VAT Pass-Trough and Inflation: Evidence from European Food VAT Reforms and Implications for Denmark

Master's Thesis – Department of Economics
Aalborg University

Student: Mikkel Gregersen Rosengreen
Student number: 20203168
Supervisor: Jawad khawaja
Date: 9/2-2026
ECTS: 30

AALBORG
UNIVERSITY

Abstract

This thesis examines the extent to which value-added tax (VAT) changes are passed through to consumer food prices in European Union countries and evaluates the potential inflationary impact of a temporary VAT reduction in Denmark. During the recent period of elevated inflation, several EU governments introduced VAT reductions on essential goods—particularly food—in an effort to ease pressure on household purchasing power. Whether such measures effectively lower consumer prices depends on the degree and timing of VAT pass-through. This thesis provides new empirical evidence on that question and applies the results to a policy-relevant Danish context.

The analysis uses monthly panel data for ten EU countries and ten food and non-alcoholic beverage categories over the period 2019–2024. Harmonised Index of Consumer Prices (HICP) data from Eurostat are combined with a manually constructed dataset of statutory VAT rates by country and month. The empirical approach follows a reduced-form framework inspired by Benedek et al. (2015), estimating regressions of monthly price changes on VAT changes with country, category, and time fixed effects. A dynamic specification with leads and lags of VAT changes is employed to capture delayed adjustment and potential anticipation effects.

The results indicate that VAT pass-through to food prices is positive but incomplete. The contemporaneous effect of VAT changes on consumer prices is small and statistically insignificant, while the largest adjustment occurs with a one-month lag. Subsequent months show partial reversal, suggesting gradual and imperfect price adjustment. The estimated cumulative pass-through is approximately 18%, implying that a 10% in the VAT-inclusive price leads to an eventual consumer price change of around 1,8%. Joint significance tests confirm that VAT changes affect food prices when considered collectively, although individual coefficients are not always precisely estimated.

A policy simulation for Denmark suggests that a three-percentage-point VAT reduction on food would lower consumer food prices by roughly 0,4–0,5 percent in the short run. While this would modestly reduce inflation, the fiscal cost would be substantial relative to the size of the price

effect. Overall, the findings indicate that VAT changes can influence consumer prices but that pass-through is partial, delayed, and limited in magnitude. Temporary VAT reductions are therefore likely to produce modest and short-lived reductions in inflation while entailing significant revenue costs.

Table of contents

Introduction

Recent years have been characterised by substantial volatility in consumer prices across Europe. Following the COVID-19 pandemic and the subsequent energy and supply-chain shocks, inflation reached levels not observed for several decades. As policymakers searched for tools to curb inflationary pressures and protect household purchasing power, indirect tax policy—particularly Value Added Tax (VAT)—gained renewed attention. Several EU member states implemented temporary or permanent VAT reductions during 2020–2024, often targeted at essential goods such as food. These interventions reflect the growing belief that changes in VAT rates can provide rapid and visible relief for consumers by directly lowering retail prices. However, whether VAT cuts are indeed passed on to consumers is an empirical question that remains debated.

VAT is a consumption tax added to the final price of goods and services. Any change in the VAT rate mechanically alters consumer prices if firms fully pass the tax onto buyers. Yet economic theory highlights reasons why pass-through may be incomplete or delayed. Under imperfect competition, firms may absorb part of the tax change in their margins. Adjustment frictions, such as menu costs or pricing rigidities, can cause temporary or asymmetric responses. Demand conditions, cost pressures, and expectations can also influence how firms set prices following tax reforms. As a result, the extent to which VAT changes translate into consumer price changes must be examined empirically rather than assumed.

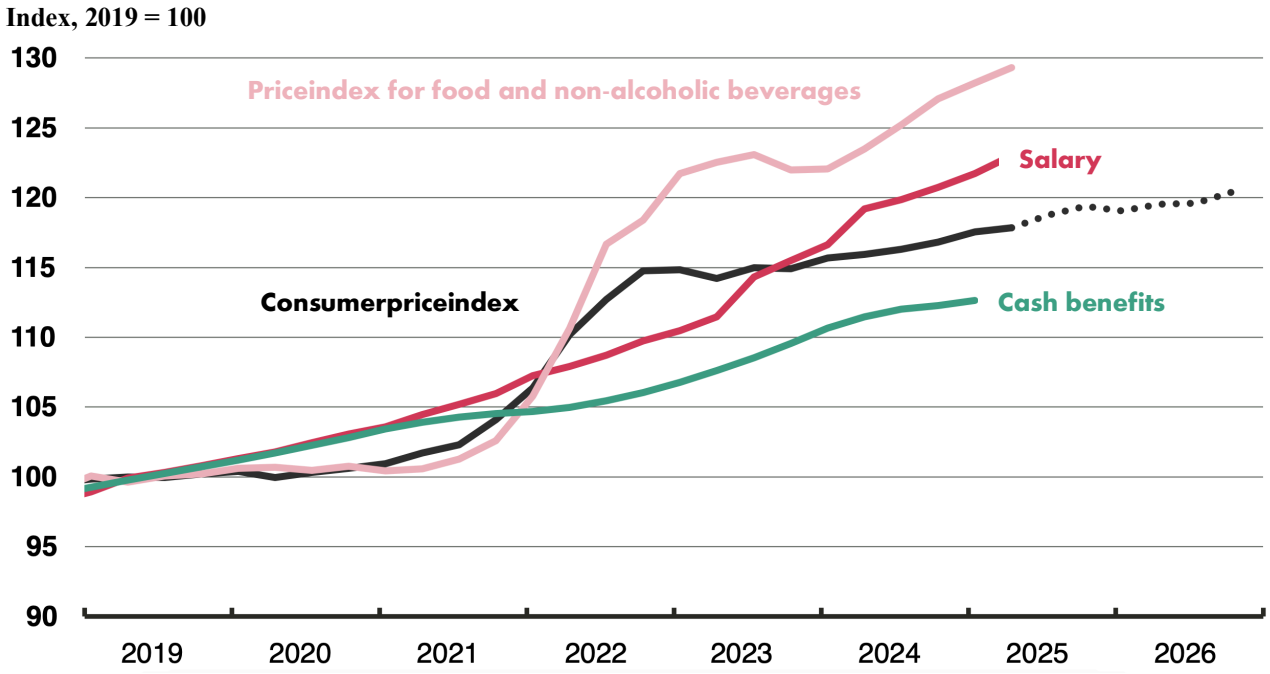

Figure 1: Danish consumerprices, cash benefits and salary growth 2019 - 2025 Source: Nationalbanken, 2025.

This question has particular policy relevance for Denmark, which did not adjust its standard VAT rate during the recent inflation spike. Nevertheless, the possibility of a temporary VAT cut has repeatedly surfaced in Danish policy discussions as a potential tool for reducing inflation quickly. As we can see in figure 1 prices for food and non-alcoholic beverages has increased by almost 30% since 2019, while both salary (23% increase) and people on cash benefits (13% increase) has seen their purchasing power decreasing. The figure also shows a larger increase in food prices than the rest of the consumerprice index indicating that a large portion of consumerprice increase has come from food and non-alcoholic beverages. The effectiveness of such a measure depends critically on the degree of VAT pass-through. If VAT cuts are largely passed on to consumers, they can generate an immediate reduction in inflation. If instead firms absorb part of the VAT reduction into margins, the effect on consumer prices may be modest or short-lived. The lack of recent Danish VAT reforms means that direct domestic evidence is limited, motivating an empirical approach that draws on experiences from other EU member states. For

Different political parties have made proposals for legislative amendment to introduce differentiated VAT's, especially on healthy foods like fruit, vegetables and organic food. Their goal is reduced food prices in generally, but also an increase in health among danes. Arguments about neighboring countries having differentiated VAT rates have been key for the supporters. On the other hand we see forces of opponents against differentiated VAT's and lowering VAT in general. Former chair of the economic council in Denmark Michael Svarer (2025) among others, critizice the debate for lacking economic sense and forgetting the hidden costs of introducing differentiated VAT rates.

Danish supermarkets have also been in the spotlight for accusations of exlpoting the inflation crises of 2022 and 2023 by price gouging, but according to Dansk Erhverv (2025) this wasn't the case. Their study finds that gross profit margins were the lowest in 10 years for supermarkets, indicating that price increases were primarily driven by rising costs rather than by attempts to expand profits, as price gourgin would have resulted in higher margins. Furthermore, the data show that producer prices for foods have risen more than consumer food prices, showing supermarkets absorbed part of the cost increases rather than passing them on to consumers.

A growing body of literature has investigated VAT pass-through using natural experiments from European VAT reforms. Benedek et al. (2015) find substantial heterogeneity in pass-through across countries and goods, with evidence of anticipatory pricing and lagged adjustments. Carbonnier (2007) documents incomplete but significant pass-through in French VAT reforms. Kosonen (2013) shows strong price effects in Finland's hairdressing industry, while more recent work on the COVID-19 VAT reductions in Germany and the United Kingdom points to substantial but incomplete price responses. These studies highlight that VAT changes can influence prices, but the size and timing of the effects vary considerably. Despite this growing empirical base, the literature has not yet provided a unified assessment of VAT pass-through in the most recent period of elevated inflation, nor has it examined the implications for Denmark specifically.

This thesis contributes to the literature in two ways. First, it provides new evidence on VAT pass-through in the EU using monthly data for ten countries and ten food categories from 2019–2024.

This period includes multiple VAT reforms related to inflation relief policies, offering a unique opportunity to study pass-through dynamics in an environment of high inflation and supply-chain disruptions. The analysis merges detailed consumer price index (HICP) data with a manually constructed dataset of monthly VAT rates, allowing for precise identification of tax changes. The econometric specification follows the framework of Benedek et al. (2015), employing first-difference regressions with country, category, and time fixed effects, as well as dynamic lead-lag structures to capture adjustment patterns.

Second, the thesis uses the estimated pass-through coefficients to simulate the potential inflationary impact of a hypothetical temporary VAT cut in Denmark. This exercise provides policy-relevant insights at a time when Danish inflation remains a central concern and when indirect tax measures continue to be debated as part of the national policy toolkit. By basing the simulation on cross-country empirical evidence rather than theoretical assumptions, the thesis offers a realistic assessment of the likely magnitude and timing of the effect.

The empirical results indicate that VAT pass-through is partial and distributed over time. The contemporaneous effect of a VAT change on consumer prices is modest, while the largest adjustment occurs with a one-month lag. Some evidence of price corrections in subsequent months suggests that firms temporarily overshoot or adjust gradually. The cumulative pass-through over several months is positive and economically meaningful, consistent with the findings of earlier studies, though slightly lower than the average estimates reported in Benedek et al. (2015). These results imply that a temporary VAT cut in Denmark would lower inflation, but the effect would likely be moderate and short-lived.

The remainder of the thesis is structured as follows. Section 2 presents the theoretical framework underlying VAT pass-through and price-setting under imperfect competition. Section 3 reviews the empirical literature on VAT reforms and price effects. Section 4 describes the construction of the dataset, including the integration of Eurostat HICP data and the VAT change log. Section 5 outlines the empirical methodology, including the dynamic pass-through specification. Section 6 presents the empirical results. Section 7 applies the estimated coefficients

to simulate the impact of a hypothetical VAT cut in Denmark. Section 8 reports robustness and sensitivity analyses. Section 9 concludes and discusses policy implications.

Theoretical Framework

This chapter outlines the theoretical foundations underlying the analysis of VAT pass-through to consumer prices. While the previous literature review summarized the empirical findings of related studies, and the methodology chapter presented the econometric approach used in this thesis, the purpose of this theory section is to provide the economic reasoning behind how and why VAT changes may be reflected in consumer prices. The focus is on the main mechanisms that the reduced-form model attempts to capture, including tax incidence, substitution patterns, general equilibrium spillovers, and dynamic price adjustments.

Although the empirical model relies on a flexible specification with leads, lags, and fixed effects, the theoretical arguments in this section help clarify what the estimated coefficients represent and how they relate to established results in public finance and price-setting theory.

In the simplest microeconomic setting, the effect of a consumption tax on prices can be understood using standard tax incidence theory. Consider a single good with consumer price P, producer price p, and ad valorem tax rate τ, and the consumer price is given by equation 1:

$$P = (1 + \tau)p \tag{1}$$

A small change in the tax rate affects both the consumer and the producer price. Linearizing around the initial equilibrium gives the familiar pass-through expression in equation 2:

$$\theta_i = \frac{\eta_{ii}^{S}}{\eta_{ii}^{S} + \eta_{ii}^{D}} \tag{2}$$

where η^{S} is the price elasticity of supply and η^{D} is the (absolute) price elasticity of demand. The intuition is straightforward: the less responsive consumers are to price changes, the greater the

share of the tax that can be shifted onto them. Similarly, the more elastic the supply curve, the more producers are willing to adjust production without bearing much of the tax burden.

This simple partial-equilibrium framework, however, has some clear limitations. It treats the good in isolation, assumes perfectly competitive markets, and typically predicts pass-through values between zero and one. These assumptions are restrictive in modern retail markets and especially in broad VAT reforms that simultaneously affect many goods.

General Equilibrium Considerations

When a VAT change applies to a wide share of consumption—such as standard or reduced food VAT rates—the theoretical predictions become more involved. Benedek et al. (2015) show that in a setting with multiple goods and cross-price interactions, a VAT shock can generate indirect price responses in markets that are not directly taxed. These indirect effects feed back into the demand for the taxed goods themselves.

If a VAT increase on one category raises its consumer price, demand may shift toward related goods. When goods are substitutes, the price of the untaxed goods tends to rise, which then partially compensates the fall in demand for the taxed good. When goods are complements, the reverse mechanism occurs, but the ultimate effect can still increase the demand curve for the taxed good. So that's why:

- If goods are **substitutes**, the VAT-induced rise in the taxed good's price increases demand for untaxed goods, pushing up their prices and effectively feeding back into stronger demand for the taxed good.
- If goods are **complements**, a VAT-induced rise in the taxed good's price decreases demand for the untaxed good, lowering its price, which again increases demand for the taxed good.

Thus, general equilibrium effects can produce **higher pass-through**, and in some cases even overshifting (consumer prices rising more than the tax increase), as also shown in Weyl and Fabinger (2013).

An important implication is that **pass-through may exceed 100%**, a situation referred to as overshifting. This can occur even in competitive markets when cross-price elasticities amplify the direct impact of the tax. It also implies that comparing taxed goods to untaxed goods to infer incidence—something occasionally done in retail-level studies—might underestimate or overestimate the true pass-through unless cross-price effects are taken into account.

Market Structure and Imperfect Competition

The food sector in Europe is characterised by a mix of highly concentrated supermarket chains, discount retailers, and specialised segments. Therefore, the assumption of perfect competition is unlikely to hold in practice. Under imperfect competition, firms set prices as mark-ups over marginal cost, and the incidence of taxes depends heavily on how mark-ups adjust.

A key insight from Bulow and Pfleiderer (1983) and later formalised by Weyl and Fabinger (2013) is that pass-through depends not only on elasticities, but also on **demand curvature**. When demand is more convex, firms tend to react more aggressively to cost shocks, which increases pass-through. Conversely, when demand is locally concave, price adjustments may be more muted.

In markets with differentiated products and strategic interaction, such as supermarket food categories, firms may react to VAT changes depending on their competitive environment. If firms attempt to protect margins during a VAT cut, pass-through will be lower. If they use VAT increases as a coordination device for broader price adjustments, pass-through may be higher. This theoretical result aligns with several empirical studies showing heterogeneous pass-through across sectors and reforms.

That's why we can conclude that the event wasn't symmetric to the existing observation which IMT made

Dynamics, Anticipation, and Adjustment Costs

A central element for VAT pass-through is the **timing** of price changes. VAT reforms are often announced in advance, giving firms time to adjust catalogues, pricing strategies, or promotional activity. When VAT increases are anticipated, firms might gradually raise prices prior to the legal change. Consumers might also shift purchases across time—accelerating purchases before an increase or delaying them before a cut.

In addition, firms may face frictions in adjusting prices immediately. Menu cost models (e.g. Mankiw, 1985; Golosov and Lucas, 2007) predict that firms change prices infrequently, and often in response to multiple shocks at once. Even small administrative costs of updating prices can lead to delayed adjustment, causing the observed pass-through to be distributed across several months.

For these reasons, empirical VAT pass-through models require leads and lags of VAT changes. The estimated coefficients reflect not only the structural incidence predicted by theory but also timing frictions, expectations, and the information environment around each reform. This is particularly relevant for recent European VAT reforms, many of which occurred during the COVID-19 period and the inflation surge of 2021–2023.

In summary, the theoretical literature identifies several determinants of VAT pass-through:

1. **Supply and demand elasticities** determine the baseline incidence.
2. **Cross-price effects and substitution patterns** can amplify or moderate pass-through.
3. **Market structure and mark-up behaviour** influence whether firms shift taxes fully, partially, or even more than fully.
4. **Expectations, menu costs, and staggered adjustments** generate dynamic responses that unfold over time.

The reduced-form approach applied in this thesis is designed to capture the **total reduced-form effect** of VAT changes on consumer prices, without requiring the direct estimation of structural elasticities. The dynamic specification with fixed effects connects closely to the theoretical mechanisms discussed above, enabling an empirical measurement of both immediate and cumulative VAT pass-through.

Literature Review

Understanding how changes in Value Added Tax (VAT) affect consumer prices has long been a central question in public economics. VAT is a consumption tax applied to most goods and services in the European Union, and because it directly alters the final price paid by consumers, it has immediate implications for inflation, household welfare, and fiscal policy. The academic literature on VAT pass-through spans several decades and includes both theoretical and empirical analyses. This review synthesises the key findings relevant to this thesis, drawing on international evidence, studies of European reforms, and recent work on VAT cuts during periods of high inflation. It also situates the contribution of this thesis within the existing scholarship and tries to find gaps in the existing litterature.

Early theoretical work on tax incidence emphasises that the pass-through of an indirect tax depends on the elasticities of supply and demand, the competitive structure of the market, and the nature of marginal costs. Under perfect competition, the full amount of a tax increase should theoretically be passed on to consumers, while tax reductions should be fully reflected in lower prices. However, many empirical studies demonstrate that this benchmark is rarely met in practice. Market imperfections, adjustment costs, and strategic pricing behaviour often lead to incomplete, delayed, or asymmetric pass-through. Modern tax incidence theory recognises that pass-through is ultimately an empirical matter influenced by institutional and market-specific conditions.

A substantial strand of research investigates VAT pass-through using retail scanner data and

price microdata. Shiraishi (2022), analysing the 2014 VAT increase in Japan, provides a detailed examination of how product-level characteristics influence price adjustments. The study shows that pass-through varies systematically with demand inelasticity, market concentration, and the curvature of demand. Products sold in more competitive environments tend to display higher pass-through, whereas those with limited competition exhibit lower or more gradual adjustment. These findings underscore the importance of heterogeneity and offer insight into why aggregate pass-through may be muted even when some products fully adjust to tax changes.

The most influential cross-country study on VAT pass-through is Benedek et al. (2015), an IMF Working Paper covering 17 euro area countries between 1999 and 2013. The authors evaluate the impact of VAT reforms on harmonised indices of consumer prices (HICP) using a panel regression model in first differences, with country and time fixed effects. Their results show that pass-through differs sharply across the type of reform: standard rate increases tend to be passed through nearly fully in the long run, while reduced rate changes often lead to much weaker or statistically insignificant price responses. This distinction is particularly relevant for food, which is commonly subject to reduced VAT rates across Europe. The study also uncovers dynamic adjustment patterns, with evidence of both anticipation effects—where prices begin to rise before the VAT increase—and lagged effects—where prices continue to adjust several months afterwards. These dynamic effects justify the use of lead–lag specifications in pass-through models, a feature adopted in this thesis.

Complementing this cross-country evidence, several studies have examined individual VAT reforms as quasi-natural experiments. Carare and Danninger (2008) analyse Germany's 2007 VAT increase, finding that approximately two-thirds of the observed increase in inflation during 2006–2007 can be attributed to the VAT reform. Importantly, they show that firms raised prices in anticipation of the increase, creating inflation pressures even before the statutory rate changed. This phenomenon, known as inflation smoothing, reveals that economic agents respond not only to the effective tax rate but also to expectations about future prices. As a consequence, simple before-and-after comparisons around reform dates may understate or misrepresent the

true magnitude of tax-induced price changes.

Another major episode examined in the literature is Germany's temporary VAT cut in 2020, implemented during the COVID-19 pandemic to stimulate consumption. Fuest, Neumeier, and Stöhlker (2020) study this intervention using web-scraped daily price data from supermarkets and apply a difference-in-differences framework with Austria as a control group. They find that the reduction of the reduced VAT rate from 7 to 5 percent on food resulted in an average price decrease of about 1.3 percent. This corresponds to roughly 70 percent pass-through—significantly less than full but still economically meaningful. Their analysis also reveals strong asymmetry: when the VAT rate returned to its previous level at the end of the year, only around half of the expected price increase materialised. These findings provide compelling evidence that temporary VAT cuts can produce smaller and more short-lived price effects than permanent changes.

Several recent studies focus specifically on essential goods, such as food and hygiene products, which are particularly relevant for policymaking during inflationary periods. Frey and Haucap (2024) examine the reduction of VAT on menstrual hygiene products in Germany from 19 percent to 7 percent. Using weekly retail product data, they show that pass-through was not only complete but in many cases exceeded 100 percent, with prices falling by more than the tax reduction. This excess pass-through is attributed to competitive pricing pressures and psychological price endings, indicating that consumer-facing industries may respond to VAT changes in ways that reinforce price salience.

Benzarti, Garriga, and Tortarolo (2024) evaluate a dramatic temporary VAT cut on basic food items in Argentina, where the rate was reduced by 21 percentage points during a period of high inflation. Their findings reveal that only around half of the VAT reduction was passed through into lower prices, but when the measure expired, nearly the full VAT increase was passed through, leading to higher prices than before the reform. The authors further show that attempts to enforce lower prices through anti-profiteering regulations disproportionately benefited

higher-income households, as compliance was stronger in large supermarkets than in smaller independent shops. This study provides a cautionary example of how VAT cuts may underperform in high-inflation environments and can even exacerbate price volatility.

Broader evidence from Europe reinforces the importance of asymmetry. Benzarti et al. (2017, 2018) examine VAT reforms across the EU from 1996 to 2015 and demonstrate that increases in VAT are more strongly passed through to consumer prices than decreases. This asymmetry is consistent with models of downward price rigidity and suggests that firms may use VAT reductions as opportunities to widen margins rather than lower prices. Their findings have significant implications for the present thesis, as asymmetry reduces the expected impact of temporary VAT cuts and magnifies potential rebound effects once the cuts expire.

Several studies outside Europe contribute additional insights about price rigidity and tax incidence. Gopinath, Itskhoki, and Rigobon show that price adjustment depends heavily on currency invoicing and menu costs, highlighting that even when costs change, firms may adjust prices only infrequently. Kosonen (2013) and Carbonnier (2007), focusing on VAT cuts in Finland and France respectively, find partial and heterogeneous pass-through, especially in service sectors where competition is weaker. These papers support the view that market structure is central to understanding pass-through and that reduced rates often show weaker responses than standard rates.

Across the literature, three main themes consistently emerge. First, VAT pass-through is rarely immediate. Both Benedek et al. and Carare and Danninger document that price adjustments begin before and continue after the formal policy change. This justifies including dynamic adjustment terms in empirical models. Second, asymmetry between VAT cuts and increases is pervasive. Increases tend to generate stronger and faster price responses than cuts, a finding mirrored in Germany's 2020 VAT reforms and Argentina's food VAT cut. Third, market structure matters substantially. Pass-through tends to be higher in competitive markets and lower in concentrated ones, while essential goods may exhibit distinctive patterns depending on supply

chain characteristics.

This thesis contributes to the literature in three ways. First, it examines VAT pass-through during the period 2019–2024, which includes the COVID-19 pandemic, supply chain disruptions, and the most significant inflation surge in recent European history. This period has been understudied in VAT research and offers a unique setting to test whether pass-through behaves differently during inflationary shocks. Second, the thesis focuses exclusively on food and non-alcoholic beverages across ten EU countries, integrating insights from both broad cross-country analyses and targeted studies of essential goods. Third, it applies estimated pass-through coefficients to a forward-looking policy question: the potential impact of a temporary VAT cut in Denmark, a country that did not implement VAT changes during the recent inflation episode. By combining empirical estimates with a policy simulation, the thesis bridges the gap between academic analysis and real-world policymaking.

Overall, the literature demonstrates that VAT pass-through is partial, dynamic, and heterogeneous. These patterns suggest that temporary VAT cuts may have more modest inflation-reducing effects than assumed and that their timing, duration, and design play crucial roles in determining their effectiveness. The evidence from Japan, Germany, Argentina, France, Finland, and the wider euro area collectively highlights the complexity of pricing behaviour in the presence of VAT reforms and provides a strong empirical foundation for the present study.

Data

This chapter describes the dataset used to estimate value-added tax (VAT) pass-through to consumer food prices. It outlines the data sources, country coverage, variable construction, and the structure of the final panel used in the empirical analysis.

The empirical analysis combines monthly consumer price data from the Harmonised Index of Consumer Prices (HICP) with a manually constructed dataset of statutory VAT rates. Price data are obtained from Eurostat, while information on VAT rates and reforms is compiled from

European Commission publications on VAT rates applied in the Member States and national policy sources. The HICP is the standard measure of inflation used for cross-country comparisons within the European Union and is constructed using harmonised definitions and classifications (Eurostat, 2024).

The sample covers ten EU countries: Spain, Poland, Portugal, Germany, the Netherlands, Czechia, Estonia, Croatia and Cyprus. These countries were selected because they implemented VAT changes affecting food or closely related consumption categories during the period 2019–2024. Several countries introduced temporary VAT reductions on basic food items in response to the COVID-19 pandemic and the subsequent cost-of-living crisis (e.g. Spain, Poland, Portugal), while others implemented broader reforms affecting reduced or standard rates that apply to food (e.g. the Netherlands, Czechia, Estonia). Including only countries with clearly identifiable VAT reforms ensures sufficient within-country variation to estimate pass-through effects in a panel framework.

This approach is consistent with the empirical VAT pass-through literature, which emphasises the importance of exploiting discrete tax reforms and disaggregated price data. In particular, International Monetary Fund research (Benedek et al., 2015) shows that pass-through varies across product categories and over time and that credible identification relies on observable statutory rate changes. Focusing on EU countries also ensures comparability of price indices due to the harmonised construction of the HICP.

The sample period spans January 2019 to December 2024 at monthly frequency. This period captures multiple VAT reforms affecting food consumption across the selected countries and provides sufficient pre- and post-reform observations to analyse dynamic price responses.

HICP food categories

The dependent variable is based on the HICP for food and non-alcoholic beverages (COICOP division 01). The analysis uses detailed subcategories identified by COICOP codes:

- CP0111 – Bread and cereals
- CP0112 – Meat
- CP0113 – Fish and seafood
- CP0114 – Milk, cheese and eggs
- CP0115 – Oils and fats
- CP0116 – Fruit
- CP0117 – Vegetables
- CP0118 – Sugar, jam, honey, chocolate and confectionery
- CP0119 – Food products n.e.c. (other foods)
- CP012 – Non-alcoholic beverages

These categories cover the majority of household food expenditure and correspond closely to items typically subject to reduced VAT rates. Using disaggregated categories increases the variation available for identification and allows for heterogeneous price responses across food groups. As we can see in figure 2 below all food groups saw a steady incline in the level of prices after early 2022, especially oils and fats (CP0115) increased as the first food group. From march until juli we saw the rest of the HCIP food groups increase aswell, with vegetables (CP0117) and oils and fats (CP0115) have increased the most at the end of our dataset in december of 2024.

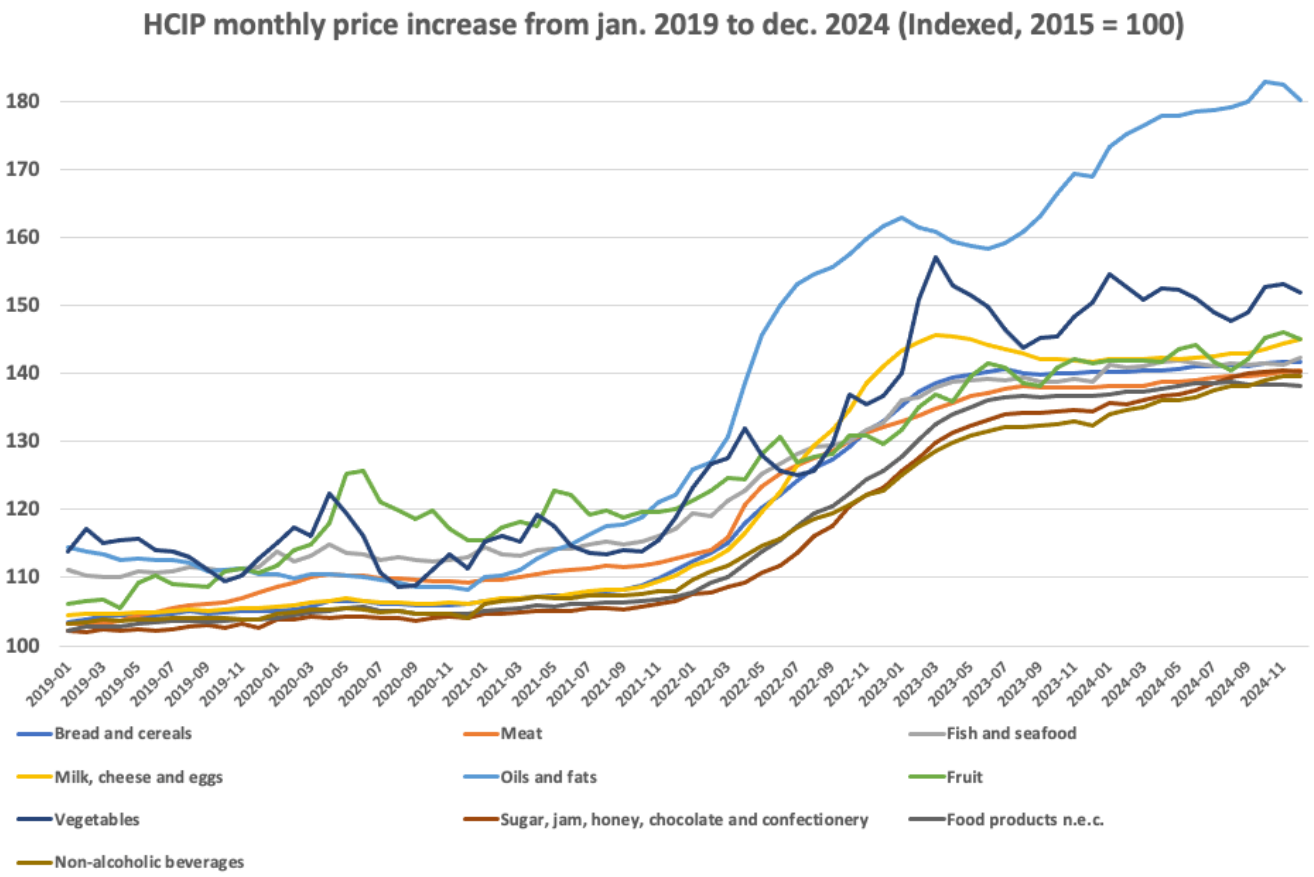

Figure 2: Combined european monthly price increase for each HCIP categori included in this papery from jan. 2019 - dec. 2024 Source: Eurostat: HCIP - monthly data (index), 2025.

VAT rate data

A monthly dataset of statutory VAT rates was constructed for each country and merged with the HICP data. For each country and month, the applicable VAT rate for food-related items was recorded. Where reduced rates apply only to specific food categories, the relevant rate was assigned; where broader reforms affected all goods or reduced-rate goods, the corresponding rate was applied to the food categories in the dataset.

The sample includes a range of policy changes, including temporary zero rates on basic foods (e.g. Spain, Poland, Portugal), reduced-rate adjustments (e.g. Croatia, Cyprus), and broader VAT reforms affecting food prices through changes in reduced or standard rates (e.g. the Netherlands,

Czechia, Estonia). These reforms generate variation in VAT rates across countries and time that can be used to estimate pass-through effects.

The final dataset is a monthly panel at the country–product–month level. The HICP data are organised by country (geo), COICOP category (coicop), and month (time), with the variable *values* representing the price index. This dataset is merged with monthly VAT rates by country and month so that each observation is assigned the relevant statutory rate.

The unit of observation is therefore:

$$country\ x\ COICOP\ food\ category\ x\ month$$

This structure allows the use of fixed-effects models that control for unobserved heterogeneity across countries, product categories, and time.

The main outcome variable is the monthly log change in the HICP price index:

$$\Delta lnP_{cit} = \ln(P_{cit}) - \ln\,(P_{cit-1}) \tag{3}$$

which approximates percentage changes in consumer food prices. VAT changes are measured as log differences in $1 + VAT$:

$$\Delta \ln(1 + VAT_{ct}) = \ln(1 + VAT_{ct}) - \ln\,(1 + VAT_{ct-1}) \tag{4}$$

reflecting the multiplicative effect of VAT on consumer prices. Lagged and lead values of VAT changes are constructed to capture delayed pass-through and potential anticipation effects. Log-differencing and fixed effects remove common trends and seasonal patterns in the data.

Descriptive statistics

In the two tables below we've shown the descriptive statistics for monthly price changes for each country in the first table and for each food category in the second table. Summary tables and figures illustrate the timing of VAT reforms and the evolution of food price inflation over the sample period. These patterns confirm substantial variation in food prices across countries, categories and time as well as heterogeneity in price dynamics across food categories, providing the basis for identifying VAT pass-through in the empirical analysis. As we can see in table 1 we've seen an average monthly price increase between 0,27% and 0,62% for our observed countries. Cypress (CY) saw the lowest average monthly price increase in the period of 0,27%, or about 3,24% yearly average inflation, while Estonia (EE) saw the highest average monthly price increase of 0,62%, or about 7,44% yearly average inflation. Looking at the standard deviation we see that countries like Germany (DE) and Nederlands (NL) had the lowest average monthly volatility. While most countries had an average monthly volatility of around 2%, Cypress saw the highest volatility of 4,633%.

Descriptive Statistics by Country

Monthly food price inflation from 2019 to 2024

geo	Mean	SD	N
CY	0.270%	4.633%	820
CZ	0.432%	2.538%	820
DE	0.428%	1.555%	820
EE	0.620%	2.475%	820
ES	0.404%	1.988%	820

Descriptive Statistics by Country

Monthly food price inflation from 2019 to 2024

geo	Mean	SD	N
HR	0.496%	1.804%	820
NL	0.382%	1.314%	820
PL	0.566%	1.723%	820
PT	0.369%	1.828%	820

Table 1: average monthly food price inflation by examined country 2019 - 2024

If we take a look at the monthly food price increase for each category included in our study in table 2, we saw price increases of around 0,328% to 0,54% across of HCIP categories in our period 2019 to 2024. Vegetables and fish and seafood were among the food categories with the lowest increase in prices and sugar and confectionery the highest, most of the food categories had an average monthly price increase of around 0,45%, or around 5,4 percent. If we compare the mean monthly price increase between food groups and countries we see a bigger spread on inflation for countries. Meaning food categories were hit more evenly with price increases, whereas some countries were hit harder than others, e.i. Cypress and Estonia.

Descriptive Statistics by Food Category

Monthly food price inflation from 2019 to 2024

food_group	Mean	SD	N
Bread and cereals	0.458%	0.868%	820

Descriptive Statistics by Food Category

Monthly food price inflation from 2019 to 2024

food_group	Mean	SD	N
Fish and seafood	0.382%	1.758%	820
Fruit	0.482%	3.746%	820
Meat	0.492%	1.137%	820
Milk, cheese and eggs	0.453%	1.214%	820
Non-alcoholic beverages	0.487%	1.111%	820
Oils and fats	0.449%	2.559%	820
Other food products	0.416%	1.093%	820
Sugar and confectionery	0.540%	1.300%	820
Vegetables	0.328%	4.695%	820

Table 2: average monthly price inflation for each HCIP group included in study from 2019 - 2024

Overall, the dataset combines harmonised monthly price indices with statutory VAT rates across multiple EU countries and food categories. Its high frequency and disaggregated structure allow for a detailed analysis of the short-run and dynamic effects of VAT reforms on consumer food prices.

Methodology

This chapter outlines the theoretical and empirical framework used to estimate the degree of pass-through from Value Added Tax (VAT) changes to consumer food prices in Europe. The analysis follows the reduced-form approach developed by Benedek et al. (2015) while adapting it to the panel dataset constructed for this thesis, which covers monthly observations for ten EU countries and ten food consumption categories between 2019 and 2024. The section proceeds in two parts. Section A presents the economic theory that links VAT changes to consumer prices, explaining the determinants of tax pass-through. Section B develops the empirical model, describes the estimation approach, and discusses identification assumptions and limitations.

Theoretical Framework

For a (possibly composite) commodity ii with consumer price PiPi and producer (pre-tax) price pipi, subject to an ad valorem VAT rate τiτi, the consumer price is:

$$P_i = (1 + \tau_i)p_i \tag{5}$$

Following Benedek et al. (2015), the **degree of pass-through** is defined as the proportionate response of the consumer price to a marginal change in the tax factor $(1 + \tau_i)$:

$$\theta_i = \frac{\Delta P_i / P_i}{\Delta(1 + \tau_i)/(1 + \tau_i)} \tag{6}$$

Full pass-through corresponds to $\theta_i = 1$, implying that a VAT increase raises consumer prices proportionately while producer prices remain unchanged. Values below one indicate incomplete pass-through, while values above one imply overshifting.

Partial Equilibrium Intuition

Consider a simple partial equilibrium model with competitive supply and demand for commodity ii. Let:

- η_{ii}^{S}: own-price elasticity of supply
- η_{ii}^{D}: (minus) own-price elasticity of demand

In this classical setting, a perturbation of the market-clearing condition yields the well-known formula for incidence:

$$\theta_i = \frac{\eta_{ii}^{S}}{\eta_{ii}^{S} + \eta_{ii}^{D}} \tag{7}$$

Pass-through is increasing in supply elasticity and decreasing in demand elasticity. However, this intuition is incomplete when tax changes affect many goods or when general equilibrium interactions matter.

General Equilibrium Considerations

VAT reforms often apply to broad subsets of consumption (e.g., standard rates covering most goods). In such cases, the prices of untaxed or differently taxed goods may also adjust, indirectly affecting demand for taxed goods. Consider two goods, 11 and 22, with VAT applied only to good 11. Allowing demand for each good to depend on both prices through uncompensated cross-price elasticities ηijDηijD, the more general pass-through formula becomes:

$$\theta_1 = \frac{\eta_{11}^{S} + \eta_{12}^{D}}{\eta_{11}^{S} + \eta_{11}^{D} + \eta_{12}^{D} + \eta_{21}^{D}} \tag{8}$$

Two insights follow:

1. **Pass-through generally exceeds the partial equilibrium level** when cross-price elasticities for goods 1 and 2 share the same sign.
2. **Prices of untaxed goods respond to VAT changes** through general equilibrium spillovers, implying that using untaxed goods as "controls" can bias estimated pass-through.

Thus, empirical pass-through reflects both movement **along** demand curves (partial equilibrium) and movement **of**demand curves (general equilibrium).

Role of Substitution, Income Effects, and Budget Shares

Rewriting the general equilibrium pass-through expression in elasticity-of-substitution form (as shown in Benedek et al.), pass-through depends jointly on:

- The elasticity of substitution between taxed and untaxed goods σ,
- The income elasticity of the taxed good ν_1,
- The budget share of the taxed good s_1,
- Supply elasticity η_{11}^S.

One compact representation is:

$$\theta_1 = \frac{\eta_{11}^S}{\eta_{11}^S + \eta_{11}^D[1 + (\sigma - 1)\nu_1 s_1]} \tag{9}$$

This illustrates:

- Higher substitution possibilities may increase or decrease pass-through depending on competing effects.
- Larger budget shares do not necessarily imply higher pass-through.
- Market structure (competition, concentration) and demand curvature also matter.

These complexities justify the reduced-form approach: rather than trying to identify structural elasticities, we estimate the total reduced-form effect.

Dynamics and Anticipation

VAT changes may not lead to instantaneous price adjustments. Three mechanisms motivate the use of leads and lags:

1. **Menu costs / price rigidity:** firms adjust with delay.
2. **Pre-announced VAT changes:** prices may move before implementation.
3. **Inventory and supply chain contracts:** cost pass-through may be distributed across several months.

Because the effect of VAT changes unfolds over time, a dynamic empirical model is required.

Empirical Model

Reduced-Form Specification

Following Poterba (1996), Besley and Rosen (1999), and Benedek et al. (2015), this thesis employs a reduced-form panel model that relates monthly changes in consumer prices to changes in VAT rates. In its general form:

$$\Delta lnP_{ict} = \sum_{j=-J}^{K} \beta_j \Delta \ln\left(1 + VAT_{c,t+j}\right) + \gamma X_{ct} + \alpha_c + \alpha_i + \mu_t + \varepsilon_{ict} \qquad (10)$$

where:

- i = food category
- c = country
- t = month
- ΔlnP_{ict} = monthly log change in the price index

- $\Delta \ln\left(1 + VAT_{c,t+j}\right)$ = monthly log changes in statutory VAT rates with leads (j<0) and lags (j>0)
- X_{cT} = macro controls (unemployment, GDP growth)
- α_c,α_i = country and category fixed effects
- μ_t = month fixed effects
- ε_{ict} = error term.

The coefficients β_j trace out **anticipatory**, **contemporaneous**, and **delayed** price reactions to VAT changes.

The cumulative pass-through measure is:

$$\hat{\theta} = \sum_{j=-J}^{K} \hat{\beta}_j \tag{11}$$

This reduced-form estimate corresponds directly to the theoretical measure in Section A.1.

Final Model:

Based on the data structure and the frequency of observed VAT changes in 2019–2024, the baseline model includes:

- **2 leads** ($j = -2, -1$): anticipation
- **1 contemporaneous term** ($j = 0$)
- **3 lags** ($j = 1,2,3$): delayed adjustment

yielding:

$$\begin{aligned}\Delta \ln(P_{ict}) = {} & \beta_0 \Delta \ln(1 + VAT_{ct}) + \beta_1 \Delta \ln\left(1 + VAT_{c,t-1}\right) \\ & + \beta_2 \Delta \ln\left(1 + VAT_{c,t-2}\right) + \beta_3 \Delta \ln\left(1 + VAT_{c,t-3}\right) \\ & + \beta_{-1} \Delta \ln\left(1 + VAT_{c,t+1}\right) \\ & + \beta_{-2} \Delta \ln\left(1 + VAT_{c,t+2}\right) + \gamma X_{ct} + \alpha_c + \alpha_i + \mu_t \\ & + \varepsilon_{ict}\end{aligned} \tag{12}$$

Fixed Effects

- **Country FE:** controls for structural pricing differences and national regulatory environments
- **Category FE:** controls for demand characteristics and product-specific inflation trends
- **Month FE:** captures euro-area-wide inflation shocks, COVID-19 disruptions, and seasonal price patterns

Standard Errors

Standard errors are clustered at the **country level**, following Benedek et al. (2015), to allow arbitrary serial correlation within countries.

Estimation Procedure

All models are estimated in R using the **fixest** package. The package handles:

- Multi-way fixed effects
- High-frequency panel data
- Cluster-robust inference
- Efficient computation of dynamic models with many lags

The use of first differences focuses the model on month-to-month adjustments, removing long-run level differences and reducing omitted-variable bias.

Dynamic Interpretation

Including leads and lags allows us to:

- Detect **anticipation** (significant positive lead coefficients)
- Capture **gradual adjustment** (significant lag coefficients)
- Avoid attributing early or late responses incorrectly to the contemporaneous term
- Calculate a **long-run pass-through** as the sum of all coefficients

This matches the theoretical expectation that firms and consumers adjust prices gradually and sometimes even before VAT reforms take effect.

Identification Strategy

Identification relies on the assumption that **monthly changes in VAT rates are exogenous** to short-run price dynamics in individual food categories.

Several features of European VAT policy support this assumption:

1. VAT reforms are typically driven by **fiscal goals**, not sector-specific price movements.
2. Many reforms in 2021–2023 were **inflation relief measures** applied broadly or to essential goods.
3. VAT rates change relatively infrequently compared to monthly price fluctuations.

However, several challenges remain:

- VAT reforms may coincide with other policy actions (e.g., energy subsidies), creating potential **confounding effects**.
- Temporary VAT decreases (notably during COVID-19) may be accompanied by **communication campaigns**affecting consumer expectations.
- Measurement error in statutory VAT changes—especially if reforms are complex or multi-tiered—may attenuate coefficients.

Despite these concerns, the extensive use of fixed effects, macro controls, and dynamic VAT indicators provides a credible reduced-form setting.

Limitations

Several limitations should be acknowledged:

1. **Reduced Form, Not Structural**
   The model does not separately identify demand and supply elasticities or market power parameters.
2. **Possible Omitted State-Level Policies**
   National measures coinciding with VAT changes (price controls, subsidies) may bias results.
3. **Limited Cross-Sectional Variation**
   Some countries have few VAT changes during the period, reducing precision for country-specific effects.
4. **Monthly Frequency**
   Important price adjustments may occur within the month, which cannot be captured with available data.
5. **Composite Consumption Categories**
   Each CPI/HICP food category aggregates many products; heterogeneous product-level responses are not observable.

Nonetheless, these limitations are standard in pass-through research and do not undermine the main objective: estimating total VAT pass-through effects in a consistent, theory-informed reduced-form framework.

The methodology applied in this thesis integrates the theoretical foundations of VAT incidence with a dynamic, panel-based empirical specification tailored to contemporary European data. The reduced-form model captures the full temporal path of price adjustment through leads and lags of VAT changes and is robust to unobserved heterogeneity through multiple fixed effects.

The resulting estimates provide evidence on both immediate and cumulative pass-through effects and form the basis for the simulation exercise evaluating the potential impact of a temporary VAT reduction in Denmark.

This combined theoretical–empirical approach follows the benchmark methodology of Benedek et al. (2015) while extending it to new data from the inflationary period of 2019–2024. The next chapter presents the empirical results, including dynamic pass-through patterns, cross-country heterogeneity, and implications for VAT policy design.

Empirical Results

This section presents the main empirical findings on VAT pass-through to consumer food prices. The analysis proceeds in three steps. First, I report baseline estimates of the contemporaneous relationship between VAT changes and food price inflation. Second, I examine the dynamic response of prices using a distributed-lag specification that captures delayed adjustment and potential anticipation effects. Third, I calculate cumulative pass-through and compare the results to existing evidence in the literature.

Throughout, the dependent variable is the monthly log change in HICP food prices, and the key explanatory variable is the log change in $1 + VAT$. All specifications include country, product-category, and time fixed effects, and standard errors are clustered at the country level.

Baseline pass-through

Table 3 reports the baseline estimates of VAT pass-through. The contemporaneous coefficient on the VAT change variable is positive but statistically insignificant. The point estimate suggests that a 1% increase in the tax-inclusive price due to VAT is associated with an approximately 0.12% increase in consumer food prices in the same month. While the sign is consistent with standard tax-incidence theory, the lack of statistical significance indicates that most of the adjustment does not occur immediately.

Static VAT Pass-Through

	Estimate	Std. Error	t
VAT change (t)	0.122	0.0966	1.263

Table 3: Estimates from static VAT pass-trough model

This result is not unexpected. Retail food prices are often characterised by short-run rigidity due to menu costs, contractual arrangements with suppliers, and the use of promotional pricing. As a result, firms may not fully adjust prices in the same month that a tax change takes effect. Instead, pass-through may occur gradually over subsequent months as retailers update price lists and adjust margins.

The baseline specification therefore provides limited evidence of immediate pass-through but suggests a positive relationship between VAT changes and food prices. To capture the timing of adjustment more accurately, I turn to a dynamic specification that includes lagged and lead terms.

Dynamic pass-through

Table 4 presents the results of the distributed-lag model. This specification includes the contemporaneous VAT change, three monthly lags, and two leads. The inclusion of lags allows for delayed price responses, while leads test for anticipation effects.

The contemporaneous coefficient remains positive but statistically insignificant. The magnitude is similar to that in the baseline model, indicating that only a small portion of the tax change is reflected in prices immediately. However, the first lag of the VAT change is positive and statistically significant at conventional levels. This suggests that a substantial portion of pass-

through occurs one month after the tax change takes effect. Economically, this pattern is consistent with firms adjusting prices with a short delay rather than instantaneously.

Dynamic VAT Pass-Through

	Estimate	Std. Error	t
VAT change (t)	0.135	0.0962	1.400
VAT change (t−1)	0.234**	0.1000	2.338
VAT change (t−2)	-0.082	0.0465	−1.765
VAT change (t−3)	-0.105***	0.0271	−3.873
VAT change (t+1)	0.043	0.0609	0.712
VAT change (t+2)	0.072	0.0787	0.914

Table 4: Estimates from dynamic VAT pass-trough model

The second lag is negative but not statistically significant, while the third lag is negative and statistically significant. Together, these coefficients indicate a partial reversal of earlier price increases after two to three months. One interpretation is that firms initially adjust prices upward in response to higher VAT but subsequently moderate those increases, possibly due to competitive pressures or demand effects. The negative coefficient at longer lags may also reflect temporary overshooting or promotional adjustments that offset earlier price changes.

The lead terms are small and statistically insignificant. This provides little evidence of anticipatory pricing behaviour prior to VAT changes. In other words, retailers do not appear to systematically raise prices in advance of known tax increases or lower prices before tax reductions take effect. This finding suggests that price adjustments are largely reactive rather than forward-looking, at least within the monthly frequency used in this analysis.

Overall, the dynamic specification indicates that VAT pass-through to food prices is gradual and occurs primarily within the first few months after a tax change. The strongest response occurs one month after implementation, followed by partial adjustment in subsequent months.

Dynamic response and timing

Figure 3 illustrates the dynamic response of food prices to a VAT change using the estimated coefficients from the distributed-lag model. The figure plots the contemporaneous effect, lagged responses, and confidence intervals, providing a visual representation of the timing of pass-through.

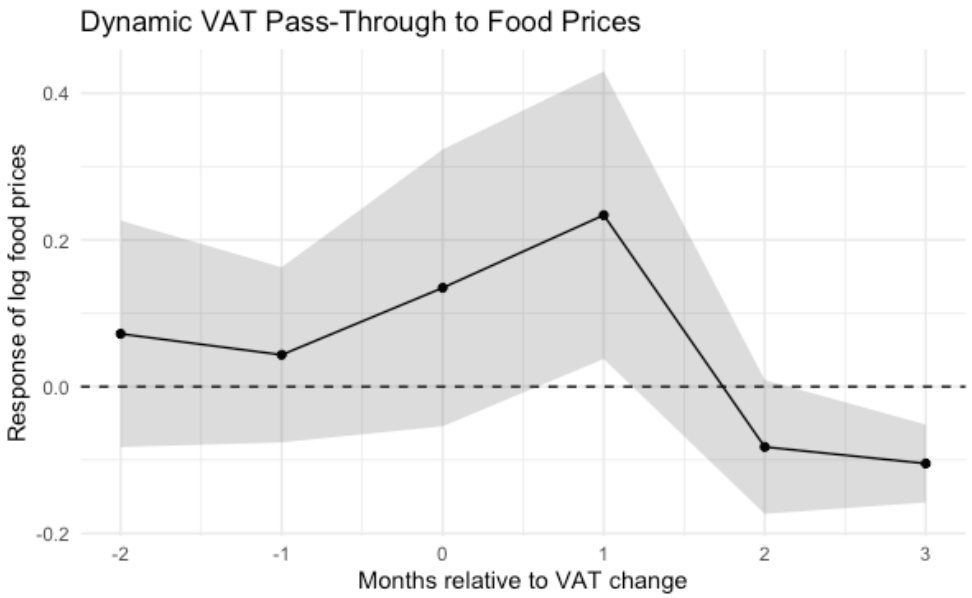

Figure 3: impulse response from Dynamic VAT pass-through model

The impulse-response pattern confirms the regression results. The immediate response is small, followed by a peak one month after the tax change. The response then declines and turns negative after two to three months, indicating partial adjustment or reversal. By the third month, most of the initial effect has dissipated.

This pattern suggests that price adjustment in the food sector is neither instantaneous nor fully permanent. Instead, VAT changes lead to a short-run increase in prices that peaks with a delay and then partially fades. Such dynamics are consistent with the presence of price rigidities and competitive pressures in food retail markets.

The absence of significant lead effects in the figure further supports the conclusion that there is little anticipation of VAT changes. Firms appear to adjust prices only after the tax change is implemented rather than in advance.

Cumulative pass-through

To assess the overall magnitude of VAT pass-through, I compute the cumulative effect by summing the contemporaneous coefficient and the three lagged coefficients. The cumulative pass-through estimate is approximately 0,182. This implies that a 10% increase in the VAT-inclusive price due to a tax change raises consumer food prices by roughly 1,8% over the subsequent months.

$$Cummulative\ effect: \quad VAT_{ct} + VAT_{ct-1} + VAT_{ct-2} + VAT_{ct-3} \tag{13}$$

$$Cummulative\ effect: \ 0{,}135 + 0{,}234 - 0{,}082 - 0{,}105 = 0{,}182$$

This estimate indicates partial pass-through of VAT changes to consumer prices. In a setting with full pass-through, the cumulative coefficient would be close to one. The estimated value below unity suggests that firms absorb part of the tax change in their margins or adjust prices only partially. Partial pass-through may reflect competitive pressures in retail markets, differences in demand elasticity across products, or the temporary nature of some VAT reforms in the sample.

The magnitude of the cumulative effect is economically meaningful but relatively modest. While VAT changes do affect consumer food prices, the impact is far from complete and unfolds gradually over time. This pattern is consistent with the idea that reduced-rate goods such as food exhibit lower and slower pass-through than standard-rated goods.

Anticipation effects

The dynamic model includes two lead terms to test whether firms adjust prices in anticipation of VAT changes. Both lead coefficients are small and statistically insignificant. This suggests that there is little systematic evidence of forward-looking pricing behaviour prior to tax reforms.

One possible explanation is that VAT changes affecting food are often implemented quickly or with limited advance notice, reducing the scope for anticipatory adjustments. Alternatively, firms may wait until the tax change is in effect before altering prices, either due to uncertainty about implementation or because consumers respond more strongly once the tax is officially in place.

The absence of anticipation effects strengthens the interpretation of the lagged coefficients as reflecting genuine post-implementation adjustments rather than pre-emptive pricing.

Model test and analysis

To assess the overall importance of VAT changes, I conduct a joint significance test of all VAT coefficients in the dynamic specification (appendix 2). A Wald test strongly rejects the null hypothesis that all contemporaneous, lagged, and lead VAT coefficients are jointly equal to zero ($p < 0{,}001$). This indicates that VAT changes have a statistically significant effect on food prices when considered collectively, even though individual coefficients are not always precisely estimated.

I also test whether the cumulative pass-through effect differs from zero by imposing the restriction that the sum of the contemporaneous and lagged VAT coefficients equals zero (appendix 3). This hypothesis cannot be rejected at conventional significance levels. While the cumulative pass-through estimate is economically meaningful, the statistical uncertainty

surrounding the estimate suggests that VAT changes have a modest and gradual effect on food prices rather than a precisely estimated long-run impact.

Overall, the results point to partial and delayed pass-through of VAT changes. The strongest price response occurs with a one-month lag, followed by partial adjustment in subsequent months. These dynamics are consistent with short-run price rigidities and competitive pressures in food retail markets.

Comparison with existing evidence

The results are broadly consistent with the existing literature on VAT pass-through. Previous research has documented that pass-through to consumer prices is often incomplete and varies across product categories. Studies using European data frequently find lower pass-through for reduced-rate goods such as food compared with standard-rated goods.

The estimated cumulative pass-through of around 18% is lower than the full pass-through predicted by simple tax-incidence models but aligns with empirical findings that firms absorb part of the tax change. Several factors may explain the relatively low pass-through in this setting. First, many VAT reforms in the sample are temporary or targeted, which may lead firms to adjust prices less aggressively. Second, the food retail sector is highly competitive, limiting the ability of firms to pass tax increases fully to consumers. Third, price rigidities and adjustment costs may slow the transmission of tax changes to retail prices.

Overall, the findings support the view that VAT changes are only partially reflected in consumer food prices and that the adjustment occurs gradually rather than immediately.

Taken together, the empirical results indicate that VAT pass-through to food prices in the selected EU countries is positive but incomplete. The immediate effect of VAT changes on prices is small and statistically insignificant, while the main adjustment occurs with a one-month delay. Prices then partially adjust back in subsequent months, resulting in a cumulative pass-through of roughly 18%.

These dynamics suggest that firms respond to VAT changes in a gradual and somewhat reversible manner. Rather than fully passing tax changes through to consumers, retailers appear to absorb part of the change in their margins or offset it through other pricing strategies. The limited evidence of anticipation effects indicates that price adjustments are primarily reactive.

The results have implications for the effectiveness of VAT policy as a tool for influencing consumer prices. Temporary reductions in VAT on food may lead to modest and delayed decreases in prices, while increases in VAT may not be fully transmitted to consumers. Policymakers should therefore consider the possibility of incomplete and gradual pass-through when designing tax measures aimed at affecting consumer price levels.

Overall, the empirical evidence points to partial and dynamic VAT pass-through in the European food sector. The combination of fixed-effects estimation, monthly panel data, and detailed product categories provides a nuanced picture of how tax changes affect consumer prices over time.

Policy implications: A hypothetical VAT reduction in Denmark

To illustrate the economic magnitude of the estimated pass-through, I simulate a hypothetical VAT reduction in Denmark. Denmark applies a uniform VAT rate of 25% to most consumption, including all food categories. Consider a policy that reduces the VAT rate on food by three percentage points, from 25% to 22%.

Using the estimated cumulative pass-through of approximately 0,18, such a VAT reduction would lower the tax-inclusive price by about 2,4%. Applying the estimated pass-through implies a decline in consumer food prices of roughly 0,4–0,5% over the following months. This suggests that even relatively large VAT reductions would lead to modest declines in consumer prices due to incomplete pass-through.

From a fiscal perspective, VAT is one of the largest sources of government revenue in Denmark. According to European Commission data, Denmark collected approximately €34 billion in VAT

revenue in 2023, corresponding to about 260 billion DKK. A three-percentage-point reduction in the standard VAT rate would therefore imply a revenue loss of roughly 12 percent, or around 30 billion DKK annually if applied broadly. If the VAT reduction were limited to food consumption, the fiscal cost would be substantially smaller but still several billion kroner per year. These calculations highlight that even modest reductions in consumer prices through VAT policy may entail significant fiscal costs relative to the estimated degree of pass-through.

These calculations highlight the trade-off between price relief for consumers and public revenue. While a VAT reduction would reduce food price inflation in the short run, the estimated pass-through suggests that the effect on consumer prices would be limited relative to the associated fiscal cost. The results therefore indicate that temporary VAT reductions are a relatively expensive policy tool for achieving modest reductions in consumer food prices.

Conclusion

This thesis examined the extent to which changes in value-added tax (VAT) are passed through to consumer food prices in European Union countries and assessed the potential inflationary impact of a temporary VAT reduction in Denmark. Using monthly panel data for ten EU countries and ten food categories between 2019 and 2024, the analysis estimated both contemporaneous and dynamic pass-through effects within a fixed-effects framework. The empirical specification followed the approach of Benedek et al. (2015), incorporating leads and lags of VAT changes to capture anticipation and delayed adjustment.

The empirical results indicate that VAT pass-through to food prices is positive but incomplete. The contemporaneous effect of VAT changes on consumer prices is small and statistically insignificant, suggesting that firms do not immediately adjust prices when VAT rates change. Instead, the largest price response occurs with a one-month delay, consistent with short-run price rigidities and menu-cost considerations. Subsequent months show partial reversals, implying that firms adjust gradually and may temporarily overshoot or absorb part of the tax change in their margins.

The cumulative pass-through estimate of approximately 18 percent implies that VAT changes are only partially reflected in consumer prices. While the magnitude is economically meaningful, it is substantially below full pass-through. Joint significance tests confirm that VAT changes have a statistically significant effect on prices when considered collectively, even though individual coefficients are not always precisely estimated. Overall, the results suggest that VAT changes influence food prices gradually and to a limited extent.

These findings are broadly consistent with the existing literature. Previous studies have documented incomplete and heterogeneous VAT pass-through, particularly for reduced-rate goods such as food. The dynamic adjustment patterns observed in this thesis align with evidence from earlier European VAT reforms, where price responses typically unfold over several months and may be weaker for temporary policy changes. The results therefore reinforce the view that VAT is an imperfect tool for influencing consumer prices in the short run.

To illustrate the policy implications, the thesis simulated the effect of a hypothetical temporary VAT reduction in Denmark. Applying the estimated pass-through coefficient suggests that a three-percentage-point reduction in the VAT rate on food would lower consumer food prices by roughly 0,4–0,5 percent. While such a measure would reduce inflation in the short run, the effect would likely be modest and short-lived. At the same time, the fiscal cost of a VAT reduction would be substantial. Given that VAT generates roughly 260 billion DKK in annual revenue in Denmark, even a targeted reduction on food would entail a significant loss of public revenue relative to the limited price effects.

Several limitations should be acknowledged. The analysis relies on a reduced-form empirical framework and does not separately identify structural supply and demand elasticities. The sample period includes a relatively small number of VAT reforms, which limits statistical precision. In addition, monthly data may not capture within-month price adjustments, and aggregate price indices may mask heterogeneous product-level responses. Despite these limitations, the dataset provides a consistent and harmonised framework for analysing VAT pass-through across countries and over time.

Future research could extend this analysis by using higher-frequency price data, exploring heterogeneity across specific food products or retail formats, and examining asymmetric responses to VAT increases and decreases. Further work could also investigate interactions between VAT policy and other inflation-mitigation measures such as subsidies or price regulations.

In conclusion, the evidence presented in this thesis suggests that VAT changes do affect consumer food prices but that the effects are partial, delayed, and relatively modest in magnitude. While temporary VAT reductions can provide some short-term relief from inflation, they are unlikely to generate large or persistent declines in consumer prices and may involve substantial fiscal costs. Policymakers should therefore weigh the limited inflationary impact of VAT cuts against their budgetary implications when considering VAT as a tool for managing inflation.

References

Benedek, D., De Mooij, R., Keen, M., & Wingender, P. (2015). *Estimating VAT Pass Through.* IMF Working Paper WP/15/214.

Benzarti, Y., Carloni, D., Harju, J., & Kosonen, T., (2018). *What Goes Up May Not Come Down: Asymmetric Incidence Of Value-Added Taxes.* NBER Working Paper, 2018, Working Paper 23849

Benzarti, Y., Carriga, S., & Tortarolo, D. (2024). *Can VAT Cuts and Anti-Profiteering Measures Dampen The Effects of Food Price Inflation.* NBER Working Paper, 2024, Working Paper 32241.

Besley, T. J. & Rosen, H. S. (1999). *Sales Taxes and Prices: An Empirical Analysis.* National Tax Journal, 52(2), 157-78.

Bulow, J., & Pfleiderer, P. (1983). *A note on the Effect of Cast Changes on Prices.* Journal of Political Economy, 91(1), 182-185.

Carbonnier, C. (2007). *Who pays sales taxes? Evidence from French VAT reforms, 1987–1999.* The Economic Journal, 117(518), 842–863.

Carare, A., & Danninger, S. (2008). *Inflation Smoothing and the Modest Effect of VAT in Germany.* IMF Working Paper WP/08/168.

Eurostat (2024). *Harmonised Index of Consumer Prices (HICP) Methodological Manual - 2024 edition.* Luxembourg: Publications Office of the European Union. ISBN: 978-92-68-12009-5.

European Commission (various years). *VAT Rates Applied in the Member States of the European Union Situation.*

European Commission. (2024). *VAT gap and VAT revenue data for EU Member States.*

Frey, A., & Haucap, J. (2024), *VAT Pass-through: the case of a large and permanent reduction in the market for menstrual hygiene products.* International Tax and Public Finance (2024) 31:160-202.

Golosov, M., & Lucas, R. E. (2007). *Menu Costs and Phillips Curves.* Journal of Political Economy, 115(2), 171-199.

Kjeldsen, M. M., Svarer, M., Kreiner, C. T., & Whitta-Jacobsen, H. J. (2025, October 17). *Differentieret moms er en virkelig, virkelig dårlig ide*. Politiken.

Kosonen, T. (2013). *More and cheaper haircuts after VAT cut? Evidence from a large VAT reform in Finland.* Journal of Public Economics, 97, 99–110.

Mankiw, N. G. (1985). *Small Menu Costs and Large Business Cycles: A Macroeconomic Model of Monopoly.* Quarterly Journal of Economics, 100(2), 529-537.

Nationalbanken (2025). *Globale Forhold driver Høje Fødevarerpriser i Danmark og Udlandet.* Analysis nr. 20, 24. september 2025.

Poterba, J. M. (1996). *Retail Price Reactions to Changes in State and Local Sales Taxes.* National Tax Journal, 49(2), 165-176.

Shiraishi, K. (2022). *Determinants of VAT pass-through under imperfect competition: Evidence from Japan.* Japan & The World Economy 61 (2022), 101120.

Weyl, E.G., & Fabinger, M. (2013). *Pass Through as an Economic Tool: Principles of Incidence under Imperfect Competition.* Journal of Political Economy, 121 (3), 528-583.

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data.* (Cambrigde MA: MIT Press).

Appendix

Appendix 1

Country	Baseline VAT (Food)	New VAT Rate(s)	Reform Period	Description
Cyprus (CY)	5%	0% → 5%	May 2023 – July 2024	Temporary zero-rating on essential foods; returned to 5%.
Czech Republic (CZ)	15%	12%	From Jan 2024	VAT restructuring: food categories moved to 12%.
Germany (DE)	7%	5% → 7%	Jul 2020 – Dec 2020	Temporary VAT cut on reduced-rate goods incl. food; restored to 7%.
Estonia (EE)	20%	22%	From Jan 2024	Standard VAT increase applied to food.
Spain (ES)	4%	0% → 2%	Jan 2023 – Dec 2024	Zero VAT on basic foods, partially restored to 2% from Oct 2024.
Croatia (HR)	13%	5%	From Apr 2022	Permanent reduction for basic food products.
Netherlands (NL)	9%	7%	From Mar 2023	Small VAT changes on food during study period.
Poland (PL)	5%	0% → 5%	Feb 2022 – Apr 2024	Anti-inflation zero-rating of food; restored to 5%.

Portugal (PT)	6%	0% → 6%	Apr 2023 – Dec 2023	Temporary zero VAT on essential food basket.

Appendix 2

```{r}
wald(m2, c("dlnVAT", "dlnVAT_l1", "dlnVAT_l2", "dlnVAT_l3"))
```

```
Wald test, H0: joint nullity of dlnVAT, dlnVAT_l1, dlnVAT_l2, dlnVAT_l3, dlnVAT_f1 and dlnVAT_f2
 stat = 41.9, p-value < 2.2e-16, on 6 and 8,458 DoF, VCOV: Clustered (geo).
```

Appendix 3

```{r}
linearHypothesis(
  m2,
  "dlnVAT + dlnVAT_l1 + dlnVAT_l2 + dlnVAT_l3 = 0"
)
```

```
Linear hypothesis test:
dlnVAT  + dlnVAT_l1  + dlnVAT_l2  + dlnVAT_l3 = 0

Model 1: restricted model
Model 2: dlnP ~ dlnVAT + dlnVAT_l1 + dlnVAT_l2 + dlnVAT_l3 + dlnVAT_f1 +
    dlnVAT_f2 | geo + coicop + time

  Res.Df Df  Chisq Pr(>Chisq)
1   8459
2   8458  1 0.9224     0.3368
```

Appendix 4

```{r}
m3 <- feols(
  dlnP ~ dlnVAT + dlnVAT_l1 + dlnVAT_l2 + dlnVAT_l3 |
    geo + coicop + time,
  data=df, vcov=~geo
)
summary(m3)
```

Description: df [4 × 5]

	Estimate <dbl>	Std. Error <dbl>	t value <dbl>	Pr(>|t|) <chr>
dlnVAT	0.132080	0.096385	1.37033	0.207800
dlnVAT_l1	0.232346	0.102174	2.27403	0.052559
dlnVAT_l2	-0.083666	0.045931	-1.82157	0.105997
dlnVAT_l3	-0.105879	0.026931	-3.93143	0.004348