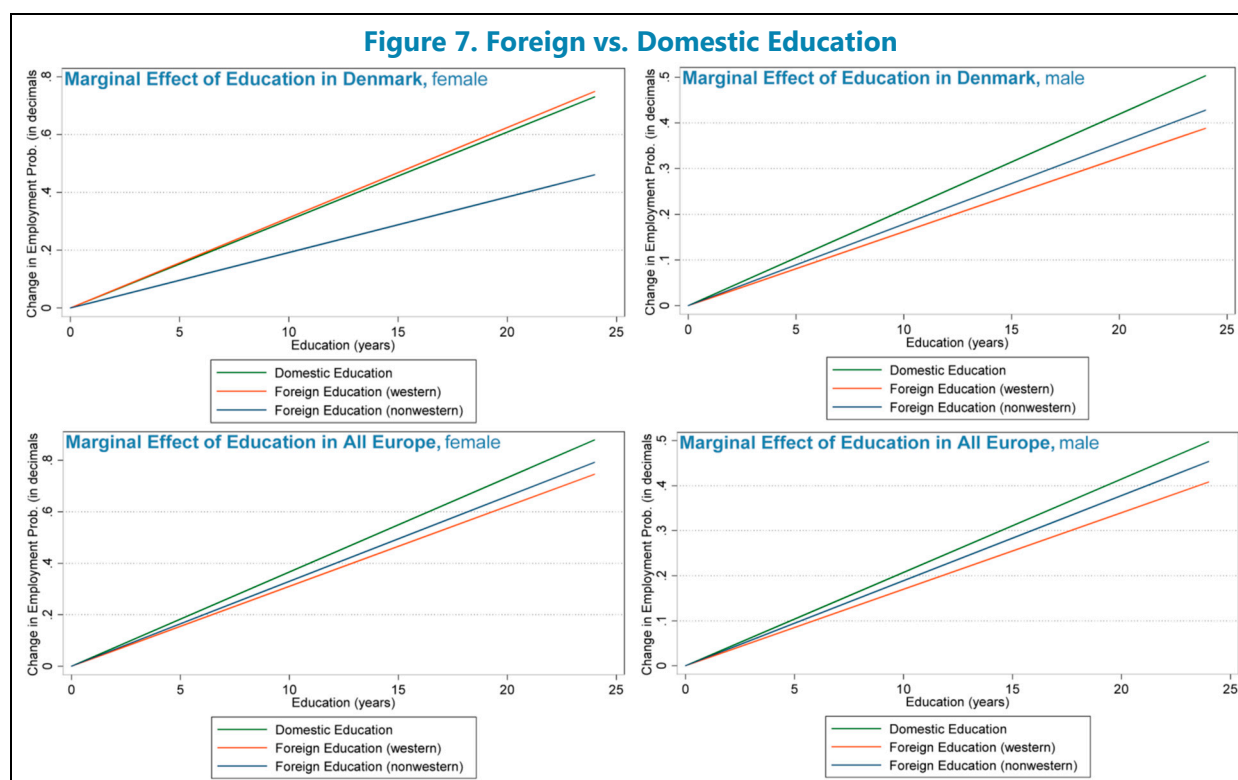
16.   **We summarize three key takeaways from Figure 7. First, domestic education raises the probability of employment more than foreign education.** Second, in all countries, the employment gains for female individuals are much higher than for male after 10 years of education in the country. In Denmark, 10 years of domestic education for female raise their chances of having a job by 30 percent whereas the corresponding probability for male is 20 percent. Third, there does not appear to be significant differences in the returns to foreign education of nonwestern male migrants to Denmark or other countries in Europe: 10 years of foreign education boost their employment probability by around 20 percent. For nonwestern female migrants, however, 10 years of foreign education raise their chances of having a job by above 30 percent in Europe whereas the corresponding gain in Denmark is 20 percent.

17.   **After coming to a country, migrants also receive domestic schooling.** However, the extent of such education in Denmark—measured in years of education received—is lagging the average for other European countries (Figure 8).[4]

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[4] The OECD PISA 2015 key findings similarly indicate that, while the average Danish performance of all 15-year old in science, mathematics, and reading exceeds the OECD average, immigrant students in Denmark do not perform as good as the average for other countries (OECD, 2016). Also, the mean literacy scores in 2012 for the 16-64 year-old foreign-born were lower for Denmark than for the EU and OECD averages (OECD, 2015).

Figure 8. Migrant Domestic Education

Average Years of Migrant Education in Receiving Country
(Years per migrant)

Sources: Eurostat Labor Force Survey (2010-2014) and Fund staff calculations.
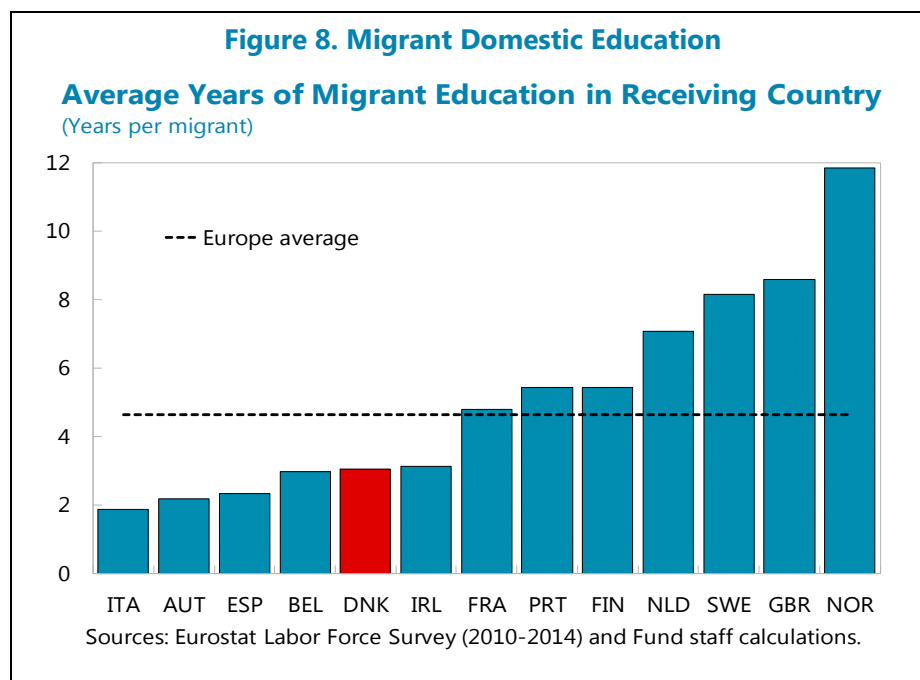
18.   Table A4 shows estimation results of equation 3, where the parameter estimate δ_4 on the interaction term (*Domestic education* Migrant*) allows for different returns to domestic education for natives and migrants. For the results in the upper panel on Denmark, δ_4 is insignificant and it flips sign based on the subsample considered. In contrast, the results for Europe in the lower panel show a negative and significant interaction term, suggesting that the employment probability of a migrant is lower than that of a native, after they each receive domestic schooling.

19.   Figure 9 illustrates the marginal effects of each additional year of domestic education, which results in lower employment probability for migrants than for natives. There are also differences among migrants of difference origin as well as among female and male. Except for female migrants in Denmark, the employment probability increases more for western than nonwestern migrants after receiving domestic education. The employment probability of nonwestern female migrants in Denmark (Europe) rises to close to 55 percent (slightly below 50 percent) after 10 years of domestic schooling, compared with around 70 percent for natives. For nonwestern male migrants in both Denmark and Europe, the probability of being employed hovers around 60 percent after 10 years of domestic schooling; the corresponding figure for natives is about 80 percent.

F.   Conclusion

20.   Understanding the complex process of migrant integration could benefit policy assessment on how to maximize the economic impact of immigration on a receiving country. Using a rich dataset and unified empirical framework, this paper provides new evidence on the labor market integration of migrants in Denmark and across Europe.

Figure 9. Domestic Education, Natives vs. Migrants
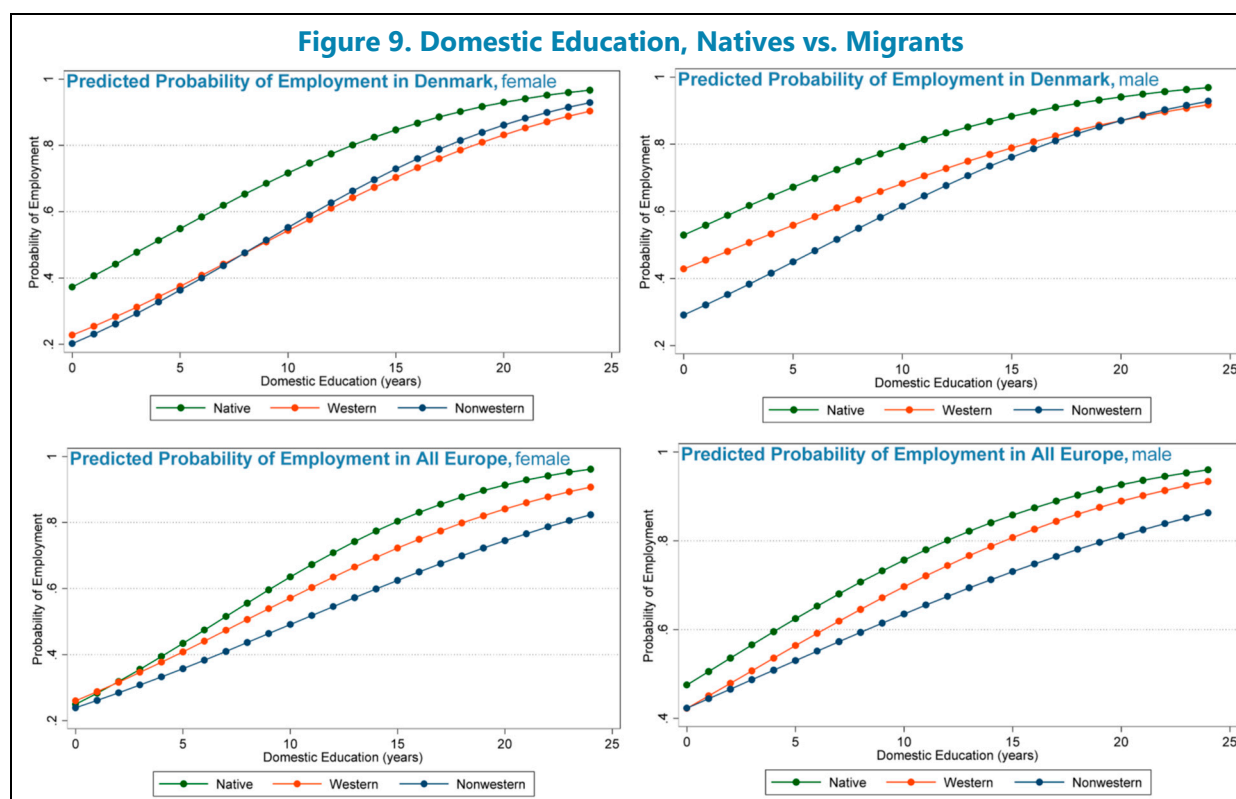
21.   The main findings are summarized as follows:

- Overall employment and participation gaps between natives and migrants from nonwestern origin are high in Denmark. They are also persistent after 30 years of residence, unlike for most other European countries.
- Initial employment gaps between natives and migrants are higher among female than male individuals and they are more pronounced for migrants from nonwestern origin.
- Despite initial better conditions for nonwestern male migrants in Denmark relative to Europe, their employment probability does not improve with years of residence, unlike for female migrants to Denmark and for other migrants in Europe.
- Education acquired by migrants prior to arrival matters, albeit to a lesser extent than domestic schooling.
- Domestic education of migrants to Denmark—which lags other countries in Europe—is key to raising their probability of employment.

In view of these individual factors determining employment outcomes of migrants, integration policy should pay specific attention to vulnerable groups such as female and migrants from nonwestern countries, given different initial conditions. Integration policy could also aim to boost the return to foreign education, such as by improving the validation of foreign degrees. Further, it is important to enhance the pay-off to domestic education for migrants, including by improving language training.

References

Borjas, G., 1995. "Assimilation, Changes in Cohort Quality, and the Earnings of Immigrants." *Journal of Labor Economics* 13, 463–89. Available via the internet http://isites.harvard.edu/fs/docs/icb.topic803549.files/Week%202-September%2015/borjas_assimilation_1985.pdf

Borjas, G., 2015. "The Slowdown in the Economic Assimilation of Immigrants: Aging and Cohort Effects Revisited Again." *Journal of Human Capital* 9(4), 483–517. Available via the internet http://www.journals.uchicago.edu/doi/abs/10.1086/676461

Chiswick, B. R., 1978. "The Effect of Americanization on the Earnings of Foreign-Born Men." *Journal of Political Economy* 86, 897–921. Available via the internet https://www.jstor.org/stable/1828415?seq=1#page_scan_tab_contents

Eurostat Labor Force Survey, Survey years 2010–2014.

Frieberg, R. 2000. "You Can't Take It with You? Immigrant Assimilation and the Portability of Human Capital." *Journal of Labor Economics* 18, 221–251. Available via the internet http://www.brown.edu/Departments/Economics/Faculty/Rachel_Friedberg/Links/Friedberg%20JOLE.pdf

Organisation for Economic Co-operation and Development/European Union, 2015. "Indicators of Immigrant Integration 2015: Settling In." OECD Publishing, Paris. Available via the internet http://www.oecd.org/els/mig/Indicators-of-Immigrant-Integration-2015.pdf

Organisation for Economic Co-operation and Development, 2016. "PISA 2015 Results." OECD Publishing, Paris. Available via the internet http://www.oecd.org/education/pisa-2015-results-volume-i-9789264266490-en.htm

Appendix I. Additional Tables

Table AI.1 Variables Entering the Baseline Specification					
Variable	Obs.	Mean	Std. Dev.	Min	Max
Pr (Employment)	3,429,355	0.72	0.5	0	1
Immigrant	3,429,355	0.13	0.3	0	1
Years since migration	449,591	19	14.3	0	61
Education years	3,348,825	12	3.1	6	24
Age	3,429,355	45	11.2	22	62
Married	3,429,355	0.6	0.5	0	1

Eurostat's Labor Force Survey and Fund staff calculations.

Table AI.2 Estimation Results of the Baseline Specification						
	All immigrants		Western Immigrant		Non-Western Immigrant	
	Female	Male	Female	Male	Female	Male
Panel 1: Denmark						
Migrant	-0.905	-0.533	-0.862	-0.579	-1.119	-0.565
	[0.058]***	[0.066]***	[0.080]***	[0.089]***	[0.098]***	[0.110]***
Years since migration	0.027	-0.012	0.049	0.002	0.029	-0.023
	[0.009]***	[0.010]	[0.014]***	[0.015]	[0.015]**	[0.016]
Years since migration squared/100	-0.051	0.049	-0.145	0.030	-0.043	0.070
	[0.033]	[0.035]	[0.051]***	[0.053]	[0.049]	[0.053]
Observations	95,425	90,873	91,810	88,160	91,843	87,746
Pseudo R-squared	0.115	0.129	0.115	0.130	0.118	0.132
Panel 2: Europe						
Migrant	-0.614	-0.524	-0.431	-0.337	-0.956	-0.842
	[0.008]***	[0.009]***	[0.012]***	[0.013]***	[0.011]***	[0.013]***
Years since migration	0.022	0.013	0.012	0.005	0.040	0.030
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
Years since migration squared/100	-0.023	-0.011	-0.011	-0.001	-0.048	-0.033
	[0.001]***	[0.002]***	[0.002]***	[0.002]	[0.002]***	[0.002]***
Observations	1,610,787	1,497,463	1,496,425	1,398,698	1,495,296	1,401,388
Pseudo R-squared	0.144	0.146	0.150	0.154	0.151	0.151

Note: All regressions include controls (not show n) for education, age, age squared, marital status, and year and country fixed effects. Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1.

Table AI.3 Estimation Results of Equation (2)

Panel 1: Denmark

	All immigrants		Western Immigrant		on-Western Immigrar	
	Female	Male	Female	Male	Female	Male
Foreign education	0.093	0.075	0.105	0.075	0.066	0.066
	[0.003]***	[0.004]***	[0.005]***	[0.005]***	[0.005]***	[0.005]***
Domestic education	0.101	0.084	0.100	0.084	0.101	0.085
	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***
Difference significant?	Y	Y	N	Y	Y	Y
Observations	85,508	79,745	81,735	76,923	81,034	75,938
r2_p	0.131	0.132	0.133	0.134	0.136	0.138

Panel 2: Europe

	All immigrants		Western Immigrant		on-Western Immigrar	
	Female	Male	Female	Male	Female	Male
Foreign education	0.097	0.074	0.098	0.076	0.093	0.070
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***
Domestic education	0.109	0.084	0.110	0.085	0.110	0.084
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Difference significant?	Y	Y	Y	Y	Y	Y
Observations	1,733,220	1,615,605	1,611,683	1,511,085	1,595,260	1,500,158
Pseudo R-squared	0.143	0.147	0.150	0.156	0.150	0.152

Note: Regressions include all controls (not show n) specified in equation (2). Robust Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table AI.4 Estimation Results of Equation (3)

Panel 1: Denmark

	All immigrants		Western Immigrant		Non-Western Immigran	
	Female	Male	Female	Male	Female	Male
Foreign education	0.094	0.074	0.102	0.068	0.070	0.073
	[0.005]***	[0.006]***	[0.007]***	[0.008]***	[0.008]***	[0.009]***
Domestic education	0.101	0.085	0.101	0.085	0.101	0.085
	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***
Domestic edu*Migrant	0.001	-0.002	-0.005	-0.011	0.006	0.010
	[0.006]	[0.007]	[0.008]	[0.010]	[0.009]	[0.011]
Observations	85,508	79,745	81,735	76,923	81,034	75,938
Pseudo R-squared	0.131	0.132	0.133	0.134	0.136	0.138

Panel 2: Europe

	All immigrants		Western Immigrant		Non-Western Immigran	
	Female	Male	Female	Male	Female	Male
Foreign education	0.078	0.064	0.083	0.073	0.066	0.052
	[0.001]***	[0.001]***	[0.001]***	[0.002]***	[0.001]***	[0.001]***
Domestic education	0.113	0.086	0.112	0.086	0.113	0.087
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Domestic edu*Migrant	-0.029	-0.015	-0.021	-0.004	-0.038	-0.026
	[0.001]***	[0.001]***	[0.001]***	[0.002]***	[0.001]***	[0.002]***
Observations	1,733,220	1,615,605	1,611,683	1,511,085	1,595,260	1,500,158
Pseudo R-squared	0.143	0.147	0.150	0.156	0.150	0.152

Note: Regressions include all controls (not show n) specified in equation (3). Robust Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

DYNAMICS OF FIRM INVESTMENT IN DENMARK: ROLE OF LEVERAGE, DEMAND, AND KNOWLEDGE INTENSITY[1]

This paper provides an investigation into the dynamics of firm investment in Denmark using an augmented version of the traditional accelerator model of investment. It finds evidence on the traditional leverage and demand channels of investment. The response is not significantly differentiated for SMEs and large firms. The paper also documents the presence of a new channel that boosts the investment response to demand, the knowledge intensity channel. Small firms in knowledge-intensive industries benefit most from investing in intangibles.

A. Introduction

1.   **Investment matters for short-term and long-term economic prospects.** Despite its relatively small share in output, investment is a volatile component of GDP and it can have a profound impact on short-term economic fluctuations. Investment also increases the capital stock and, by boosting factor productivity, it can lift potential growth.

2.   **Investment in Denmark has remained low since the crisis.** In the run-up period to the global financial crisis (GFC), investment as percent of GDP in Denmark rose markedly, reaching a very high level, mostly due to an exceptional housing boom. After the crisis, investment dropped sharply and its level in recent years remains low in comparison with the period prior to the housing boom.[2] Abstracting from residential housing investment, the corporate investment rate (calculated as investment relative to operating surplus) also dropped from a high level since the GFC and it remains below the average for the Euro area (Figure 1). More generally, while investment growth has lagged the economic recovery across several countries (Banerjee and others, 2015), its level remains low in Denmark.

Gross Fixed Capital Formation (GFCF)
(Percent of GDP, current prices)
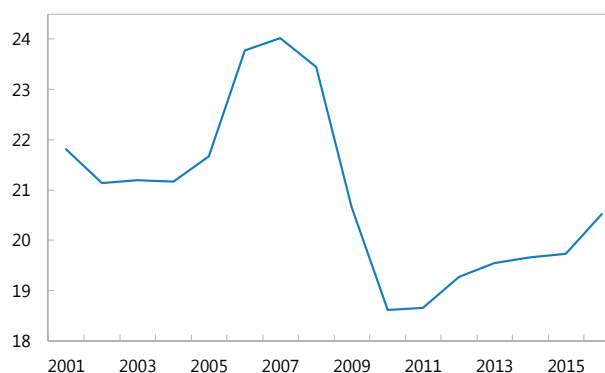
Source: Statistics Denmark.

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[1] Prepared by Rima A. Turk. I would like to thank John Bluedorn and Christian Ebeke for kindly sharing the code they used for a related project the Euro Area, and David Hofman, Andreas Kuchler, and the Danish authorities for helpful comments and feedback. All remaining errors are my own.

[2] The Danish Economic Council argues that, when measured on a real PPP-basis, there is no evidence of weak capital formation in Denmark relative to GDP (Danish Economic Council, 2016).

Figure 1. Investment Trends, Rates, and Composition

Gross Fixed Capital Formation
(Percent of GDP, current prices)

Legend: DNK, DEU, NLD, SWE, EA19

GFCF of Non-Financial Corporations
(Percent of GDP, index 2007=100)

Legend: DEU, DNK, NLD, SWE, EA19

Corporate Investment Rate (Percent)
(Ratio of gross fixed capital formation to gross operating surplus of NFC)

Legend: DNK, DEU, NLD, SWE, EA (19)

Composition of Investment (Percent)

Legend: Cultivated assets, Intellectual property products, Machinery & equipment, Dwellings & other structures

Sources: Eurostat, OECD, and Fund staff calculations.

3.   The policy uncertainty channel is one possible explanation for the slump in physical capital spending (Bloom and others, 2007; International Monetary Fund, 2015). If returns on capital are uncertain or expected to be low, firms become reluctant to make irreversible investments (Guiso and Parigi, 1999; Banerjee and others, 2015). In the context of Denmark, Business Tendency Surveys indicate that low demand continues to play a major role in the low economic activity, suggesting that low investment reflects increased uncertainty about economic conditions and reduced demand.

4.   The financing channel may also play an important role as corporate leverage is high in Denmark. High corporate debt pre-crisis in part explains the sharp fall in investment during the GFC, as firms wanted to deleverage to strengthen their balance sheets and retain flexibility in future financing choices (Kuchler, 2015a). Post GFC, credit constraints do not seem to be curbing investment growth, as Danish firms appear to have good access to finance (Andersen and Kuchler, 2016; Kramp and Pedersen, 2015). Yet, although the need for consolidation among firms is subsiding

Debt-to-Assets of NFCs, 2010-2015 (Percent)

Legend: SME, Large Firms

FRA SWE NOR ITA FIN ESP DEU CHE GBR IRL NLD DNK

Sources: Orbis and Fund staff calculations.
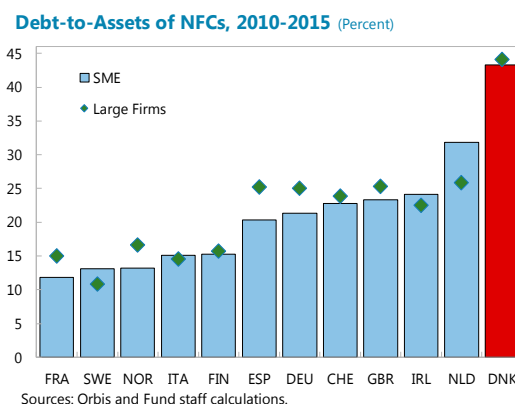
(Danmarks Nationalbank, 2015), firm leverage is still very high in Denmark in comparison with other European countries. In turn, strained balance sheets may reduce firms' ability and willingness to invest.

5.   **The strength of the uncertainty and financing channels could differ by firm size.** The literature (Banerjee and others, 2015; Bluedorn and Ebeke, 2016) documents different impact from these two channels for large firms and Small and Medium Enterprises (SMEs). In Denmark, SMEs contribute significantly to the economy, employing about 38 percent of the labor force and accounting for over 42 percent of total investment since 2000 (Figure 2).

Figure 2. Firms Contribution to the Economy

Sources: Statistics Denmark and Fund staff calculations.
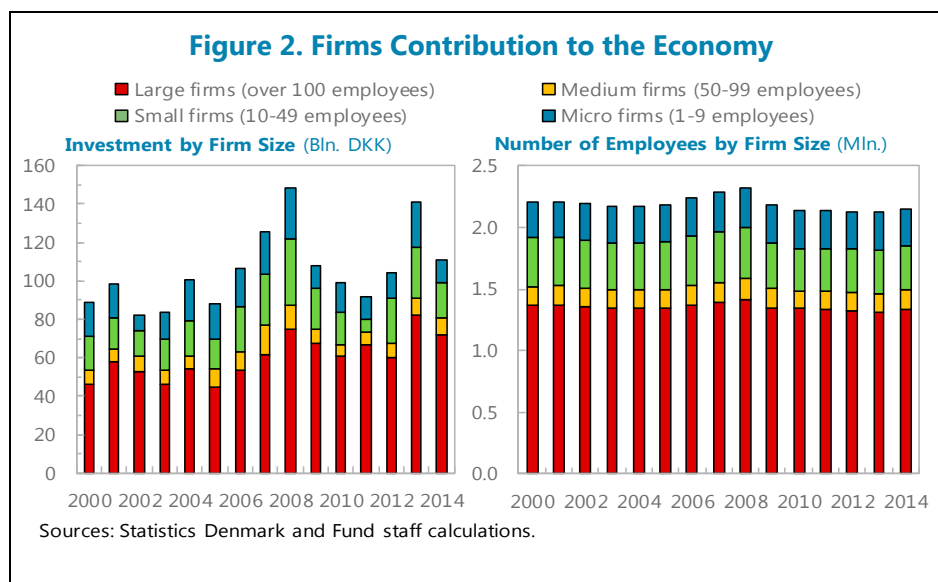
6.   **The role of investment in intangibles has received not received much attention.** Also known as investment in Knowledge-Based Capital (KBC), intangibles capture investment in computerized information (software and databases) and research and development (R&D). But intangibles are broader than what is recorded in the system of national accounts. Studies by the OECD and the European Investment Bank suggest that the measurement of the knowledge-content of products and services produced would have to consider not just technology and R&D, but also what is known as economic competencies. The

Intangible and Tangible Investment (Average 2000-2013)
(Percent of GDP)

Source: Corrado et al. (2016), European Investment Bank.

latter include, among others, brand equity, firm-specific human capital, networks of people and institutions, and organizational know-how that increases enterprise efficiency (Organization for
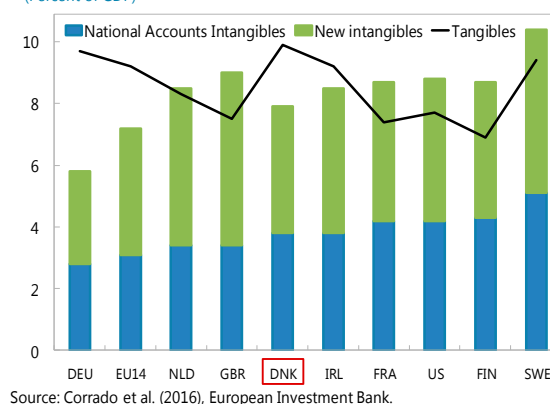
Economic Cooperation and Development (OECD), 2013a and b; Corrado and others, 2016).[3] In the case of Denmark, accounting for such "new intangibles" would broaden KBC by more than 100 percent relative to the current national accounts definition of intangibles.

7.   The composition of investment in Denmark has recently shifted away from physical capital to intangibles. The recent period is marked by a shift in composition away from tangible investments and into intellectual property products (computer software and databases, research and development (R&D), mineral exploration, and artistic originals). Across many OECD economies, building on new human knowledge is driving the value of most of the largest firms (OECD, 2013a and b). This is also likely the case in Denmark, where knowledge-intensive sectors—defined as high- and medium-technology manufacturing sectors and knowledge intensive services (Appendix C)—have increased their contribution to gross value added (GVA) over the past two decades from below 40 to over 50 percent.

Share of HTKIS Sectors in GVA 1/ (percent)
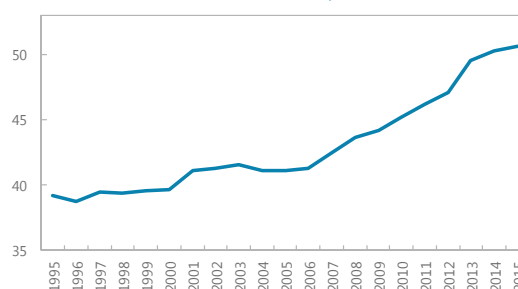
1/ HTKIS refers to high- and medium-technology manufacturing sectors and knowledge intensive services sectors.
Source: Statistics Denmark and Fund staff calculations.

8.   There is growing evidence that intangibles represent an important source of growth. The production, distribution, and use of knowledge are key for innovation and for sustaining a firm's competitive advantage. Not only do intangible investments produce new ideas and knowledge, but they also generate positive spillovers (Griliches and others, 1991; Jaffe and others, 1993; Corrado and others, 2013). A growing body of literature shows that intangible assets are both a source of value creation for individual firms and a driver of growth at the macroeconomic level (OECD, 2013a and b; Corrado and others, 2013 and 2016). Using a broad classification of intangibles, Corrado and others (2016) find that intangible capital deepening accounted for as much as 30 percent of labor productivity growth on average for Europe and the U.S. between 2000 and 2013.[4]

9.   This paper examines possible drivers of Denmark's investment and it also explores the role of intangibles. It starts by presenting an overview of corporates in Denmark and peer countries in Section B, focusing on investment, saving, and the status of deleveraging.[5] Section C describes the research design and data, investigating the importance of leverage and demand on firm investment and testing for the presence of a new channel—the knowledge intensity channel—using a difference-in-difference approach. Section D discusses the empirical findings. Section E concludes.
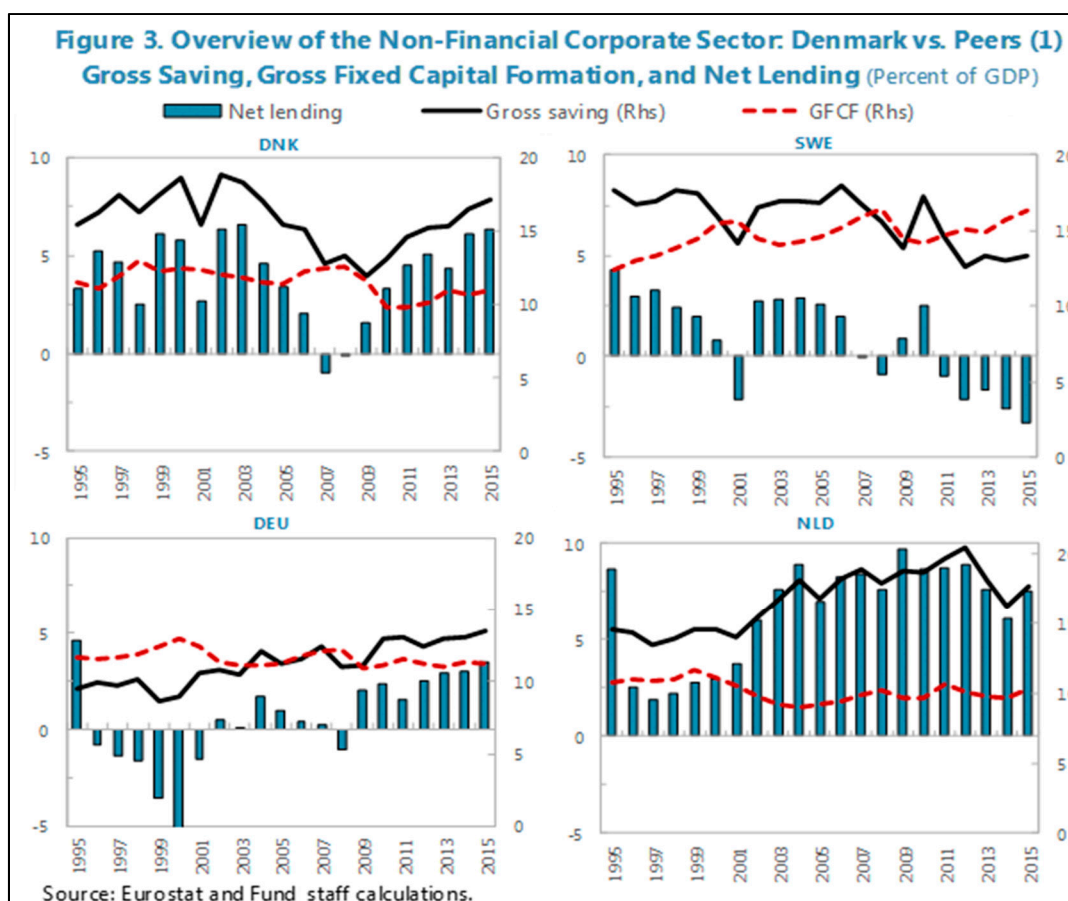
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[3] Economic competencies are categorized as: brand-building advertisement, marketing research, worker training, management consulting, and own-organizational investment.

[4] In comparison, the contribution of tangible capital deepening to growth in labor productivity was 40 percent on average over the same period.

[5] The corporate sector refers to non-financial corporations (NFC).

B. Overview of the Corporate Sector: Investment, Saving, and the Status of Deleveraging

10.   Corporate investment remains sluggish in Denmark. Following a prolonged period of uncertainty—both from the GFC and the sovereign debt crisis in Europe—firms across most countries seem to be reluctant to make irreversible long-term investment commitments (Figure 3).

Figure 3. Overview of the Non-Financial Corporate Sector: Denmark vs. Peers (1)
Gross Saving, Gross Fixed Capital Formation, and Net Lending (Percent of GDP)

Source: Eurostat and Fund staff calculations.

11.   In parallel, corporate savings are high in Denmark due to a number of factors. In the period leading up to the crisis, saving by corporations in Denmark declined sharply, unlike for other countries, but this trend has since been reversed (Figure 3). The rise in corporate savings can be explained by rising income from investments abroad, along with falling interest expenses and tax payments (Brandt and others, 2012). Improvement in firm profitability since 2009 (despite remaining slightly below peers) coupled with lower dividend payments may have also contributed to greater corporate savings (Figure 4).

12.   The resulting increase in corporate surplus in Denmark is not accompanied by a notable increase in cash accumulation on firms' balance sheets. Together, low investment and high saving have increased the corporate surplus or net lending in Denmark to above 6 percent of GDP since 2009, a level that was previously recorded during the pre-boom years. In parallel, the share of cash and liquid assets in financial assets has not significantly increased. It could be that the

Figure 4. Overview of the Non-Financial Corporate Sector: Denmark vs. Peers (2)
Net Income and Profit Distribution (Percent)

1/ Operating surplus minus interest, taxes, contributions, and transfers. Source: Eurostat and Fund staff calculations.
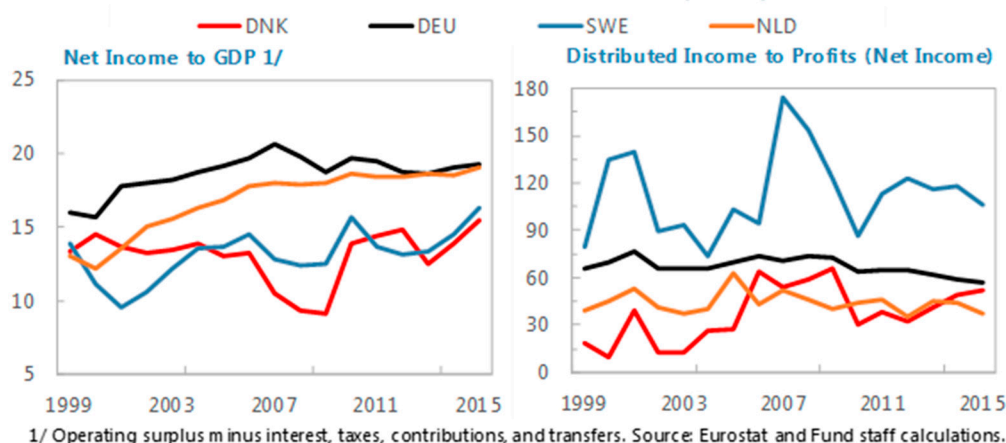
corporate savings surplus has been used in recent years for loan repayment, investment in liquid portfolios, and also foreign direct investment (Kuchler, 2015b).

13.   In addition, corporates do not seem to have significantly deleveraged post-crisis. The ratio of corporate debt in relation to GDP did not noticeably decline in Denmark in the post-crisis, showing rather a debt-stabilization pattern that is similar to that in other countries (Figure 5). Debt overhang, defined as the ratio of total debt to gross operating surplus, also remains highest in Denmark compared with peers, despite having moderated from the

peak that was reached during the GFC. There is thus no clear evidence that firms have used their high surplus in recent years to substantially pay down debt.
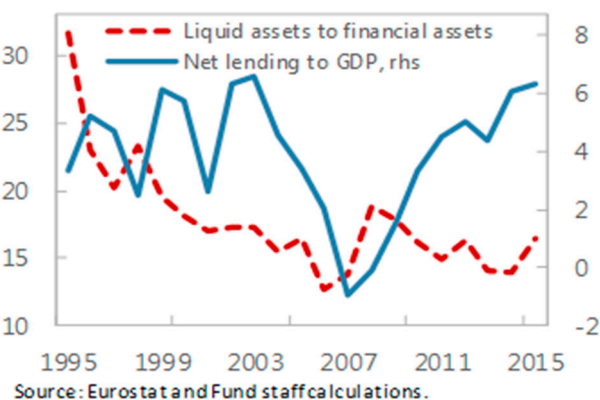
14.   More broadly, corporate financial liabilities continue to accumulate in Denmark (Figure 6). The steady build-up of financial assets at Danish firms is accompanied by a sharp increase in financial liabilities, which is highest in Denmark at close to 350 percent of GDP. In view of stagnating corporate debt, the rising importance of other financing sources including overdraft facilities and leasing in part account for greater financial liabilities (Andersen and Kuchler, 2016).

Figure 5. Overview of the Non-Financial Corporate Sector: Denmark vs. Peers (3) Indicators of Leverage

Total Debt of NFC
(Percent of GDP, index 2000 = 100)

Debt Overhang of NFC
(Debt over gross operating profit, times)
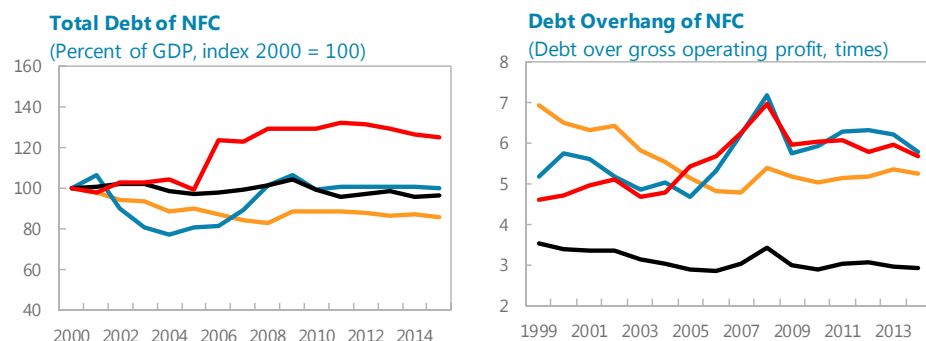
Sources: OECD and Fund staff calculations.

Figure 6. Overview of the Non-Financial Corporate Sector: Denmark vs. Peers (4) Financial Assets and Financial Liabilities (Percent of GDP)

- - - Financial Liabilities   —— Financial Assets

DNK

SWE

NLD

DEU
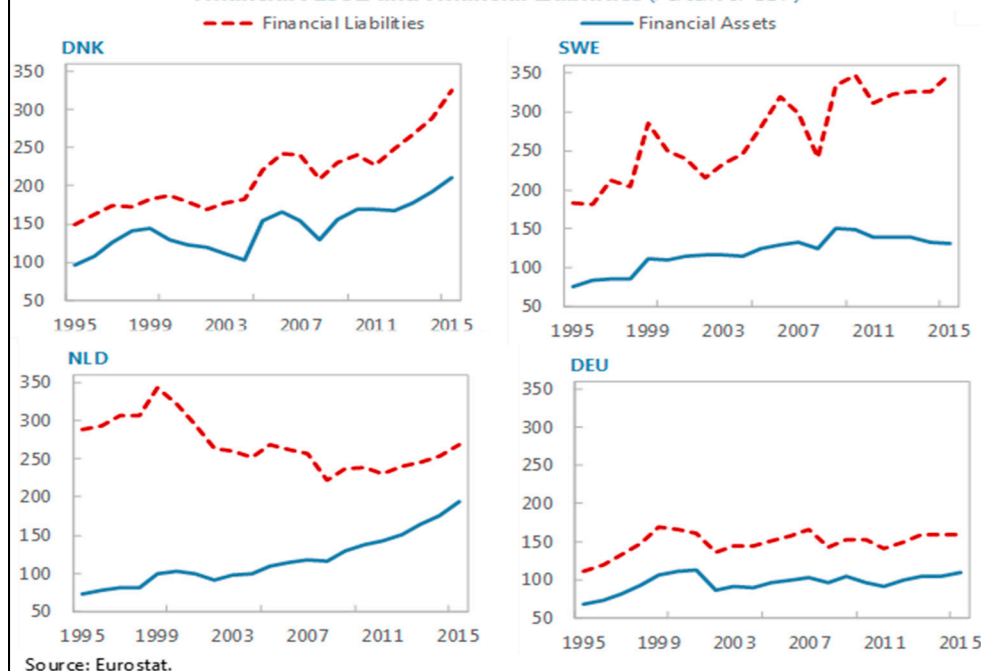
Source: Eurostat.

C.   Research Design and Data

15.   The baseline investment regression is a variation of the standard specification generally used in the literature. It rests on an augmented version of the traditional accelerator model of investment with demand changes and other controls as the main drivers (Lang and others, 1996; Kalemli-Ozcan and others, 2015; Magud and Sosa, 2015; Bluedorn and Ebeke, 2016). The key additional variables are firm leverage, size, and intensity of intangibles. The baseline specification is:

$$Y_{it} = \eta_1 Lev_{i,t-1} + \eta_2 Sales_{i,t} + \Theta Controls_{i,t-1} + \alpha_i + \omega_{jt} + \varepsilon_{i,t} \qquad (1)$$

Where Y_{it} denotes firm i's real net tangible investment ratio at time t, calculated as the ratio of the change in real tangible fixed assets to lagged real tangible assets; Lev is firm leverage—measured as the lag in the ratio of total debt to total assets—reflecting the burden of firm debt.[6] $Sales$ is contemporaneous growth in real sales capturing the growth opportunities of the firm or more generally firm-specific demand conditions. $Controls$ include debt maturity proxied by the lagged ratio of long-term debt to total debt and the natural logarithm of total assets. Y, Lev, $Sales$, and $Controls$ are expressed in percent. α are firm i-specific fixed effects and ω are sector j-year t fixed effects that absorb sector-wide yearly common shocks to firms.[7]

a) Effect of leverage and demand

The η_1 and η_2 parameters from equation (1) estimate the direct effect of firm leverage and real sales growth, respectively, on real tangible investment.

Firms with high debt have less external borrowing flexibility relative to less indebted peers when faced with the need to fund a positive net present value project (Lang and others, 1996; Aivazian and others, 2005). By increasing the risk of bankruptcy, a greater debt burden may also incentivize shareholders to forgo value-enhancing investments because expected benefits would mostly accrue to debtholders. Or firms may simply prefer to reduce their debt burden to strengthen their balance sheet to retain financing flexibility and better meet future investment needs (Kuchler, 2015a). Thus, higher firm leverage is expected to correlate negatively with firm investment.

For firms with high real sales growth, capital accumulation rises when demand conditions improve (Guiso and Parigi, 1999). Indeed, a strengthening of domestic conditions improves the responsiveness of investment to a given demand shock (Bloom and others, 2007).[8] To assess the broader investment response to firm leverage and demand in the presence of non-linearities, equation (1) is augmented with interaction terms as follows:

$$Y_{it} = \beta_1 Lev_{i,t-1} + \beta_2 Sales_{i,t} + \beta_3 SME_{i,t} + \theta_1 Lev_{i,t-1} \times Sales_{it} + \theta_2 Lev_{i,t-1} \times SME_{i,t} + \theta_3 Sales_{i,t} \times SME_{i,t} + \theta_4 Lev_{i,t-1} \times Sales_{i,t} \times SME_{i,t} + \Theta Controls_{i,t-1} + \alpha_i + \omega_{jt} + \varepsilon_{i,t} \quad (2)$$

---

[6] Since leverage may be persistent (such as from building-up debt over time to prepare for a future investment opportunity, or from past borrowing associated with previous investments), consideration was given to lagging leverage by two periods instead of one. The main results are generally unchanged under those robustness checks.

[7] The results are robust to removing firm fixed effects and controlling for firm characteristics such as firm age and profitability. Adding region fixed effects also does not affect the main findings.

[8] Strong domestic conditions weaken the real option channel, according to which firms hold back irreversible investment as means to increase resilience to future shocks.

Where *SME* is a dummy variable for firms with less than 250 employees.[9] The total marginal effects of firm leverage and real sales on real investment for SMEs are calculated as $(\beta_1 + \theta_1 \times Sales_{it} + \theta_2 \times SME_{it} + \theta_4 \times Sales_{i,t} \times SME_{it})$ and $(\beta_2 + \theta_1 \times Lev_{it} + \theta_3 \times SME_{it} + \theta_4 \times Lev_{i,t} \times SME_{it})$, respectively. The interaction terms are also used to assess differences in the investment reaction to leverage and demand by SMEs and large firms.

b) Role of knowledge intensity

The idea that knowledge capital is an important driver of modern economic growth is gaining prominence (Corrado and others, 2009). In mature economies like Denmark, investing in ideas and skills (sometimes even more than in physical capital) is driving most of the value of large firms. KBC allows for the design, development, and upgrading of complex and sophisticated products, all of which lie at the heart of competitiveness (OECD, 2013a and b). In the presence of more innovative, higher quality products, a firm is able to differentiate itself and move away from cost-based competition thereby sustaining its position in the market. Indeed, knowledge accumulation from, say computerized information, R&D, product design and branding, employee training, good marketing skills, or efficient organizational management, could improve the quality and desirability of firm products. Thus, if intangible capital strengthens the competitive advantage of a firm, the prospects of higher sales growth could increase, which may in turn boost the investment response. If this is the case, the effect from intangible capital on the firm's investment response to demand should be larger for sectors that are more knowledge-intensive relative to others.

This paper tests this prediction by exploiting industry variation in knowledge intensity using a difference-in-difference approach (Rajan and Zingales, 1998). The difference-in-difference approach consists in identifying an industry-specific factor that affects the way that knowledge intensity could impact the firm's decision to invest more. One such latent characteristic is the knowledge-intensive feature of an industry. If knowledge intensity matters for firm investment, then we should observe a higher investment response to demand in sectors that are knowledge intensive.

We identify knowledge-intensive sectors using Eurostat's taxonomy for high- and medium-technology manufacturing sectors and knowledge intensive services (*Htkis*) (Appendix C) and generate a dummy variable *Htkis* equal to 1 if the firm belongs to such a sector.[10] We then test for the strength of the knowledge intensity channel by extending the baseline equation as follows:

$$Y_{it} = \gamma_1 Lev_{i,t-1} + \gamma_2 Sales_{i,t} + \delta_1 Sales_{i,t} \times Knowledge_{i,t} \times Htkis + \Theta Controls_{i,t-1} + \alpha_i + \omega_{jt} + \varepsilon_{i,t} \quad (3)$$

---

[9] Using an alternative the definition of SMEs such as the classification by Statistics Denmark (as in Figure 2) does not change the results. It should be noted, however, that SMEs as defined by the number of employees may also include subsidiaries of foreign firms operating in Denmark, which are part of a larger firm structure and may therefore behave differently from Danish SMEs.

[10] Eurostat classifies manufacturing industries according to their technology intensity (based on the ratio of R&D expenditures to value added) and services according to their degree of knowledge intensity (based on the share of people with tertiary education in the activity).

Where $Knowledge$ denotes the knowledge intensity measured as the ratio of firm intangible fixed assets to total assets in percent. The coefficient of interest in this specification, δ_1, captures the extent to which knowledge intensity leads to a greater investment response to demand in knowledge-intensive sectors relative to other sectors. To assess heterogeneity in the investment responsiveness more broadly across knowledge-intensive and other sectors, a similar analysis is run by abstracting from the $Htkis_t$ term in equation (3) and running the same specification separately for *Htkis* and *Non-Htkis* sectors.

16.   Data from the Orbis database is used for Danish firms over the period 2010–2015.[11] Unconsolidated data are retained in the sample, allowing the analysis to focus on firms at the plant level.[12] Data prior to 2010 is dropped from the sample and, similar to Kuchler (2015a), sole proprietorships are also excluded. Annex I details the cleaning and filtering procedures that were applied to the original data sample.

17.   Key variables of interest are constructed. The ratio of real net investment to the capital stock in the previous year—the dependent variable—is calculated as the annual change in real tangible fixed assets net of depreciation in percent of the previous year's stock of real net tangible fixed assets.[13] Leverage is measured as the sum of short- and long-term debt scaled by total assets, also in percent. Short-term debt is generated by excluding creditors (debt to suppliers and contractors) and other current liabilities not payable to financial institutions (pension, personnel costs, taxes, intragroup debts, etc.) from total current liabilities. As for long-term debt, it is retrieved from the non-current liabilities portion of the balance sheet which includes, in addition to long-term loans and credits, provisions and other non-interest bearing long-term liabilities not related to financial institutions but to taxes, group companies, pension loans, etcetera. Debt maturity is the share of the long-term debt in percent of total debt. Firm sales growth is the annual percent change in real operating revenue and knowledge intensity is the ratio of intangible assets to total assets, all in percent.

18.   The data exhibit variability across firm size and knowledge-intensity of the industry. Large firms invest in tangible assets more than small firms and, as would be expected given their size and capabilities, their knowledge intensity is much higher too. Further, firms in *Htkis* or knowledge-intensive sectors invest in tangible assets more than firms in *Non-htkis* sectors and their knowledge intensity is naturally also higher. Firm size does not seem to impart significant differences in leverage (real sales growth), with average debt-to-assets (real sales growth) of 43 and 45 percent (5.4 and 5.5 percent), respectively, for SMEs and large firms. Leverage also does not seem

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[11] Danish firm representation in Orbis prior to 2010 is scant in the Orbis database.

[12] Consolidated data report financial statements at the parent level for all firm subsidiaries, whether the subsidiaries are located in Denmark or abroad. In contrast, unconsolidated statements focus on the operations of firms in Denmark at the plant level, all of which contribute to GDP.

[13] In Orbis, tangible fixed assets refer to buildings, machinery, etcetera. Intangible fixed assets include expenses for formation, research, development, goodwill, and all other expenses with a long-term effect. Fixed assets additionally comprise other fixed assets (long-term investments, shares and participations, pension funds) which are not used.

to differ for firms in *Htkis* sectors or otherwise, although firms in *Non-htkis* sectors are able to borrow with longer maturities. However, real sales growth is also higher in *Htkis* versus *Non-htkis* sectors. These statistics suggest that traditional leverage and demand channels of investment may not alone account for differences in investment across different firms.

D.   Empirical Findings

19.   Lower leverage and better demand conditions are associated with higher investment ratios. The direct effects of leverage and real sales reported in Appendix Table B1—η_1 and η_2 parameters from equation (1)—are aligned with those documented for the Euro Area using a similar analysis (Bluedorn and Ebeke, 2016). From the baseline specification, a 10 percentage point reduction in leverage raises tangible investment by 2.9 percentage points; the corresponding figure for the Euro Area is 3.6 percentage points. Similarly, for a 10 percentage points increase in real sales growth, the investment ratio rises by 1.3 percentage points, whereas for corresponding estimate for the Euro Area is 2.6 percentage points.

20.   The economic significance of these effects varies slightly by firm size. The empirical literature (Lang and others, 1996; Kalemli-Ozcan and others, 2015; Bluedorn and Ebeke, 2016) documents that the adverse effect of leverage is statistically stronger and the positive demand effect weaker for smaller firms, typically attributing this finding to more limited access to finance and/or higher financing costs for SMEs. For Danish firms, the results in Table B1 do not point to a statistically different response to leverage and demand conditions across SMEs and large firms, a finding that is similar to Kuchler (2015a) who also reports an insignificant effect for the more heterogeneous group of large firms. This result can be attributed to the fact that access to finance is not reported as a hurdle to investment growth in Denmark (Kramp and Pedersen, 2015; Andersen and Kuchler, 2016). More detailed results by firm size category (Table 2) indicate that the parameter estimate of leverage is slightly larger for the smallest firms, suggesting a more adverse investment response than for other firms. As for demand conditions, although there is similarly no statistical difference in the response of small and large firms (Table B1), the magnitude of the parameter estimates on real sales growth increases as the firm size gets bigger (Table 2). Larger firms respond to better growth opportunities more strongly than small firms maybe because of higher retained earnings and smaller firms may also prefer a wait-and-see strategy before committing to long-term investments.

		Obs.	Mean	St. Dev.	p25	p50	p75	Min	Max
	Table 1. Denmark: Descriptive Statistics by Firm Size and Sector								
By firm size	**Large firms**								
	Real net tangible investment ratio, percent	1,322	5.3	35.9	-10.3	-2.2	11.8	-94.6	200.0
	Knowledge intensity, percent of assets	1,747	5.6	10.0	0.0	1.1	6.6	0.0	70.8
	Real sales growth, percent	1,320	5.4	23.7	-5.4	2.6	12.2	-94.1	100.0
	Debt-to-assets, percent	1,747	43.0	19.6	28.1	42.0	56.5	0.1	96.3
	Long-term debt to total debt, percent	1,747	15.6	23.2	0.0	2.1	25.2	0.0	99.6
	Log(total assets)	1,747	18.6	1.3	17.8	18.5	19.3	13.8	23.6
	SME								
	Real net tangible investment ratio, percent	27,069	3.0	58.3	-26.7	-8.1	9.0	-100.0	200.0
	Knowledge intensity, percent of assets	44,906	3.1	9.2	0.0	0.0	0.7	0.0	98.4
	Real sales growth, percent	26,864	5.5	29.6	-10.2	2.0	16.3	-99.1	100.0
	Debt-to-assets, percent	44,906	45.0	21.2	28.7	44.6	60.8	0.0	99.6
	Long-term debt to total debt, percent	44,904	12.7	21.8	0.0	0.0	18.4	0.0	100.0
	Log(total assets)	44,906	14.6	1.8	13.2	14.4	15.9	9.1	22.8
By sector of knowledge intensity	**Non-knowledge-intensive sectors**								
	Real net tangible investment ratio, percent	20,509	2.4	55.9	-25.2	-7.5	8.5	-100.0	200.0
	Knowledge intensity, percent of assets	33,672	2.1	6.8	0.0	0.0	0.4	0.0	93.3
	Real sales growth, percent	20,354	4.9	28.6	-10.3	1.5	15.2	-99.1	100.0
	Debt-to-assets, percent	33,672	44.8	20.8	28.7	44.4	60.3	0.1	99.6
	Long-term debt to total debt, percent	33,672	13.4	22.0	0.0	0.0	20.5	0.0	99.5
	Log(total assets)	33,672	14.7	1.8	13.3	14.5	16.0	9.1	23.6
	Knowledge-intensive sectors								
	Real net tangible investment ratio, percent	7,882	5.0	61.1	-27.6	-8.1	11.2	-100.0	200.0
	Knowledge intensity, percent of assets	12,981	6.0	13.3	0.0	0.0	4.3	0.0	98.4
	Real sales growth, percent	7,830	7.0	31.1	-8.5	3.1	18.1	-99.1	100.0
	Debt-to-assets, percent	12,981	45.4	22.1	28.7	45.0	61.5	0.0	99.4
	Long-term debt to total debt, percent	12,979	11.5	21.5	0.0	0.0	12.6	0.0	100.0
	Log(total assets)	12,981	14.8	2.1	13.2	14.6	16.2	9.7	22.9
All firms	Real net tangible investment ratio, percent	28,391	3.1	57.4	-26.0	-7.7	9.2	-100.0	200.0
	Knowledge intensity, percent of assets	46,653	3.2	9.3	0.0	0.0	0.9	0.0	98.4
	Real sales growth, percent	28,184	5.5	29.3	-9.9	2.0	16.0	-99.1	100.0
	Debt-to-assets, percent	46,653	45.0	21.2	28.7	44.6	60.6	0.0	99.6
	Long-term debt to total debt, percent	46,651	12.8	21.9	0.0	0.0	18.8	0.0	100.0
	Log(total assets)	46,653	14.7	1.9	13.3	14.5	16.1	9.1	23.6

Source: Eurostat's Labor Force Survey and Fund staff calculations.

21. **The investment response to leverage and demand conditions is insignificant for start-ups but pronounced for young firms.** Table 3 shows results similar to those in Table 2 but with firm age substituted for firm size. Columns (1) and (2) show insignificant effects from leverage and real sales growth on tangible investment for start-ups (less than 5 years of age). It could be that those companies operate with more equity than debt financing relative to older firms and they are also less sensitive to real sales growth, as their new products need time to make it to the market. In

comparison, the leverage and demand effects are most pronounced for young firms (companies that have been operating between 5 and 14 years).

Table 2. Denmark: Role of Leverage and Demand by Firm Size Category

Dependent: Real tangible investment	Micro		Small		Medium		Large	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged leverage	-0.350	-0.397	-0.232	-0.236	-0.274	-0.272	-0.300	-0.282
	[0.107]***	[0.116]***	[0.076]**	[0.080]**	[0.051]***	[0.053]***	[0.086]***	[0.087]***
Sales growth	0.107	-0.069	0.106	0.086	0.183	0.193	0.207	0.344
	[0.025]***	[0.055]	[0.036]**	[0.060]	[0.023]***	[0.035]***	[0.054]***	[0.114]**
Lagged leverage x Sales growth		0.004		0.000		-0.000		-0.003
		[0.001]***		[0.001]		[0.001]		[0.003]
Lagged long-term debt to total debt	-0.463	-0.454	-0.429	-0.429	-0.307	-0.307	-0.048	-0.040
	[0.099]***	[0.094]***	[0.080]***	[0.080]***	[0.109]**	[0.109]**	[0.105]	[0.101]
Log(total assets)	33.360	33.055	22.312	22.362	23.923	23.929	7.324	6.705
	[5.982]***	[5.983]***	[4.807]***	[4.776]***	[4.578]***	[4.580]***	[6.042]	[5.499]
Observations	7,846	7,846	9,010	9,010	6,047	6,047	1,254	1,254
R-squared	0.331	0.332	0.304	0.304	0.352	0.352	0.357	0.358

Micro are firms with 2-9 employees; Small employ 10-49 employees; Medium have 50-249 employees; and Large have 250 employees and more. All regressions include firm fixed effects and sector-year fixed effects. Robust standard errors are clustered at the sector level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 3. Denmark: Role of Leverage and Demand by Firm Age Category

Dependent: Real tangible investment	Start-Ups		Young		Mature		Well-Established	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged leverage	-0.086	-0.120	-0.348	-0.383	-0.209	-0.225	-0.478	-0.459
	[0.356]	[0.350]	[0.088]***	[0.100]***	[0.096]*	[0.104]*	[0.103]***	[0.100]***
Sales growth	0.080	0.003	0.210	0.085	0.054	-0.056	0.116	0.254
	[0.062]	[0.130]	[0.032]***	[0.084]	[0.024]**	[0.050]	[0.024]***	[0.072]***
Lagged leverage x Sales growth		0.002		0.003		0.002		-0.003
		[0.002]		[0.002]		[0.001]		[0.001]**
Lagged long-term debt to total debt	-0.662	-0.651	-0.448	-0.444	-0.326	-0.326	-0.257	-0.263
	[0.242]**	[0.241]**	[0.101]***	[0.099]***	[0.102]***	[0.102]***	[0.066]***	[0.068]***
Log(total assets)	22.669	22.511	28.178	28.165	26.015	26.035	27.718	27.709
	[11.506]*	[11.425]*	[4.721]***	[4.759]***	[5.137]***	[5.094]***	[3.942]***	[4.088]***
Observations	1,266	1,266	9,212	9,212	11,368	11,368	3,093	3,093
R-squared	0.450	0.450	0.319	0.319	0.287	0.288	0.323	0.323

Start-ups are less than 5 years old; Young have ben operating for 5-14 years old; and Well-Established have more than 35 years of operations. All regressions include firm fixed effects and sector-year fixed effects. Robust standard errors are clustered at the sector level in brackets. *** p<0.01, ** p<0.05, * p<0.1

22. **The results lend support to the presence of a knowledge intensity channel.** When considering the role of knowledge intensity (Table 4), the coefficients on leverage and real sales growth are little changed relative to the baseline estimation (Table B1, Column 1). The parameter of interest—δ_1 from equation (3)—is positive and statistically significant (Column 3). Its order of magnitude is about 10 percent of the response of investment to real sales growth and the total marginal effect of real sales growth is highly significant. This result provides evidence that a greater

knowledge intensity boosts the investment response to demand for firms operating in knowledge-intensive sectors.

23. **Additional tests by sector confirm the strength of the knowledge intensity channel, especially for smaller firms.** Table B2 shows the results from the baseline specification (equation 1) and the difference-in-difference specification (equation 3) by knowledge-intensive and non-knowledge-intensive sector.[14] What stands out is the persistent strength of the knowledge intensity channel for knowledge-intensive sectors. The coefficient on the interaction term is positive and statistically significant for the *Htkis* sector (Column 4) but not for other industries (Column 3). Another interesting finding is a smaller size effect on firm investment in *Htkis* sectors, whereby the economic significance of the parameter estimate of log(total assets) drops by half. Further tests by firm size class (Table B3) indicate that the knowledge intensity channel in *Htkis* sectors is stronger for smaller firms with less than 50 employees.

Table 4. Denmark: Role of Knowledge Intensity			
Dependent: Real tangible investment	(1)	(2)	(3)
Lagged leverage	-0.292	-0.294	-0.293
	[0.045]***	[0.045]***	[0.045]***
Sales growth	0.130	0.116	0.115
	[0.016]***	[0.017]***	[0.017]***
Knowledge Intensity x Htkis	0.346	0.230	
	[0.141]**	[0.191]	
Sales growth x Intangibles Intensity x		0.010	0.010
		[0.001]***	[0.001]***
Lagged long-term debt to total debt	-0.376	-0.377	-0.377
	[0.076]***	[0.075]***	[0.075]***
Log(total assets)	26.322	26.168	26.191
	[3.650]***	[3.641]***	[3.645]***
Observations	24,952	24,952	24,952
R-squared	0.310	0.311	0.311

Htkis refer to high- and medium-technology manufacturing sectors and knowledge intensive services (Appendix Table A3). All regressions include firm fixed effects and sector-year fixed effects. Robust standard errors clustered at the sector level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

24. **Greater knowledge intensity is associated with a stronger investment response to demand.** Figure 7 illustrates the predicted effect of demand on investment for high and low knowledge intensity firms in *htkis* sectors, overlaid on the sample distribution of real sales growth which is roughly symmetric. For these sectors, the investment response to demand is significantly boosted for high knowledge-intensive firms. A 10 percent rise in sales growth is associated with a 5 percentage point increase in the real investment ratio for a high knowledge intensity firm

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[14] These sectoral tests suggest potentially greater heterogeneity in the investment response than what is usually captured by sector fixed effects only, but a fuller investigation is beyond the current scope of the paper.

(intangibles-to-assets ratio above 95 percent), while the response is less than 2 percentage points for a low knowledge intensity firm (intangibles-to-assets ratio below 5 percent) in *htkis* sectors. Figure 8 brings in an additional dimension to the picture, comparing the investment response to demand for *htkis* and non-*htkis* sectors also at different levels of knowledge intensity. Going from the 5th percentile to the 95th percentile of knowledge intensity (from 0 to 37 percent of the intangibles-to-assets ratio) is associated with a further 5 percentage points higher investment response to a 10 percentage point rise in real sales growth, with the results also positive but insignificant for non-*htkis* sectors. These findings are consistent with the hypothesis of a knowledge intensity channel. It appears that firms in *htkis* sectors are better able to respond to a demand shock if their knowledge intensity is greater.

Figure 7. Predicted Effect of Real Sale Growth for Firms in HTKIS Sectors
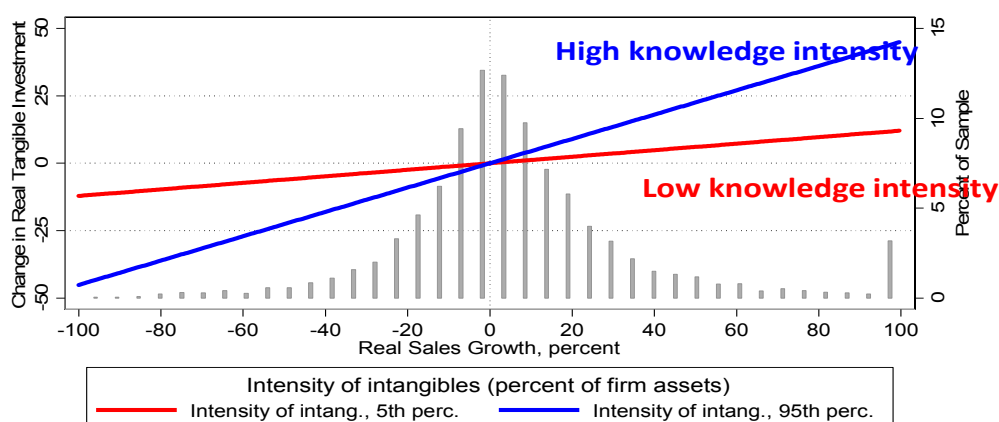
Note: Lines show the predicted change in firm real tangible investment given the indicated value of real sales growth, with the intensity of intangibles at either the 5th or 95th percentile of its distribution. Bars show the histogram of real sales growth, with percent of the sample shown on right axis. Change in Real Tangible Investment is a ratio in percentage points. Parameter estimates are significant at the 1 percent level

Figure 8. Marginal Effect of Real Sales Growth
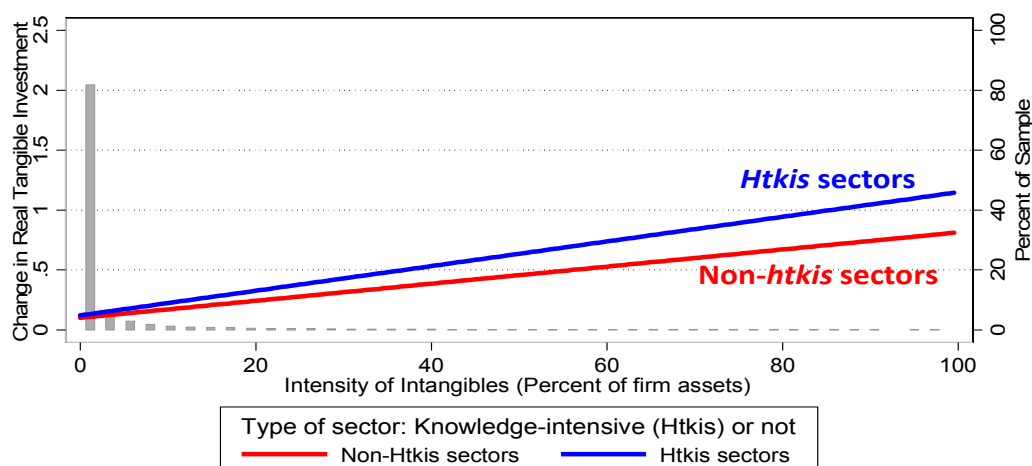
Note: Lines show the marginal effect of one percentage point change in real sales growth on firm real tangible investment, given the indicated value of intensity of intangibles and whether or not the firm is in Htkis sector. Bars show the histogram of the intensity of intangibles, with percent of the sample shown on the right axis. Change in Real Investment is a ratio in percentage points. Parameter estimates are significant for htkis firms (1 percent level).

E.   Conclusion

25.   There is a negative effect from leverage on firm investment.[15] Abstracting from the effects of the crisis and focusing on the more recent period of 2010–2015, this study examined the dynamics of firm investment in Denmark. The results indicate that high corporate leverage dampens investment in tangible fixed assets. Debt overhang in Denmark constrains firms of all sizes, unlike other European countries where SME financing constraints are more important.

26.   Strong demand conditions raise investment. The positive relationship between real sales growth and firm investment in Denmark is similar to what is documented for other European countries (Banerjee and others, 2015; Bluedorn and Ebeke, 2016), although firm size also does not seem to play a significant role in Denmark.
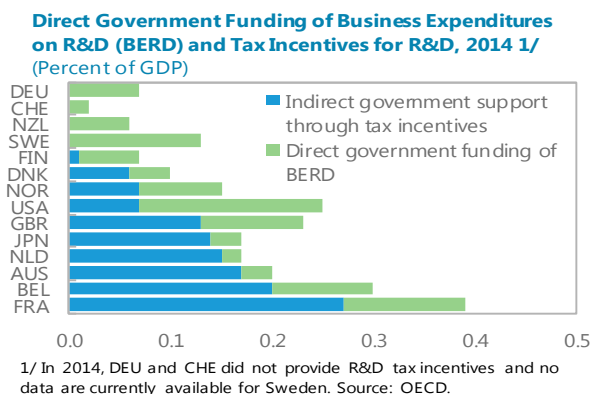
27.   The responsiveness of investment to demand is boosted by greater knowledge intensity for firms operating in knowledge-intensive industries. By identifying intangible assets or KBC on corporate balance sheets and using a difference-in-difference approach, this chapter shows that greater knowledge intensity leads to a stronger investment response to a positive demand shock in sectors that are more knowledge-intensive. This knowledge intensity channel is strong not only in sectors that are highly dependent on KBC but also for small firms. Such evidence on the mechanisms through which the demand channel works could benefit policy assessment on how to minimize macroeconomic volatility from variations in investment.

28.   Policies to reduce firm leverage, including via the tax system, could stimulate corporate investment in Denmark. Despite the reduction of corporate tax rates and limits to interest rate deductions, the Danish tax system considerably favors debt over equity financing (Kuchler, 2015b). Considering the very high corporate debt in Denmark, policies should seek to reduce firm leverage thereby also helping contain macroeconomic stability risks. In some countries, introducing an incremental Allowance for Corporate Equity (ACE) has proved to be effective in mitigating the debt bias, helping harmonize the tax treatment of various types of financing (IMF, 2016a).[16] One of the attractive properties of the incremental ACE is that it neutralizes the debt bias, which renders corporate income tax neutral with respect to marginal investment decisions. By shifting the capital structure from debt to equity, the ACE would reduce leverage ratios, which this study shows can help boost investment in Denmark.

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[15] The analysis has documented sectoral heterogeneity in the results, suggesting that payoffs to investment projects may vary across industries, an issue that was not further investigated in this paper.

[16] The ACE seems well-established in Italy; Switzerland is planning to introduce it; and Belgium is considering removing it for reasons unrelated to implementation or effectiveness. Other countries have a similar tax scheme for sectors where economic rents are important; e.g., Norway has a special petroleum tax scheme under which the tax base equals taxable income minus an allowance of 7.5 percent of the investment cost for the first four years.

29. **Encouraging investment in intangibles will further broaden KBC and help boost investment as the economy strengthens further.** Policies aimed at encouraging the accumulation of intangibles—notably in knowledge-intensive industries—are helpful, especially if directed toward smaller firms. Fiscal incentives for one form of intangible investment, R&D, are already in place in Denmark, but their scope could be broadened. Whereas it is difficult to establish which type of instrument fosters innovation more effectively, subsidies and tax incentives each have their own strengths and can usefully complement each other (IMF, 2016b).

Direct Government Funding of Business Expenditures on R&D (BERD) and Tax Incentives for R&D, 2014 1/
(Percent of GDP)

Legend:
- Indirect government support through tax incentives
- Direct government funding of BERD

1/ In 2014, DEU and CHE did not provide R&D tax incentives and no data are currently available for Sweden. Source: OECD.

30. **Deeper understanding of the role of intangibles requires improved measurement.** By using a firm-reported measure of intangibles, the analysis likely accounts for wide-ranging intangible investments that are beyond what is recorded in the national accounts. To better capture the benefits from knowledge capital, it would be helpful to extend the capitalization of intangibles in the national accounts to expenditures on economic competencies that refer to firm investment in reputation and human and organizational capital.

References

Aivazian, V., Y. Ge, and J. Qiu. 2005. "Debt Maturity Structure and Firm Investment." *Financial Management* 34(4), 107–119. Available via the internet: https://www.jstor.org/stable/3666400?seq=1#page_scan_tab_contents

Andersen, S., G and A. Kuchler, 2016. "Credit Standards and Capital Allocation in a Low Interest Rate Environment," Danmarks Nationalbank Working Paper No. 107. Available via the internet: http://www.nationalbanken.dk/en/publications/Pages/2016/06/Working-paperCredit-standards-and-capital-allocation-in-a-low-interest-rate-environment_EN.aspx

Banerjee, R., J. Kearns, and M. Lombardi, 2015. "(Why) Is Investment Weak?" BIS Quarterly Review, March. Available via the internet: http://www.bis.org/publ/qtrpdf/r_qt1503g.pdf

Bloom, N., S. Bond, and J. Van Reenen. 2007. "Uncertainty and Investment Dynamics," *Review of Economic Studies* 74, 391–415. Available via the internet: https://oup.silverchair-cdn.com/oup/backfile/Content_public/Journal/restud/74/2/10.1111/j.1467-937X.2007.00426.x/2/74-2-391.pdf?Expires=1487425192&Signature=aoOqDF73~IOUCp-EBqCagtze5gxcTQfILu1simGjR2Cii1rzLNMW9bcUpu4vgJRJjWg3mJMSL3KEOR4YYb7HujW-WWrlH9R-06OeO4PEcWIej6EfyX9QrHgUce-v6EItvB8km9wB2f2W6Fazfsz0QmiQdIWaP0tTQu5b0YjwgbooUG6r2T5Nbmi1RPvYqsPzcTWwknKpgU-v0tKy9bB~tSKP1VNleBMpoQMCWdXs6Il-gtQ401Y1xdwgHZYFSUg8qPUPnv5kfyjTI19Iv0G6yJVyADc9XmlrBqI-qp0ZJPmXUSYLosxiDaxwRy0~AKLqSBsJMxCr~4mobeUM17BBrA__&Key-Pair-Id=APKAIUCZBIA4LVPAVW3Q

Bluedorn, J. and C. Ebeke, 2016. "Investment, Firm Size, and the Corporate Debt Burden: A Firm-Level Analysis of the Euro Area," International Monetary Fund (IMF), Euro Area Selected Issues, Washington DC. Available via the internet: https://www.imf.org/external/pubs/ft/scr/2016/cr16220.pdf

Brandt, K.E., J. Isaken, and S.V. Sørensen, 2012. "Corporate Saving and Investment," Monetary Review, 4th quarter, Part 1, pp. 57–70, Danmarks Nationalbank. Available via the internet: http://www.nationalbanken.dk/en/publications/Documents/2013/01/Mon_Rev_1_Del_2012.pdf

Cleary, S., 1999. "The Relationship Between Firm Investment and Financial Status," *Journal of Finance* 54, 673–692. Available via the internet: http://onlinelibrary.wiley.com/doi/10.1111/0022-1082.00121/abstract

Corrado, C., C. Huklten, and D. Sichel, 2009. Intangible capital and U.S. economic growth, *Review of Economics and Wealth* 55(3), 661–685. Available via the internet: http://onlinelibrary.wiley.com/doi/10.1111/j.1475-4991.2009.00343.x/epdf

Corrado, D., J. Haskel, C. Jona-Lasinio, and M. Iommi, 2013. "Innovation and Intangible Investment in Europe, Japan, and the United States," *Oxford Review of Economic Policy* 29(2), 261–286. Available via the internet: https://academic.oup.com/oxrep/article-abstract/29/2/261/523018/Innovation-and-intangible-investment-in-Europe?redirectedFrom=PDF

———, 2016. "Intangible Investment in the EU and US Before and Since the Great Recession and its Contribution to Productivity Growth," European Investment Bank Working Paper 216/08. Available via the internet: http://bei.europa.eu/attachments/efs/economics_working_paper_2016_08_en.pdf

Danish Economic Council, 2016. "Danish Economy," Autumn. Available via the internet: https://www.dors.dk/files/media/rapporter/2016/E16/e16_english_summary.pdf

Danmarks Nationalbank, 2015. "Monetary Review," 2nd Quarter. Available via the internet: http://www.nationalbanken.dk/en/publications/Documents/2015/06/Monetary%20Review%202nd%20Quarter%202015.pdf

Griliches, Z., B. H. Hall, and A. Pakes, 1991. "R&D, Patents, and Market Value Revisited: Is there a Second (Technological Opportunity) Factor?" *Economics of Innovation and New Technology* 1(3), 183–201. Available via the internet: http://www.tandfonline.com/doi/abs/10.1080/10438599100000001?journalCode=gein20

Guiso, L. and G. Parigi, 1999. "Investment and Demand Uncertainty," *Quarterly Journal of Economics* 114(1), 185–227. Available via the internet: https://www.jstor.org/stable/pdf/2586951.pdf

Haskel, J., 2016. "Intangibles, Mismeasurement, and the International Productivity Slowdown," Imperial College, London Business School Discussion Paper 2016/04, July. Available via the internet: https://spiral.imperial.ac.uk/bitstream/10044/1/34720/2/Haskel%202016-04.pdf

International Monetary Fund, 2015. World Economic Outlook, April 2015, Washington, D.C. Available via the internet: http://www.imf.org/external/pubs/ft/weo/2015/01/pdf/text.pdf

———, 2016a. Taxation, leverage, and Macroeconomic Stability, Policy Paper, D.C. Available via the internet: https://www.imf.org/external/np/pp/eng/2016/100716.pdf

International Monetary Fund, 2016b. Fiscal Monitor, April, Chapter 2, D.C. Available via the internet: file:///C:/Users/rturk/Downloads/_fm1601pdf.pdf

Jaffe, A., M. Trajtenberg, and R. Henderson, 1993. "Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations," *Quarterly Journal of Economics* 108(3), 577–598. Profits and Market Value. NBER Working Paper, 1986. Available via the internet: https://www.jstor.org/stable/2118401?seq=1#page_scan_tab_contents

Kalemli-Özcan, Ş., L. Laeven, and D. Moreno. 2015. "Debt Overhang in Europe: Evidence from Firm-Bank-Sovereign Linkages." Manuscript. Available via the internet:
https://www.imf.org/external/pubs/ft/scr/2016/cr16220.pdf

Kramp, P., L. and J. Pedersen, 2015. "Why is Investment So Weak?" Monetary Review, 2nd quarter, pp. 1–12, Danmarks Nationalbank. Available via the internet:
https://www.nationalbanken.dk/en/publications/Documents/2015/06/Why%20is%20Investment%20so%20Weak.pdf

Kuchler, A., 2015a. "Firm Leverage and Investment During the Crisis," Danmarks Nationalbank Working Paper No. 96. Available via the internet:
http://www.nationalbanken.dk/da/publikationer/Documents/2015/06/DNWP_96_Firm.pdf

———, 2015b. "Firms' Leverage and Investment," Monetary Review 3rd quarter 2015, pp. 63–72, Danmarks Nationalbank. Available via the internet:
https://www.nationalbanken.dk/en/publications/Documents/2015/09/Firms_Leverage_and_Investment.pdf

Lang, L., E. Ofek, and R. Stulz. 1996. "Leverage, Investment, and Firm Growth," *Journal of Financial Economics* 40, n. 1: 3–29. Available via the internet:
http://www.sciencedirect.com/science/article/pii/0304405X95008423

Magud, N. and S. Sosa, 2015. "Investment in Emerging Markets: We are not in Kansas Anymore or are we?" International Monetary Fund Working Paper WP5/77, Washington DC. Available via the internet: https://www.imf.org/external/pubs/ft/wp/2015/wp1577.pdf

Organisation for Economic Co-operation and Development, 2013a. New Sources of Growth: Knowledge-Based Capital. Available via the internet:
http://www.oecd.org/sti/inno/newsourcesofgrowthknowledge-basedcapital.htm

———, 2013b. Supporting Investment in Knowledge Capital, Growth, and Innovation. Available via the internet: http://www.oecd-ilibrary.org/docserver/download/9213021e.pdf?expires=1490127699&id=id&accname=ocid195787&checksum=41EF17CF78043EBA40FC4258DF2FEF13

Rajan, R. and L. Zingales, 1998. Financial Dependence and Growth, *American Economic Review* 88, 559–586. Available via the internet:
https://www.jstor.org/stable/116849?seq=1#page_scan_tab_contents

Appendix I. Data Sample

A number of basic filtering procedures are applied to the sample. The Orbis sample excludes sectors of agriculture, forestry and fishing; financial industry; mining and quarrying; public administration and defense; utilities; and real estate activities. Observations for which key financial variables are nonsensical (e.g., negative values for total assets, fixed assets, current assets and liabilities, and sales) were removed. The original sample included 26,101 firms or a total of 69,922 firm-year observations. After applying the filtering rules detailed above, the final sample was reduced to 19,699 firms or 46,653 firm-year observations. Roughly 96 percent of companies in the dataset are privately held and the majority of firms are SMEs (fewer than 250 employees) distributed across the services, manufacturing, and construction sectors (Table A).

Table AI. Descriptive Statistics by Board Sector

Sector	Real net tangible investment ratio, percent	intensity, percent of assets	sales growth, percent	Debt-to-assets, percent	Long-term debt to total debt, percent	Log (total assets)
C - Manufacturing	2.9	2.5	4.2	43.7	18.8	15.6
F - Construction	2.8	1.5	9.8	45.3	10.2	13.8
G - Wholesale & retail trade; repair of motors	1.7	2.0	3.2	43.9	11.0	15.0
H - Transportation and storage	4.8	1.8	8.2	44.9	22.7	15.4
I - Accommodation and food service activities	6.9	4.2	6.7	46.9	16.4	13.7
J - Information and communication	5.5	10.0	11.3	47.2	6.9	14.6
M - Professional, scientific & technical activities	5.6	4.6	5.5	45.3	8.2	14.5
N - Administrative & support service activities	3.4	3.5	6.1	50.9	12.8	14.5
P - Education	7.4	4.2	4.4	50.9	8.2	13.7
Q - Human health and social work activities	2.5	9.0	4.8	44.9	14.9	13.2
R - Arts, entertainment and recreation	2.7	4.4	4.6	50.3	17.3	14.7
S - Other service activities	5.9	4.4	3.3	44.9	13.0	13.7

Source: Eurostat's Labor Force Survey and Fund staff calculations.

Key variables are winsorized following the practice in the literature. All Orbis nominal data are first converted to local currency and transformed into real values using sector-specific national accounts deflators. Key variables are also winsorized in line with the literature (Cleary, 1999; Aivazian and others, 2005; Bluedorn and Ebeke, 2016). Real sales growth is set to 100 (-100) percent if greater (less) than 100 (-100); the ratios of debt to assets and long-term debt to assets are set to 100 (0) if greater (less) than 100 (0); the ratios of tangible and intangible investment to capital are set to 200 (-200) if greater (less) than 200 (-200).

Appendix II. Additional Tables

Table AII.1 Role of Leverage and Demand					
Dependent: Real tangible investment	(1)	(2)	(3)	(4)	(5)
Lagged leverage	-0.289	-0.310	-0.308	-0.350	-0.306
	[0.045]***	[0.050]***	[0.136]**	[0.131]**	[0.135]**
Sales growth	0.130	0.037	0.038	0.157	0.336
	[0.016]***	[0.034]	[0.034]	[0.047]***	[0.103]***
Lagged leverage x Sales growth		0.002	0.002	0.002	-0.002
		[0.001]**	[0.001]**	[0.001]**	[0.003]
SME			-12.235	-12.175	-10.627
			[8.892]	[8.233]	[9.093]
Lagged leverage x SME			-0.001	0.043	-0.002
			[0.147]	[0.144]	[0.155]
Sales growth x SME				-0.124	-0.309
				[0.059]*	[0.107]**
Lag. leverage x Sales growth x SME					0.004
					[0.003]
Lagged long-term debt to total debt	-0.376	-0.374	-0.373	-0.373	-0.373
	[0.075]***	[0.075]***	[0.075]***	[0.075]***	[0.075]***
Log(total assets)	26.365	26.367	26.139	26.172	26.166
	[3.670]***	[3.683]***	[3.703]***	[3.702]***	[3.694]***
Observations	24,952	24,952	24,952	24,952	24,952
R-squared	0.310	0.310	0.310	0.311	0.311

All regressions include firm fixed effects and sector-year fixed effects.
Robust standard errors clustered at the sector level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table AII.2 Role of Knowledge Intensity by Sector				
	Non-Htkis	Htkis	Non-htkis	Htkis
Dependent: Real tangible investment	(1)	(2)	(3)	(4)
Lagged leverage	-0.266	-0.354	-0.265	-0.361
	[0.058]***	[0.087]***	[0.058]***	[0.084]***
Sales growth	0.112	0.171	0.100	0.121
	[0.023]***	[0.015]***	[0.022]***	[0.030]***
Sales growth x Knowledge Intensity			0.007	0.010
			[0.004]	[0.002]***
Lagged long-term debt to total debt	-0.435	-0.218	-0.437	-0.224
	[0.064]***	[0.123]	[0.064]***	[0.119]
Log(total assets)	31.805	16.349	31.841	15.990
	[3.401]***	[6.863]**	[3.370]***	[6.595]**
Observations	18,068	6,884	18,068	6,884
R-squared	0.312	0.312	0.312	0.314

Htkis refer to high- and medium-technology manufacturing sectors and knowledge intensive services
(Appendix C). All regressions include firm fixed effects and sector-year fixed effects.
Robust standard errors clustered at the sector level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table AII.3 Role of Knowledge Intensity by Firm Size Category								
	Micro		Small		Medium		Large	
Dependent: Real tangible investment	Non-htkis	Htkis	Non-htkis	Htkis	Non-htkis	Htkis	Non-htkis	Htkis
Lagged leverage	-0.295	-0.487	-0.238	-0.258	-0.206	-0.421	-0.231	-0.384
	[0.139]*	[0.144]**	[0.065]**	[0.215]	[0.055]***	[0.120]***	[0.109]*	[0.300]
Sales growth	0.094	0.057	0.070	0.128	0.167	0.186	0.052	0.439
	[0.029]**	[0.042]	[0.041]	[0.062]*	[0.033]***	[0.056]**	[0.097]	[0.069]***
Sales growth x Knowledge Intensity	0.007	0.015	0.006	0.011	0.001	0.004	0.019	-0.022
	[0.007]	[0.003]***	[0.003]*	[0.003]***	[0.006]	[0.006]	[0.001]***	[0.007]**
Lagged long-term debt to total debt	-0.487	-0.448	-0.495	-0.219	-0.336	-0.237	-0.167	0.095
	[0.126]***	[0.080]***	[0.060]***	[0.194]	[0.073]***	[0.237]	[0.130]	[0.115]
Log(total assets)	41.002	20.031	25.386	14.413	24.730	21.812	8.840	7.671
	[4.153]***	[8.361]**	[4.177]***	[11.285]	[5.002]***	[5.996]***	[8.808]	[7.236]
Observations	5,754	2,091	6,760	2,250	4,207	1,840	807	447
R-squared	0.343	0.313	0.296	0.334	0.343	0.374	0.373	0.406

Htkis refer to high- and medium-technology manufacturing sectors and knowledge intensive services (Appendix C). Micro are firms with 2-9 employees; Small employ 10-49 employees; Medium have 50-249 employees; and Large have 250 employees and more. All regressions include firm fixed effects and sector-year fixed effects. Robust standard errors are clustered at the sector level in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix III. High-Tech and Knowledge-Intensive Sectors (NACE Rev. 2)

Manufacturing

High-technology:

Manufacture of basic pharmaceutical products and pharmaceutical preparations (21)

Manufacture of computer, electronic and optical products (26)

Manufacture of air and spacecraft and related machinery (30.3)

Medium-high-technology:

Manufacture of chemicals and chemical products (20)

Manufacture of weapons and ammunition (25.4)

Manufacture of electrical equipment (27)

Manufacture of machineryand equipment n.e.c. (28)

Manufacture of motor vehicles, trailers and semi-trailers (29)

Manufacture of other transport equipment (30) excluding Building of ships and boats (30.1) and excluding Manufacture of air and spacecraft and related machinery (30.3)

Manufacture of medical and dental instruments and supplies (32.5)

Services

High-tech knowledge-intensive services:

Motion picture, video and television programme production, sound recording and music publishing activities (59)

Programming and broadcasting activities (60)

Telecommunications (61)

Computer programming, consultancy and related activities (62)

Information service activities (63)

Scientific research and development (72)

Knowledge-intensive market services (excluding financial intermediation and high-tech services):

Water transport (50)

Air transport (51)

Legal and accounting activities (69)

Activities of head offices; management consultancy activities (70)

Architectural and engineering activities; technical testing and analysis (71)

Advertising and market research (73)

Other professional, scientific and technical activities (74)

Employment activities (78)

Security and investigation activities (80)

Knowledge-intensive financial services:

Financial service activities, except insurance and pension funding (64)

Insurance, reinsurance and pension funding, except compulsory social security (65)

Activities auxiliary to financial services and insurance activities (66)

Other knowledge-intensive services:

Publishing activities (58)

Veterinary activities (75)

Public administration and defence; compulsory social security (84)

Education (85)

Human health activities (86)

Residential care activities (87)

Social work activities without accommodation (88)

Creative, arts and entertainment activities (90)

Libraries, archives, museums and other cultural activities (91)

Gambling and betting activities (92)

Sports activities and amusement and recreation activities (93)

Source: Eurostat, European Commission websites:

http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries

http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Knowledge-intensive_services_(KIS).