INTO THE UNKNOWN: A REVISED ESTIMATE OF THE DEBT SERVICE RATIO FOR THE CZECH REPUBLIC

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Abstract

Czech household debt is currently not as high as in the most developed countries in the world, but its dynamics have been noticeable in recent years. This paper aims to calculate the Debt Service to Income (DSTI) ratio of Czech households and assess how it will evolve in the future. Using the modified BIS methodology and EU-SILC data, we compute our measure of DSTI. We found that the traditional measurement methodology overestimates household income and underestimates interest paid. Thus, the DSTI indicator is higher. We also find that even a relatively small change in interest rates can significantly increase the DSTI. This is particularly important for Czech households taking out mortgages with low interest rates and short fixation periods. Once the fixation period ends, they may find it challenging to repay the mortgage or reduce their consumption, which may have adverse economic consequences.

Keywords

DSTI, Household Debt, Mortgage, Disponible Income, EU-SILC

I. Introduction

Although Czech household debt is currently not as high as in the case of the most developed countries in the world, its dynamics have been noticeable in recent years. At the same time, however, the incomes of Czech households have been rising in recent years. For the implementation of economic policy, it is necessary to know the size of the debt service to income (DSTI). However, DSTI data are not available for the Czech household sector. The aim of this paper is to calculate the DSTI of Czech households and assess how it will evolve in the future. To do this, we compute Debt Service Ratio (DRS) based on BIS (2017) methodology. Moreover, we suggest an alternative measure – DSTI, which is based on the BIS methodology but uses a different measure of income and interest rates.

Debt service is tightly linked to borrowing and lending. Drehmann et al. (2017) then identify debt service as the very and inevitable counterpart of borrowing. Debt service stems from the relationship between borrower and lender and has a significant impact on the activity of economic agents. The essential finding is that in obtaining a loan, the borrower can increase his purchasing power in the present but commits to debt service in the future. The debt service then consists of interest payments and amortization.

Debt service can be defined using the average household in the Czech Republic headed by an employed person, of which there are 2 246 890 and 50,3 % of all households. This represents approximately 6 000 000 inhabitants (57.7% of the total population). The average disposable income of this household with an employed head is CZK 49 000 per month. We assume that this household takes out an average mortgage of CZK 3 000 000 with a repayment period of 20 years and a 2% variable annual interest rate. For the same monthly repayments, the borrower's debt service costs will be approximately CZK 15 000 at the initial interest rate. The debt service ratio (DSR) will then be approximately 31 %. However, if the interest rate rises by three percentage points to 5 %, the debt

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service cost rises to approximately CZK 20 000. The DSR will then be as high as approximately 41 %.

Drehmann and Juselius (2012) then conclude that an increase in the DSR will significantly affect the borrower's ability to consume, and the borrower is also exposed to a possible reduction in disposable income in the future. However, it is also evident that even a tiny change in the interest rate can significantly impact a household's economic and resource performance. Especially in the case of the unexpected, there could be a problem. By these changes, we can also mean the catching-up of mortgage loans. The impact of interest rate increases has certain inertia in households, which will only be affected in the future. In addition, the CNB (2021) points out that exceeding the 40% DSR leads to increased risk for the borrower and the applicant. The risk arises from the possibility of default on the loan and the inability of the lender to meet its obligations in the future.

These processes then operate fundamentally at the microeconomic level and have a redistributive effect. However, the aggregate macroeconomic effects are not entirely negligible. Hofmann and Peersman (2017) argue that there are changes in the marginal propensity to consume and invest for lenders and borrowers. Borrowers are typically credit or liquidity constrained and thus are likely to have a higher propensity to consume or invest relative to lenders. At the aggregate level, then, an increase in DSR and a shift of income from borrowers to lenders can reduce the aggregate output of the economy. An increase in lenders' consumption cannot offset a reduction in borrowers' consumption.

Conversely, a reduction in DSR can lead to increased economic activity due to a transfer of resources from creditors to debtors. However, according to Drehmann and Juselius (2012), more severe effects may occur during economic crises. In particular, during the global financial crisis, excessive borrowing in the private sector led to destabilizing effects. High household and firm indebtedness becomes particularly problematic in situations of income shortfalls or reductions. This can result in an inability to balance consumption and generate new investment. More significant income shortfalls then lead to inability to repay and bankruptcies. The output of the economy then becomes volatile at the aggregate level. Drehmann et al. (2015) note that debt distress comes to the fore, especially during financial crises and financial cycles in general. It is then crucial to track the evolution of the DSR during these periods. In particular, the DSR captures the link between debt repayments and consumption. For this reason, the DSR is an essential variable for understanding the interactions between debt and the real economy.

II. Methods and data

This section explains how the debt service-to-income ratio can be calculated. We describe two approaches - the calculation of the DRS and the DSTI. This section also includes a description of the data used.

Original (BIS) methodology

The debt service ratio (DSR) is defined as the ratio of interest payments plus amortizations to income. As such, the DSR provides a flow-to-flow comparison – the flow of debt service payments divided by the flow of income. To derive the DSR on an internationally consistent basis, the BIS applies a unified methodological approach and uses, as much as possible, input data that are compiled on an internationally consistent basis (BIS, 2017). Debt service ratios (DSRs) measure the amount of income used for interest payments and amortisations. BIS (2017) original methodology also follows an approach used by the Federal Reserve Board (Dynan et al., 2003) to construct debt service ratios for the household sector This approach measures amortisations indirectly.

By using the standard formula for calculating the fixed debt service costs of an instalment loan and dividing it by income, the DSR for sector j at time t is calculated as:

$$DSR_{j,t} = \frac{i_{j,t}}{(1-(1+i_{j,t})^{-s_{j,t}}} \cdot \frac{D_{j,t}}{Y_{j,t}} \quad (1)$$

where $D_{j,t}$ denotes the total stock of debt, $Y_{j,t}$ denotes income, $i_{j,t}$ denotes the average interest rate on the existing stock of debt and $s_{j,t}$ denotes the average remaining maturity.

BIS (2017) also notes that the non-linearities in the instalment loan formula can generate an approximation error when aggregate data are used. Nevertheless, the methodology should correctly capture how the DSR in a particular country changes over time, even if it does not necessarily accurately measure its level relative to what one could obtain from the correct micro data. For practical purposes, the difficulties in pinpointing the level imply that it is most meaningful to compare DSRs over time. The same holds for DSTI indicator. Dynam et al. (2003) argues that changes in financial markets are imposing adjustments in the structure and methodology of the debt service ratio calculation.

In our paper, we calculate both the DSR indicator according to the BIS (2017) methodology and our own indicator (DSTI), which modifies the above methodology. Two differences in the construction of the two indicators are explained below.

Differences in income calculation

The first aspect in which our indicator differs from the DSR indicator is the way in which income is measured. While BIS (2017) uses GDI based on national accounts, we use disponible income available from Household Income and Living Conditions - EU-SILC data (CZSO, 2020). The publication contains results of the Living Conditions Survey 2020, a national module of the EU-SILC (European Union - Statistics on Income and Living Conditions) survey obligatory for all EU member states.

Table 1 Comparability of income components

Type of income	Comparability
Employee cash or near cash income	High
Income from self-employment	Medium
Property income received	Medium/ Low
Social benefits other than social transfers in the kind received	High
Social contributions and taxes on income paid	High
Taxes on wealth paid	Low
Other current transfers received	Low
Other current transfers paid	Low

Source: EUROSTAT (2018)

The household income in National Accounts is defined by ESA 2010, while in EU-SILC it follows the EU-SILC legislation. Eurostat (2018) provides the methodological comparison of household income measured by both approaches. Apart from some general differences (population differences - all persons vs. reference population, or measurement issues in the data) there are quite large differences in the measurement of disposable income. The indicative evaluation of comparability of each income component is marked as low, medium, and high based on Eurostat (2018) in Table 1.

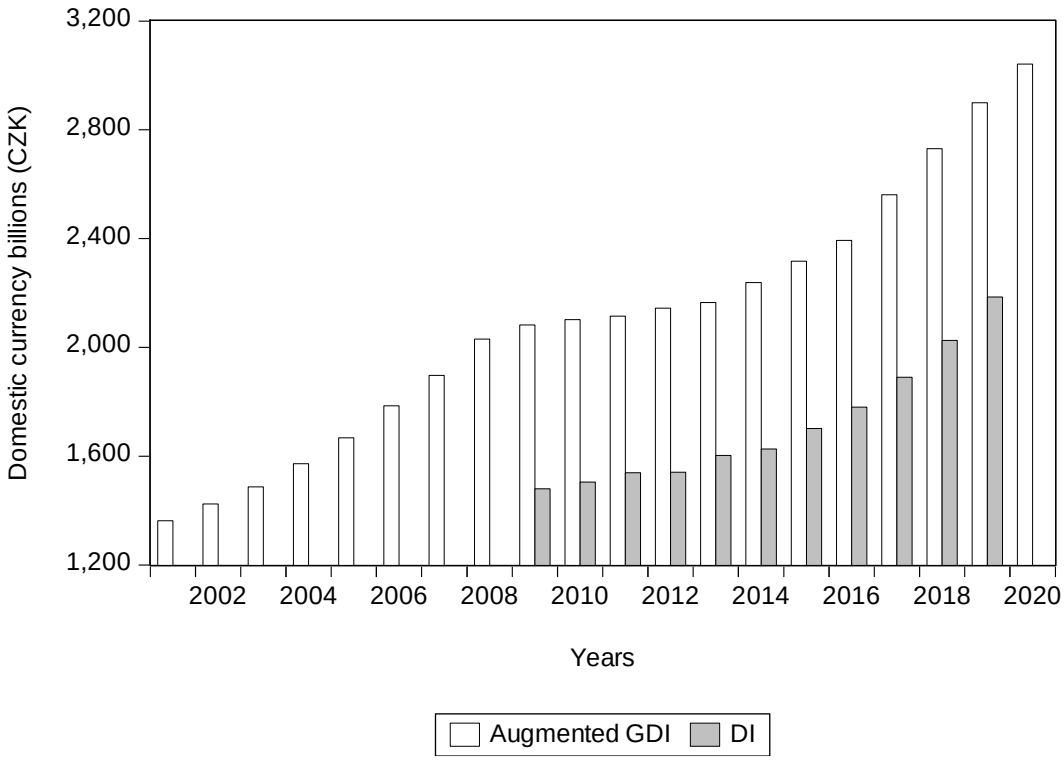
The following income components are included in the National Accounts definition of GDI but not in EU –SILC disposable income definition:

- Income from household production of services for own consumption;
- Property income paid;
- Property income attributed to insurance policy holders;
- Operating surplus (including imputed rent);
- Employer's imputed social contributions;
- Financial Intermediation Services Indirectly Measured (FISIM).

The advantage of the GDI is that it is based on national accounts and is therefore available quarterly and for all countries of the world. The EU SILC income methodology is based on household sample surveys and is available at an annual frequency for EU countries only. On the other hand, the GDI overestimates household income. For example, it includes imputed rent (the price that a household living in its own house or flat would pay for rent). The same applies to income from household production of services for own consumption. This is important in terms of calculating GDP, but for the purposes of tracking household consumption expenditure this does not play a role, as households cannot spend money they do not have.

As concerns FISIM, BIS (2017) uses the augmented GDI that is equal to GDI plus interest payments excluding FISIM. FISIM is not added to the augmented GDI for the household sector because it is not considered an element of intermediary consumption and is therefore not deducted from the various types of income households earn to get GDI. FISIM is a service that is included in the final consumption. The fact that FISIM is not taken into account when calculating disposable income simplifies the calculation.

Figure 1 Development of Augmented GDI and Disponible Income



Source: CZSO (2021), CZSO (2021a), own calculations

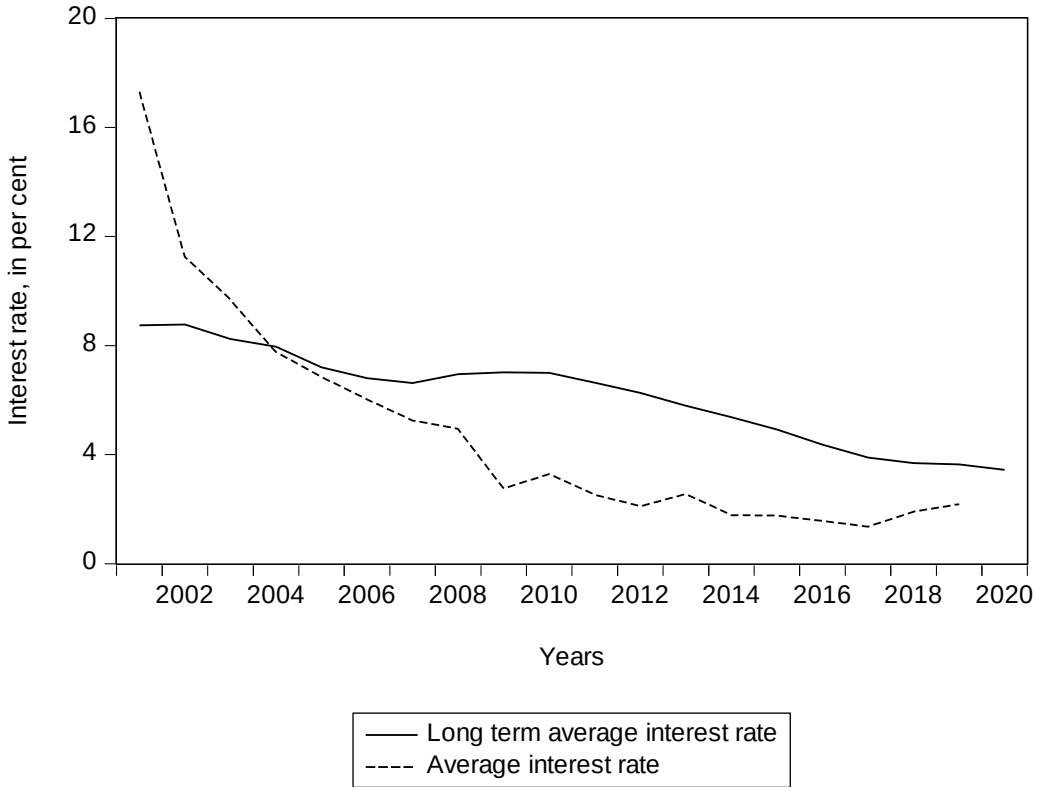
Other items such as property income paid, or property income attributed to insurance policy holders play a minor role and/or can be included in the calculation of disposable income as they are surveyed in the EU SILC.

Figure 1 compares GDI and household disposable income. It is clear that they differ in level (GDI is overestimated for the reasons mentioned above) but their evolution is similar.

Differences in interest rate calculation

The second aspect in which our indicator differs from the DSR indicator is the way in which interest payments are measured. BIS (2017) measures aggregate debt servicing costs. It is computed by dividing gross interest payments plus financial intermediation services indirectly measured (FISIM) by the stock of debt (Average Interest Rate). As we are mainly interested in long-term debt repayments (especially mortgages), we prefer to use average interest rates on debts with maturities over five years (Long-Term Average Interest Rate) provided by the ARAD database (ARAD, 2021).

Figure 2 Development of Average Interest Rate and Long-Term Average Interest Rate



Source: CZSO (2021a), ARAD (2021), own calculations

Figure 2 compares the aggregate interest rate computed by BIS with our approximation by ARAD data. Our interest rates are slightly higher than the BIS calculation, which is to be expected as the interest rates on loans with longer maturities tend to be higher.

Data description and sources

In calculating both indicators, it is necessary to know the values of four variables - income, total debt, interest rates on debt, and average maturity. While we use the same data for debt and maturity length as BIS (2017), the data differ for income and interest rates. The reasons and possible implications are discussed above. Table 2 captures the data description and sources. We use annual data from 2001 to 2020 (2009 to 2019 in the case of disponible income).

Table 2 Data description and sources

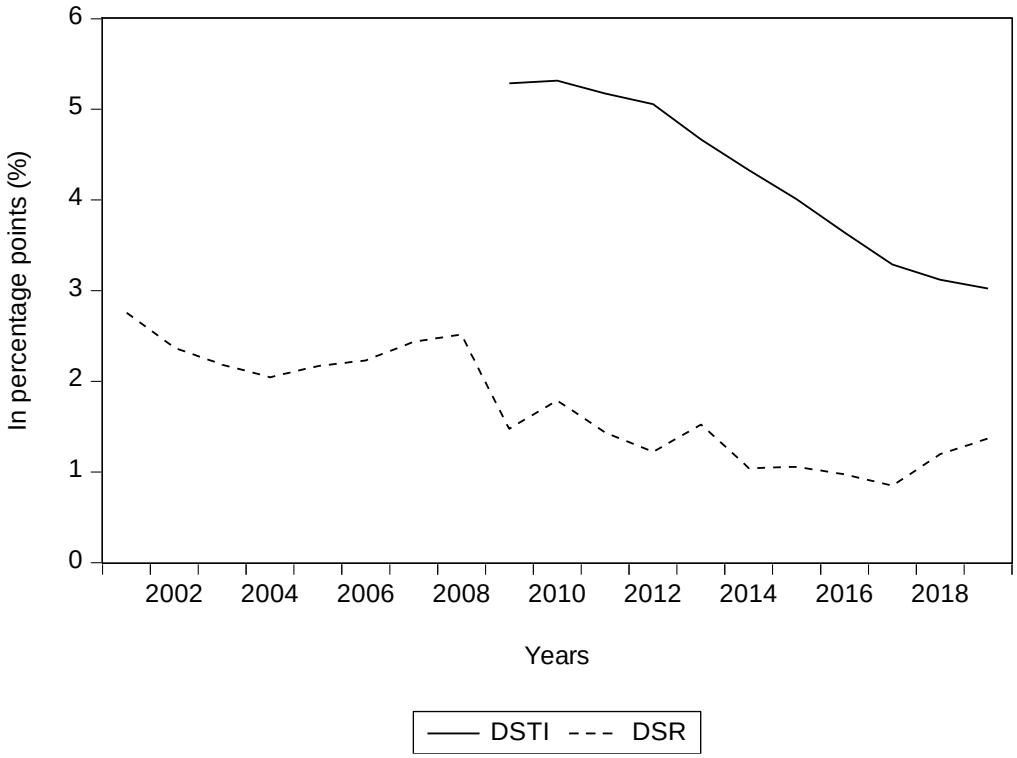
Variable	DRS		DSTI	
	Description	Source	Description	Source
Total stock of debt	Credit from all sources to the households	BIS (2021)	Credit from all sources to the households	BIS (2021)
Income	Augmented GDI	National accounts	Disposable Income	EU-SILC (2021)
Interest rate of debt	Average Interest Rate (gross interest payments plus FISIM divided by the stock of debt)	National accounts	Long-Term Average Interest Rate (household interest rate over 5 years maturity)	ARAD (2021)
Remaining maturity	18 years	Drehmann et al (2015)	18 years	Drehmann et al. (2015)

Source: own elaboration

III. Results

Figure 3 shows the development of DSR and DSTI. It is clear that the DSTI is higher than the DSR, as it assumes lower household incomes and higher interest rates. However, their evolution over the period under review is similar.

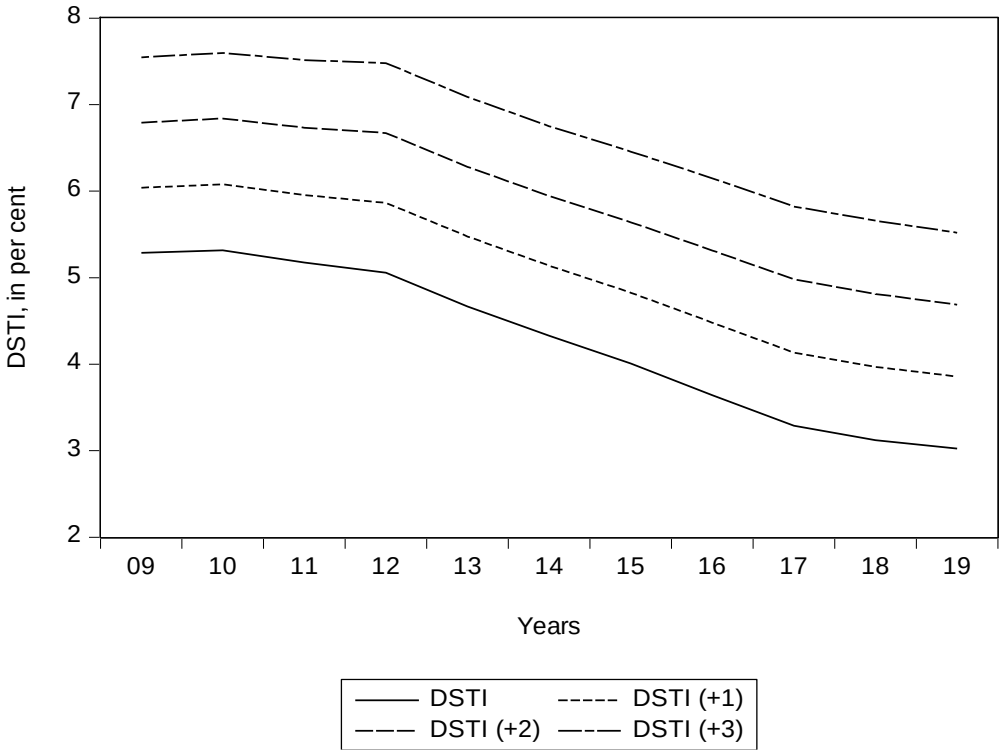
Figure 3 Development of Debt Service Ratio and Debt Service to Income



Source: own calculations

Next, we investigate what changes in the DSTI are induced by a possible change in interest rates. In the first variant (ex-post), we examine the historical evolution of income and debt. In other words, Figure 4 captures how the DSTI would change if the interest rates were 1, 2, and 3 percentage points higher in the past, respectively. In 2019, for example, an increase in interest rates of one percentage point would result in a 0.831 percentage point increase in the DSTI, which is an increase of 27.5%.

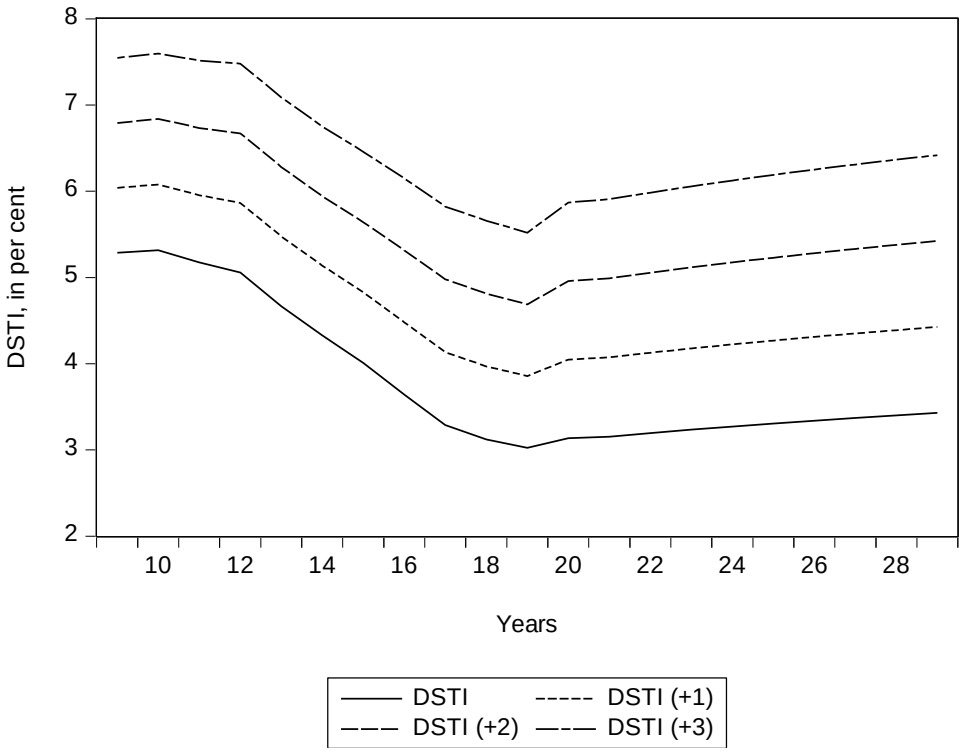
Figure 4 Ex-post prediction of DSTI



Source: own calculations

In the second variant (ex-ante), we try to predict the future development. Since we do not have enough information on the future evolution of the economy, we assume that income and debt will continue to grow at the average rate of the last ten years. In contrast, we do not assume that interest rates will continue to fall. For their forecast, the 2019 value is used in each variant, again increased by 1, 2, and 3 percentage points.

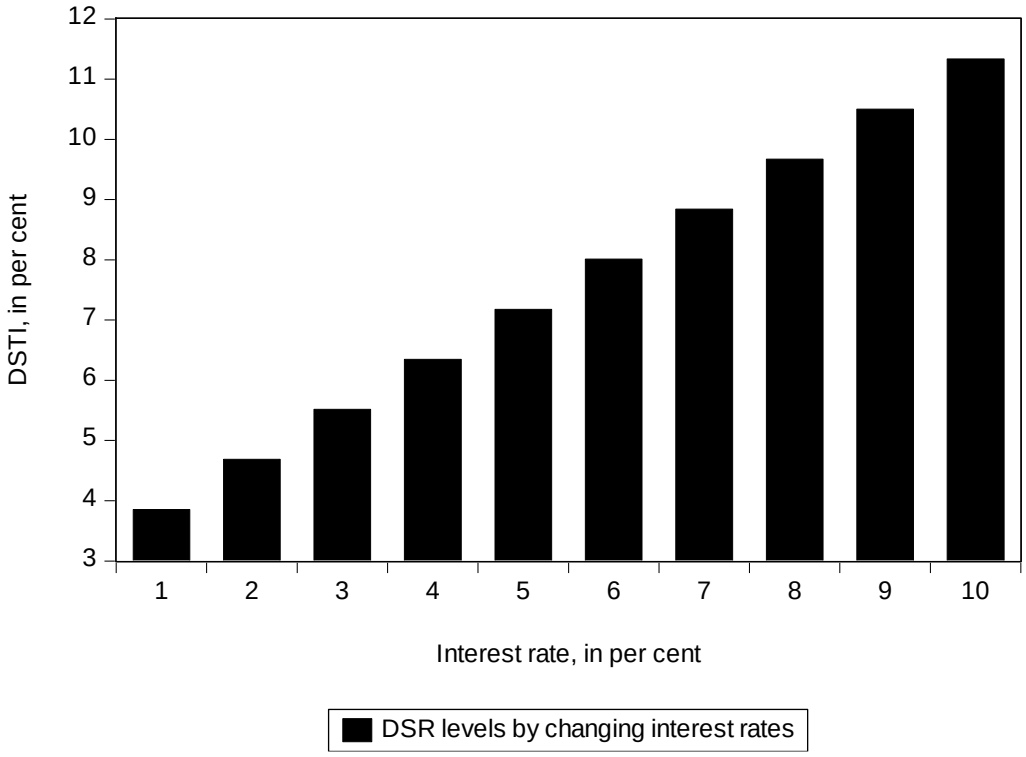
Figure 5 Ex-ante prediction of DSTI



Source: own calculations

Figure 5 shows both the past (actual) evolution of the DSTI and our prediction of future developments. In this case, the DSTI would respond even more sensitively to interest rate changes than in the previous scenario. For example, in 2029, an increase in interest rates of one percentage point for every one percentage point increase in interest rate would result in a 0.997 percentage point increase in the indicator, an increase of more than 29%. Figure 6 shows how much change in the DSTI is induced by a change in interest rate. It can be seen that the DSTI increases at an approximately linear rate of one to one.

Figure 6 Responses of DSTI to changes in interest rates



Source: own calculations

IV. Conclusion

The aim of the paper was to calculate the DSTI in the Czech Republic and to assess its future development. For this purpose, we have modified the method of calculating the DSR according to the BIS (2017) methodology to better reflect the real situation of Czech households. We found that the original methodology overestimates household income (it includes, for example, imputed rent) and, on the contrary, underestimates interest payments (it includes loans with shorter maturities). The DSR and DSTI indicators follow similar trends, but the DSTI is higher.

While the DSTI better reflects the real disposable income of households, it also has disadvantages. The data are only available at an annual frequency with a relatively long-time lag. In addition, it is only available for EU countries that are obliged to carry out a household sample survey according to the EU-SILC methodology. The DSTI is thus more suitable for monitoring past developments or as a tool for ex-post adjustment of the DSR.

Both indicators have a common shortcoming - they track households at the aggregate level. It would certainly be more interesting to track only those households that have a mortgage. Aggregate indicators are biased and have low predictive value. If we know that the DSR or DSTI is 10% in a country, what conclusions can be drawn from this without knowing the structure of indicators across households? Unfortunately, micro-level data are not publicly available.

However, the information we can obtain is the sensitivity of the DSTI to changes in interest rates. The conclusion of this analysis is that a 1 percentage point change in interest rates will cause the aggregate DSTI to increase by about 1 percentage point. Thus, even a relatively small change in interest rates can lead to an increase in the DSTI. If we consider that the aggregate indicator includes households that do not repay any loan, the impact on households with a loan (mortgage) will be even greater.

Furthermore, if we consider that mortgage rates in the Czech Republic are still low, which attracts households, a potential risk may arise in the future. This risk stems from the expected rise in mortgage rates. If a household takes out a cheap mortgage today with a fixation period of three or five years, it is reasonable to expect that interest payments will increase after the end of the fixation period. Even a relatively small change in interest rates can put a significant burden on a household. In the worst-case scenario, they may not be able to repay the mortgage. In the better case, it will result in a fall in their consumption, which may undermine the development of the economy.

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