

Economic Commentaries

Definitions of income and debt in Sweden

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Introduction

A widely used measure when analysing the financial conditions in the household sector, whether it is from an indebtedness, financial stability or distributional policy perspective, is the debt-to-income (DTI) ratio. The DTI is also a potential macroprudential policy tool used in some countries to limit credit growth. In Sweden, both the Riksbank² and Finansinspektionen³ have stressed the need to consider implementing DTI limits in order to dampen household indebtedness. Yet, before calibrating such a policy tool, it is useful to consider the various ways in which the DTI can be measured. Income and debt may be defined in different ways depending on the source, sample and treatment of the data. This in turn may lead to different assessments of household indebtedness, both in terms of levels and distribution of debt, and in terms of what a reasonable DTI limit may be if introduced.

Based on the Riksbank's credit data⁴ of borrowers from the eight largest banks⁵ in Sweden, this Economic Commentary aims to illustrate how various definitions of income and debt, on both the individual and household level, can influence the average level and distribution of the DTI ratio.

In previous Riksbank publications on household debt⁶, the focus has been on presenting the actual levels and distribution of the DTI ratio, loan-to-value (LTV) ratios and amortisation behaviour in Sweden. For the purpose of obtaining an overview of debt levels and debt repayment behaviour, choices had to be made regarding which debt measures to use. In this Economic Commentary, we take a step back, and instead discuss alternative definitions of indebtedness within the narrower context of the DTI ratio.

Based on a sample of mortgage borrowers representing 97 per cent of the stock of mortgage borrowers in Sweden, we show that the DTI ratio is sensitive to how income and debt are defined and whether the ratio is based on individuals or households. This sensitivity implies significant differences between the mean and median DTI ratio distributions.

Below, we first discuss the pros and cons of defining DTI ratios based on households versus individuals. We then go on to present three different definitions of income and show how these differ in level and over time. We then

The debt-to-income (DTI) ratio is frequently discussed in conjunction with possible macroprudential measures to restrict the build-up of vulnerabilities among Swedish households due to rising household debt and to increase the resilience of the Swedish economy. This Economic Commentary illustrates how the DTI ratio, a measure often used to describe household indebtedness, can vary depending on the definition of income and debt used, and whether the ratio is based on individuals or households. Because different households have different marginal propensities to consume, the DTI definition employed is likely to influence the effect of any DTI policy implemented.

1. The authors wish to thank Gustav Alfelt, Johan Almenberg, Kerstin Hallsten, Tor Jacobson and Kasper Roszbach for useful comments.

2. See *Financial Stability Report 2015:2* and *Financial Stability Report 2016:1*, Sveriges Riksbank.

3. See *Stability in the Financial System*, Finansinspektionen May 2016.

4. This credit data represent the stock of borrowers in these banks and should not be confused with Finansinspektionen's survey data of new mortgage borrowers.

5. The eight largest banks are Danske Bank, Handelsbanken, Länsförsäkringar Bank, Nordea, SBAB, SEB, Skandiabanken, and Swedbank.

6. See Winstrand, J. and Ölcer, D. (2014), How Indebted are the Swedish Households, *Economic Commentaries* No. 1, 2014, Sveriges Riksbank and Alfelt, G. and Winstrand, J. (2015), Household Indebtedness in Sweden – update for 2014, *Economic Commentaries* No. 1, 2015, Sveriges Riksbank.

present the debt levels when shared loans are assigned to household members in two ways. Finally, we show how the DTI ratio may differ for different definitions of income and debt used, both for individuals and households.

Household definitions

Since adult household members in Sweden need approval for assuming loans, borrowing decisions are legally made at the household level, rather than by individual household members. An analysis of indebtedness would therefore ideally be conducted at the household level.

Our loan level data are gathered and provided by the credit bureau UC on behalf of the eight major banks. UC matches the borrowers of the loans with their income and address among other information and then anonymizes the data. A practical reason for us to study individuals, in addition to households, is that our data do not contain a commonly accepted household identifier. In other words, we do not observe the identity of a given borrower's partner (either married or cohabiting) in order to group individuals into households.

Our data record the address of a borrower. However, rather than observing the precise address, the street name and number has been converted into a serial number by UC, for privacy reasons. One immediate issue that arises here is that the street name plus street number is insufficient to identify individual apartments within an apartment complex. In many cases, the exact apartment number is known by UC, but in some cases it is not, resulting in a non-negligible number of addresses with many residents.⁷

To obtain a better definition of a household, we combine the address-based household definition with information on co-applications for loans. We observe all borrowers associated with a given loan contract. Borrowers are therefore classified into households based on who they share loans with. To combine the address-based and loan-based household definitions, we use the following rules of thumb:

- Individuals in one-member households (based on address) are single-person households, even if they share loans with people living at other addresses.⁸
- Individuals in multiple-member households (based on address) are grouped into households with people they share both address and loan with.

Using these rules as a basis, our constructed household definition implies that only 0.12 per cent of households contain more than two adult members, drastically improving the imprecise address-based definition.

Even though we believe that this constructed household definition reasonably captures actual cohabiting arrangements between individuals, and therefore their debt-sharing conditions, we emphasize that it will not be a perfect description of an actual household. In addition, since our data do not contain information on non-indebted individuals, we do not observe, for instance, the income of non-indebted members of the household. This could be relevant, for example, in households where one member assumed a loan before the joint household was formed, so that co-signing of a loan was not yet required.

With these limitations of analysing individuals versus households in mind, we report results for both households and individuals.

7. Around 90 per cent of the approximately two million addresses have one or two residents. Six per cent of individuals live at an address with at least 20 residents.

8. This can occur if, for instance, a parent co-signs a mortgage loan for a child.

Income definitions

We consider three measures of individual income; gross income (GI), net income (NI) and disposable income (DI). The first and the last are reported directly by the Swedish Tax Agency (Skatteverket) to the credit bureau UC, while net income is calculated by us given the information about individuals' total taxes and net capital income.

- Gross income (or earned income, *förvärvsinkomst*) includes income from employment, pension income and profits for self-employment, minus pension savings deductions.
- Net income (or earned income after taxes disregarding capital, *nettoinkomst*) is defined as gross income minus all taxes not related to capital.
- Disposable income (or after-tax income, *inkomst efter skatt*) is defined as gross income plus net capital income minus all taxes.

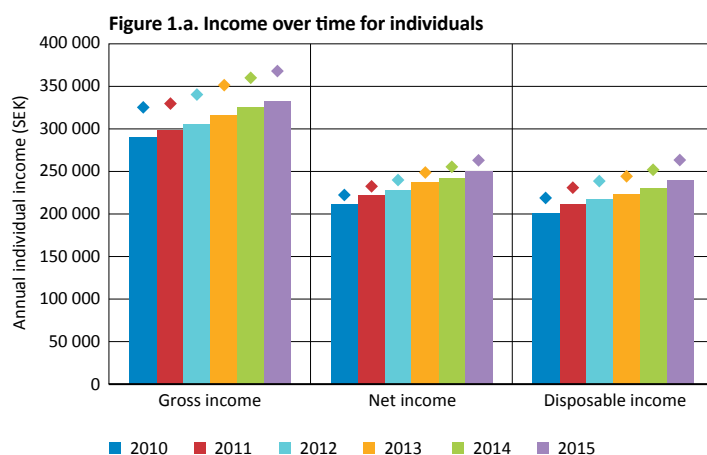
For assessing indebtedness, each income measure has its own advantages and disadvantages. Gross income has the advantage of excluding net capital income, which (for the vast majority) is not a stable source of income, and can be large (either negative or positive). Excluding these transitory income components therefore yields a more stable income measure, matching the long-term nature of mortgage debt. Net income has the same advantage, and in addition deducts all non-capital taxes paid. However, excluding taxes on net capital income implies that tax deductions of mortgage interest payments are not accounted for either, which in our mortgage-borrowers-only sample may be a considerable amount. Disposable income is closer to actual income in a given year as it includes net capital income and subtracts all taxes, and is therefore a better description of current debt capacity, but less stable due to realized capital income.

In the data, we observe negative disposable income. This implies that those individuals have a negative DTI ratio. In order to avoid negative DTI measures, we exclude individuals with negative disposable income.

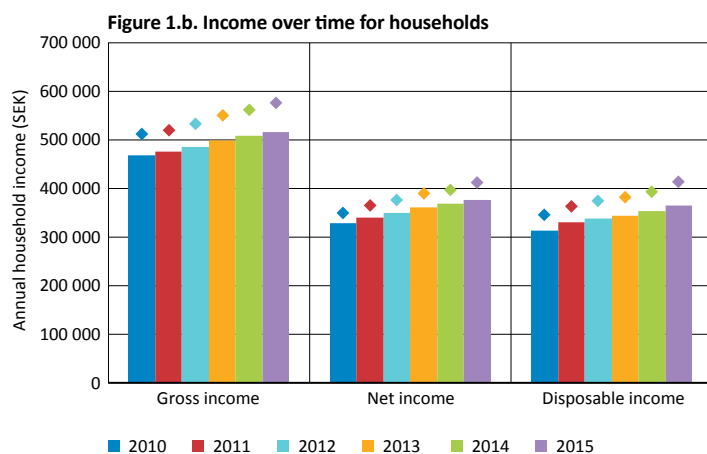
None of the income measures takes (tax-free) transfers, such as child and housing support, into account, which is particularly relevant for low-income households. This implies that (*ceteris paribus*) we will overestimate the DTI levels, and more so for low-income households, using our three measures of income.⁹ Unfortunately, individuals' income including tax-free transfers is not available to us.

Figure 1.a and Figure 1.b show the development of the three different income measures, at the individual and household level, respectively, over the period 2010–2015. The bars denote the medians, while the diamonds denote the means, a convention we use throughout this Economic Commentary. Figure 1.a and Figure 1.b not only show that there are significant differences in income levels depending on whether the individual or household is considered, but also that the levels of income depend on which income measure is used. Not surprisingly, gross income is significantly higher than the after-tax measures of income. But whereas the levels do differ, the trends are very comparable across the different income measures. In other words, we expect the different income measures to primarily affect the level of the debt-to-income ratios, but not its trend over time.

9. A median household (with a monthly gross income of SEK 43,075), having two children, is entitled to SEK 2,250 in child support per month. This means that this tax free transfer corresponds to 5.2 per cent of the household's gross income, implying that we overestimate the DTI ratio for this household by approximately 5.2 per cent.



Note. The bars denote the medians, while the diamonds denote the means.



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Debt definitions

The credit data includes all loans (mortgages, credit cards and other consumer loans) extended by the eight largest banks in Sweden. The preferred measure of debt is therefore the sum of all loaned amounts, per borrower. Note that we do not have information on debt outside the eight largest banks, so this measure does not include student loans extended by CSN, for instance, nor second lien mortgages taken at niche banks.

For every loan, we observe the anonymised identities of the borrowers written on the contract.¹⁰ The majority of the mortgage loans (66 per cent) in our data have two borrowers.

Above, we described some pitfalls of household definitions. With household identifiers in place, five per cent of the loans are shared between households, i.e. people living at different addresses. This can occur if, for instance, a parent co-signs a mortgage loan for a child.¹¹

We next describe how we allocate the loan amount for shared loans to the participating borrowers. We apply the same sets of rules to both households and individuals; for the latter, the way debt is divided between co-applicants has a substantial impact on the level and trend of indebtedness, as about two-thirds of all mortgage loans have multiple borrowers.

One could choose not to divide the borrowed amount at all between the loan-takers. For instance, a mortgage loan of SEK 1 million with two borrowers written on the contract

10. For privacy reasons, the true personal identification number is replaced by a serial code generated by UC.

11. Just as we do not observe partnerships in the data, we cannot identify parent-child relationships.

would result in a loan of SEK 1 million per borrower. This option would be in line with a legal perspective, where all co-applicants are ultimately responsible for the full amount. Though from an economic perspective, this option is less attractive, as we would double-count all shared loan amounts. Therefore, we do not pursue this option.

Below, we give four examples of how shared debt could be split between borrowers.

1. Debt is split equally between borrowers co-signing the loan
2. Debt is split proportionally to the borrowers' gross income
3. Debt is split proportionally to the borrowers' net income
4. Debt is split proportionally to the borrowers' disposable income

The first option in the above list is to split the debt equally between the loan-takers. For instance, a mortgage loan of SEK 1 million with two borrowers written on the contract would result in two loans of SEK 500,000, one loan per borrower.

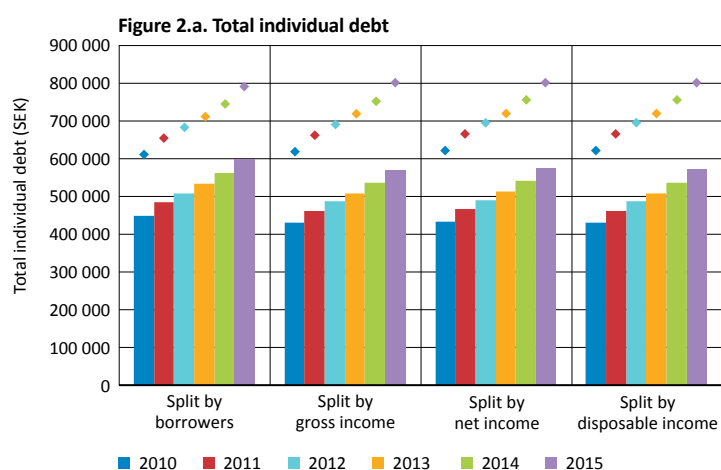
The second, third and fourth option are to divide the debt proportionally to each borrower's gross, net, and disposable income, respectively.¹² As an example, consider the same SEK 1 million loan, if borrower A has an (annual) income of SEK 100,000 and borrower B an income of SEK 300,000, debt for borrower A would amount to SEK 250,000 (i.e. the SEK 1 million loan times his share of income, $100,000 / (100,000 + 300,000) = 0.25$). Debt for borrower B would amount to SEK 750,000. This way, the borrower with the highest income is allocated most of the debt.

Choosing between the first option based on the number of borrowers and the other three options based on income is not trivial, and has significant implications for how the DTI ratio varies with income. To illustrate this point, consider the same two borrowers described above. When splitting debt equally (option 1), borrower A has a DTI of 500 per cent, whereas borrower B has a DTI of 167 per cent. By construction, when splitting debts based on income (options 2, 3, and 4), both borrower A and B have a DTI of 250 per cent. Note that the DTI of 250 per cent is identical to the ratio obtained by simply dividing total debt by the sum of the borrowers' incomes, i.e. $\text{SEK } 1 \text{ million} / (100\,000 + 300\,000) = 250 \text{ per cent}$. For completeness, note that the DTI of both borrowers would be much higher when not splitting the debts at all, with a DTI of 1,000 per cent for borrower A and 333 per cent for borrower B.

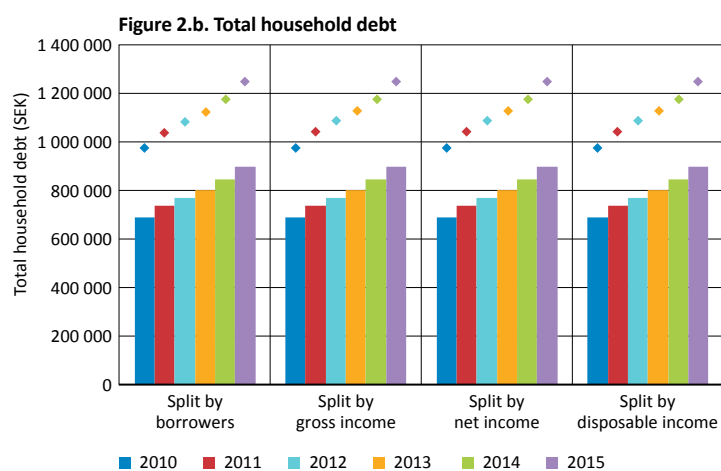
The advantage of splitting the debt based on the number of borrowers (option 1) is its simplicity and transparency: all borrowers registered on a loan carry equal amounts of debt. However, when deciding on how much to borrow, the overall income of the two borrowers is likely the main determinant. Indeed, borrower A would probably have difficulties in getting a loan worth SEK 500,000 with an income of SEK 100,000 from a bank. In contrast, options 2, 3, and 4, while being more complex and less transparent, have the advantage of yielding the same DTI ratio for all borrowers on the same loan.

Figure 2.a and Figure 2.b show the development of median indebtedness over time for four different measures for individuals and households, respectively. All four measures are very similar, both in level and trend. When splitting debt by borrowers (option 1), the median debt level is slightly higher.

12. Mirroring the discussion on which income measure to use in the definition of DTI, we also need to decide which income measure to use for allocating the debts. We use gross income to allocate debts to the different loan-takers when calculating debt to gross income, and likewise for net and disposable income.



Note. The bars denote the medians, while the diamonds denote the means.



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Debt-to-Income

Above, we discussed three definitions of income and four definitions of debt. We now combine these definitions in order to construct six different DTI measures, as shown in Table 1.¹³

Table 1. Definitions of debt-to-income

Debt-to-Income	Income	Debt
DTDI, split by borrowers	Disposable income	Split by borrower
DTDI, split by disposable income	Disposable income	Split by disposable income
DTNI, split by borrowers	Net income	Split by borrower
DTNI, split by net income	Net income	Split by net income
DTGI, split by borrowers	Gross income	Split by borrower
DTGI, split by gross income	Gross income	Split by gross income

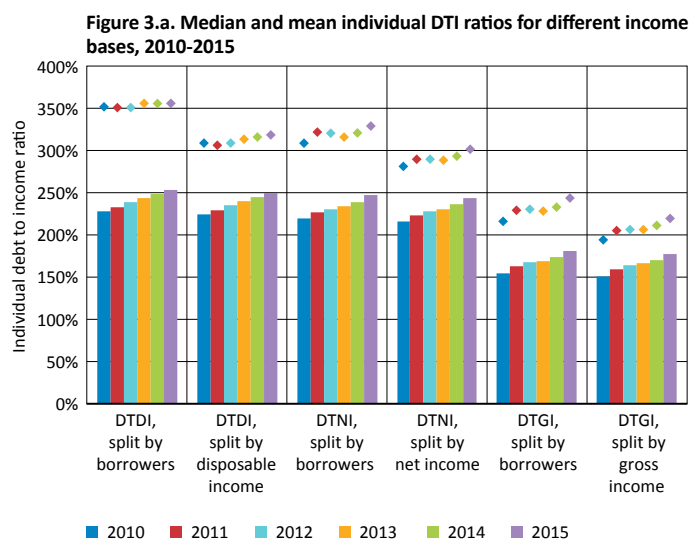
13. We disregard six definitions that are of lesser interest.

Figure 3.a (for individuals) and Figure 3.b (for households) present the medians and means, over time, of the six different DTI measures. As expected, the debt ratio is significantly lower when gross income is used, and highest with disposable income in the denominator.

An important feature of Figure 3.a is the development of the mean DTI ratio over time. In Figure 3.a, the first measure is the debt with shared loans split by the number of borrowers over disposable income.¹⁴ When looking at this measure, the mean DTI has been fairly constant between 2010 and 2015, slightly above 350 per cent. This pattern seems intuitively difficult to reconcile with the 62 per cent increase in apartment prices (28 per cent for houses), and 10 percentage point increase in the aggregate debt ratio over the same period. Amongst the six DTI measures, only the ones based on disposable income and an equal split of loans among co-borrowers show a similar pattern for the averages. For instance, when using gross income in the denominator (the right-most bars in Figure 3), the mean DTI ratio increased by around 25 percentage points during the five-year period.

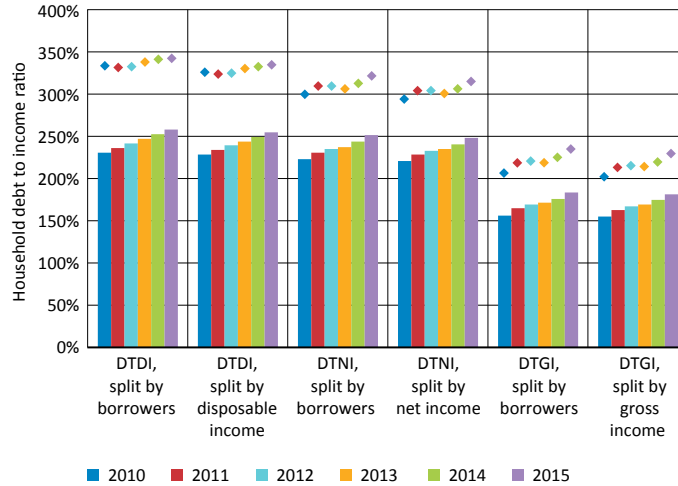
Note also that the trends in the medians are very comparable across the six different measures, with an increase of approximately 25 percentage points for each measure.

As mentioned previously, DTI limits have been discussed in conjunction with possible macroprudential measures to restrict the build-up of vulnerabilities among Swedish households due to rising household debt. In a number of studies by the Riksbank and Finansinspektionen, a DTI limit of 600 per cent has been used to analyse the macroeconomic effects of such a limit. It is important to note that the definitions of debt and income vary across these studies. Our data on the stock of mortgage borrowers show that in 2015, 13.1 per cent of the households and 14.1 per cent of the individuals (266,459 households and 444,925 individuals) had a debt-to-disposable income above 600 per cent when debt is split by number of borrowers on the loan contract. When debt is instead allocated to co-signers based on disposable income, 12.7 per cent of the households and 11.4 per cent of the individuals (257,871 households and 361,283 individuals) had a debt-to-disposable income ratio above 600 per cent.



14. In previous Riksbank publications on household debt, the measure of indebtedness has typically been the first variable in Figure 3.a, i.e. the nominator being debt with shared loans split by the number of borrowers and the denominator being disposable income. For the previous Riksbank studies, see Winstrand, J. and Ölcer, D. (2014), How Indebted are Swedish Households?, *Economic Commentaries* No. 1, 2014, Sveriges Riksbank, Alfelt, G. and Winstrand, J. (2015), Household Indebtedness in Sweden – update for 2014, *Economic Commentaries* No. 1, 2015, Sveriges Riksbank as well as Alfelt, G., Lagerwall, B. and Ölcer, D. (2015), An Analysis of the Debt-to-Income Limit as a Policy Measure, *Economic Commentaries* No. 8, 2015 Sveriges Riksbank.

Figure 3.b. Median and mean household DTI ratios for different income bases, 2010-2015



Note. The bars denote the medians, while the diamonds denote the means.

The relation between DTI and income

Last, to get an impression of how the distribution of debt varies by income for different DTI measures, we study the distribution of the six different DTI measures by income decile, using the 2015 data only. Figure 4.a shows the distribution for individuals and Figure 4.b for households.

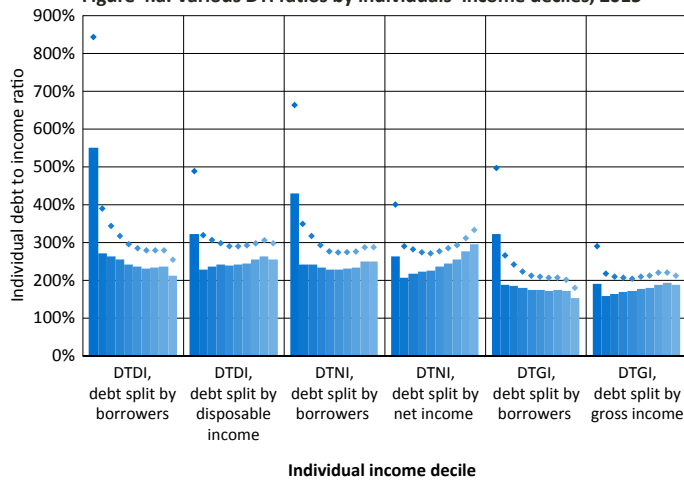
A few results stand out. First, for any measure, the first (lowest) income decile always has the highest debt ratio. The DTI level in this decile is, as we observed earlier, likely to be upward biased by the fact that (tax-free) transfer income is not observed in our data. Hence, we should interpret the first income decile with caution, especially for the debt-to-disposable-income (DTDI) measure.

Second, when splitting debt based on the number of borrowers, we find that the debt is higher amongst the lowest income earners. For instance, the DTDI ratio is 346 per cent for the third income decile, and 278 per cent for the eighth decile. In other words, lower income households are more indebted, relative to their disposable income, than higher income households.

However, note that this pattern is essentially reversed when splitting debt based on the relative income share. By construction, for the shared loans, the high-income earners are attributed the most debt; so we should expect an evening-out of the debt ratio. However, we even find the opposite result: high-income households have more debt (again, relative to their income) than low-income households. This reversal is especially apparent for the median debt ratio, using either disposable or gross income.

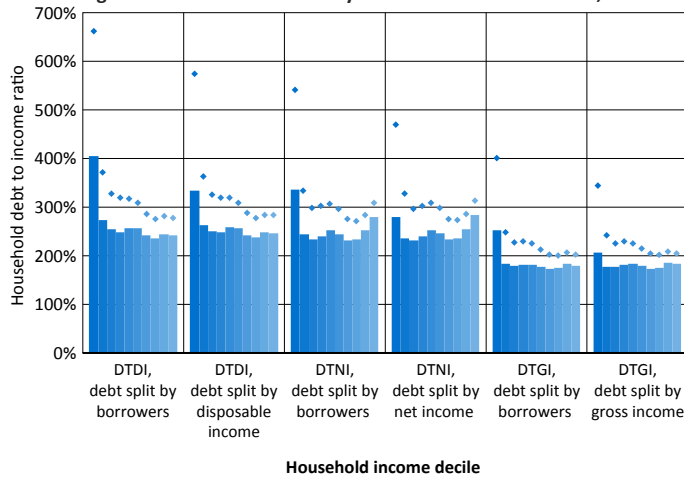
For households (Figure 4.b), the median debt ratio is relatively flat over the income distribution, suggesting that debt is proportional to households' income. In addition, the way debt is allocated to borrowers on shared loans has virtually no effect on the distribution of DTI by income.

Figure 4.a. Various DTI ratios by individuals' income deciles, 2015



Note. The bars denote the medians, while the diamonds denote the means. Each distribution of the debt-to-income ratio is over the individuals' income measure used in the definition of debt-to-income.

Figure 4.b. Various DTI ratios by households' income deciles, 2015



Note. The bars denote the medians, while the diamonds denote the means. Each distribution of the debt-to-income ratio is over the households' income measure used in the definition of debt-to-income.

Conclusion

This Economic Commentary shows that the precise definition of a DTI ratio can greatly affect our assessment of how debt is distributed among individuals and households. To assess the extent to which households are vulnerable to economic or financial shocks as well as exposed to policy shocks, it is important to evaluate scenarios and expected policy effects for different measures of the DTI ratio. We have seen that the level of the various debt ratios, their trend over time and their distribution across income deciles can vary substantially when using one measure or another.

Appendix

Table A1. Summary statistics for individuals with mortgages

Based on 2.94 million individuals in 2010, 3.16 million individuals in 2015

	Variable	Year	Mean	P10	P25	P50	P75	P90	SD	
Debt to disposable income	Debt split by borrowers	2010	353%	57%	116%	229%	419%	705%	444%	
		2015	357%	61%	129%	255%	442%	706%	390%	
	Debt split by disposable income	2010	310%	57%	115%	225%	401%	630%	305%	
		2015	319%	61%	128%	251%	424%	631%	282%	
Debt to net income	Debt split by borrowers	2010	310%	58%	115%	220%	387%	622%	325%	
		2015	330%	63%	129%	248%	419%	649%	324%	
	Debt split by net income	2010	282%	58%	114%	217%	373%	564%	248%	
		2015	302%	62%	128%	245%	404%	588%	251%	
Debt to gross income	Debt split by borrowers	2010	217%	40%	81%	155%	275%	441%	218%	
		2015	245%	46%	94%	181%	310%	484%	243%	
	Debt split by gross income	2010	195%	40%	80%	152%	261%	393%	164%	
		2015	220%	45%	93%	178%	294%	431%	183%	
Total debt (thousand SEK)	Split by borrowers	2010	613	109	225	450	818	1 284	652	
		2015	793	136	293	600	1 064	1 625	884	
	Split by disposable income	2010	623	97	207	430	814	1 347	732	
		2015	804	119	267	572	1 065	1 703	986	
	Split by net income	2010	623	98	209	434	818	1 341	725	
		2015	804	121	270	577	1 068	1 698	968	
	Split by gross income	2010	621	97	206	430	812	1 341	725	
		2015	803	119	267	571	1 063	1 703	968	
	Monthly income	Gross income	2010	27 132	12 750	18 208	24 283	31 433	42 708	18 887
			2015	30 759	13 892	20 333	27 783	36 183	48 558	20 827
		Net income	2010	18 613	9 073	13 136	17 713	22 447	28 136	9 913
			2015	21 930	10 511	15 263	20 873	26 832	33 298	11 393
Disposable income		2010	18 320	8 317	12 317	16 783	21 625	27 800	21 274	
		2015	21 986	9 867	14 542	20 008	26 100	33 500	24 701	

Table A2. Summary statistics for households with mortgages

Based on 1.88 million households in 2010, 2.03 million households in 2015

	Variable	Year	Mean	P10	P25	P50	P75	P90	SD	
Debt to disposable income	Debt split by borrowers	2010	335%	58%	118%	232%	417%	670%	373%	
		2015	344%	63%	132%	259%	441%	672%	338%	
	Debt split by disposable income	2010	327%	57%	116%	230%	413%	660%	352%	
		2015	335%	62%	130%	256%	436%	660%	317%	
Debt to net income	Debt split by borrowers	2010	301%	59%	117%	223%	387%	597%	288%	
		2015	322%	65%	132%	252%	419%	624%	292%	
	Debt split by net income	2010	295%	58%	116%	222%	384%	590%	275%	
		2015	316%	63%	130%	249%	415%	615%	277%	
Debt to gross income	Debt split by borrowers	2010	207%	42%	82%	157%	271%	416%	189%	
		2015	236%	47%	96%	184%	306%	458%	215%	
	Debt split by gross income	2010	203%	41%	81%	155%	269%	409%	179%	
		2015	230%	46%	95%	182%	303%	450%	202%	
Total debt (thousand SEK)	Split by borrowers	2010	974	155	334	690	1 312	2 117	1 019	
		2015	1 247	195	426	900	1 681	2 665	1 370	
	Split by disposable income	2010	976	150	327	689	1 320	2 134	1 041	
		2015	1 250	182	413	900	1 692	2 688	1 403	
	Split by net income	2010	976	150	327	689	1 320	2 133	1 043	
		2015	1 251	183	414	900	1 692	2 687	1 402	
	Split by gross income	2010	976	149	326	689	1 320	2 134	1 041	
		2015	1 250	182	413	900	1 693	2 689	1 397	
	Monthly income	Gross income	2010	42 728	17 500	25 417	39 108	53 350	70 133	27 854
			2015	47 921	18 750	28 092	43 075	60 767	80 017	31 389
		Net income	2010	29 253	12 247	18 286	27 444	37 771	47 215	15 949
			2015	34 163	13 987	21 114	31 456	44 414	56 085	18 775
Disposable income		2010	28 789	11 417	17 250	26 183	36 292	46 508	28 728	
		2015	34 261	13 300	20 192	30 517	43 308	56 225	33 714	