MARKET POWER IN THE DAIRY VALUE CHAIN IN UKRAINE

by

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Abstract

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This thesis examines whether price adjustment in the Ukrainian dairy value chain is consistent with market-power mechanisms. It studies two links: farm-gate raw milk to processor-level dairy products, and processor or procurement prices to retail or consumer-facing prices. The question is whether shocks pass through quickly and symmetrically, or are delayed, incomplete, asymmetric, or filtered by contracts and retail strategy.

The core evidence comes from observed monthly State Statistics Service of Ukraine farm-gate, industrial producer, and consumer-price series, with Prozorro procurement data and Silpo/Novus stock keeping unit (SKU)-level observations used as shorter mechanism layers. After auditing units, product labels, package quantities, and mappings, the thesis applies cointegration, ECM/ARDL, asymmetric/NARDL, local projection, VECM, procurement, and retail-promotion specifications under a source hierarchy.

The findings support a cautious market-power interpretation. Farm-gate and processor prices are strongly connected for drinking milk, hard cheese, and sour cream, but adjustment is uneven. Downstream evidence is product-specific: sour cream gives the clearest processor-to-consumer signal, drinking milk is supported by processor-consumer and procurement-consumer links, and Prozorro-to-retail windows identify mechanisms rather than a stable retail equilibrium. This staged map is the contribution.

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AI USE DECLARATION

During preparation of this thesis, the author used generative AI tools in limited support roles. The tools included ChatGPT and, for selected coding tasks, Claude and Codex. They were not used to produce research findings, choose the final methodology, or write thesis text for direct inclusion without author review.

The tools were used for three purposes:

1. Research organization: AI-powered tools helped organize the notes, locate public materials for checking, and clarify wording in working outlines. All cited sources were reviewed by the author before use.

2. Methodological comparison: AI-powered tools helped evaluate and compare already selected econometric approaches, including cointegration, ECM, ARDL, VECM, NARDL, threshold and structural-break checks, temporal-disaggregation and interpolation methods, and promotion-related models. These outputs were used as working explanations, not as literature-review text or source summaries.

3. Technical coding support: AI-agent and AI tools helped debug, refactor, comment, check scripts for scraping, cleaning, product mapping, interpolation, visualization, monitored the reliability of the econometric modelling workflow. In scraping tasks, the assistance was crucial, but it used already existing libraries and methods, it was limited to routine code quality, logging, retry, rate-limiting, error-handling, while was not used to bypass access restrictions or website security protections.

All substantive choices, data construction, model estimation, interpretation, and conclusions were made and verified by the author. Any AI suggestion was checked against original sources, code outputs, and thesis evidence before use.

LIST OF ABBREVIATIONS

aCPT. Asymmetric Cost Pass-Through

AMCU. Antimonopoly Committee of Ukraine

ARDL. Autoregressive Distributed Lag model

AVM. Association of Milk Producers

CME. Chicago Mercantile Exchange

CPI. Consumer Price Index

DG AGRI. Directorate-General for Agriculture and Rural Development

DOLS. Dynamic Ordinary Least Squares

EC. European Commission

ECM. Error Correction Model

EU. European Union

FAO. Food and Agriculture Organization of the United Nations

HACCP. Hazard Analysis and Critical Control Point

HHI. Herfindahl-Hirschman Index

HS 04. Harmonized System chapter 04

ITC. International Trade Centre

KSE. Kyiv School of Economics

LP. Local Projection

MMO. Milk Market Observatory

MPS. Market Price Support

NARDL. Nonlinear Autoregressive Distributed Lag model

NBU. National Bank of Ukraine

OECD. Organisation for Economic Co-operation and Development

OLS. Ordinary Least Squares

PSE. Producer Support Estimate

RAU. Retail Association of Ukraine

SKU. Stock Keeping Unit

SMP. Skimmed Milk Powder

SSSU. State Statistics Service of Ukraine

UAH. Ukrainian hryvnia

UN. United Nations

USDA. United States Department of Agriculture

USDA ERS USDA. Economic Research Service

USDA FAS USDA. Foreign Agricultural Service

UTP. Unfair Trading Practices

VECM. Vector Error Correction Model

VPT. Vertical Price Transmission

Chapter 1

INTRODUCTION

The starting of this thesis is not a coefficient, or specific estimated effect, but a concrete policy problem in the Ukrainian food-market chain. Since the beginning of the war, Ukrainian food suppliers and large grocery chains have argued over payment terms, supplier liquidity, and whether the retailer-supplier relations should be regulated by the government (Filipenko 2023; Antimonopoly Committee of Ukraine 2023). There are multiple disagreements on the market between food suppliers and national retail chains, reporting contested supplier-retailer balance reached UAH 4.83 billion by early August 2022 (Filipenko 2023). That is why business media and policy materials describe this conflict as a dispute over settlement periods, self-regulation, and administrative interventions (Filipenko 2023; Nedashkivskyi 2025). The 2023 industry memorandum aimed to set a 30-calendar-day payment rule for basic domestically produced foods, including milk, kefir, butter, sour cream, and soft cheese, while the Antimonopoly Committee of Ukraine (AMCU) separately assessed the memorandum because it involved coordinated action by major chains (Filipenko 2023; Antimonopoly Committee of Ukraine 2023).

Another significant reason why this policy debate matters is the fact that market power in food chains is not expressed only as high shelf prices (Sexton 2013). With specific tools like delayed payment, private-label terms, promotion funding, assortment access, or the timing of repricing some powerful buyer can shift risks (Directive (EU) 2019/633; Loy 2023). Those instruments are not clearly observed directly in public data, but their consequences must cause some additional effects in price transmission: shocks may be passed through quickly, delayed, or partly absorbed, or even be visible to consumers only through promotions (Loy 2023).

Ukraine's war economy with regular blackouts, damaged infrastructure, labor shortages, logistics issues and uncertainty, and population displacement change costs at different stages of the chain disproportionately , and decrease outside options for the business, which makes this mechanism even more important (Cabinet of Ministers of Ukraine 2024; Tarassevych 2024; MilkUA.info 2026). In such circumstances, farms that cannot store raw milk for long face a different bargaining problem from processors that can redirect product mix. At the same time, both of them face another bargaining problem from retailer that manage shelf prices, assortment, discounts, and payment terms for the supplier (FAO 2013; Litvinov 2025b; Loy 2023). The market-power question therefore becomes not only whether consumers pay too much, but also whether stronger chain actors can shift adjustment risk to weaker actors (Sexton 2013; Litvinov 2025b).

1.1. Dairy as the empirical case

Ukraine has public discussion, legal materials, and sector evidence on bargaining pressure, yet the gap is clearly the absence or lacking amount of systematic evidence showing where adjustment power appears inside a specific food chain (Filipenko 2023; Antimonopoly Committee of Ukraine 2023; Litvinov 2025b). This thesis does not try to cover all grocery products, narrowing the question to dairy, where the entire value chain can be observed more clearly: raw milk is produced continuously, must be cooled and collected quickly, because it is perishable, then it is transformed by processors, and only after that appears in procurement, retail, and official consumer-price data (FAO 2013; Litvinov 2025a; Litvinov 2025b).

The dairy market is valuable, because it connects household food security with complexity of the diversified production chain, and with bargaining in relations between businesses. The Food Security Strategy reports milk and dairy products

as 13.7 percent of Ukrainian household monetary food expenditure in 2021, while official consumption data show a stable pre-war physical demand around 200-210 kg per person per year (Cabinet of Ministers of Ukraine 2024; State Statistics Service of Ukraine n.d.c). However, the value is not only in the final consumption itself, but the transformation through the production into diversified products as a domestic value chain. On the production side, total raw-milk output declined 31.3 percent from 2018 to 2025 , with increasing role of industrial farms and higher-grade milk (Litvinov 2025a).

Once dairy market is selected, the upstream market-power question becomes unavoidable. Raw milk is perishable – farms cannot cheaply store it, so local buyer density determines outside options (FAO 2013; Litvinov 2025a). KSE's bottleneck report links dairy-sector weaknesses to traceability gaps, payment delays, weak contractual models, as well as the risk of downstream abuse (Litvinov 2025b). This means that downstream payment terms and shelf-access conditions can pressure processors, while processors may still exercise monopsony-like power over farms (Sexton 2013; Litvinov 2025b). That is why the thesis studies four stakeholder layers – farmers, processors, institutional procurement buyers, retailers – because adjustment risk can be shifted across more than one interface, while not being equally strong on all layers (Litvinov 2025b; FAO 2013).

1.2. Research question, hypotheses, and novelty

The central research question is whether the price adjustment in the Ukrainian dairy value chain is consistent with market-power mechanisms: from farm-gate raw milk to processor-level dairy products, and from processor/procurement prices to retail and consumer-facing prices. The question is deliberately narrower than existing public disputes on the market, because the goal is to evaluate

whether public and constructed price data show delayed, asymmetric, not full, or strategically managed adjustment.

Core Hypothesis 1 (H1) is the expectation that price transmission from farm-gate raw milk to processor-level dairy products is delayed, incomplete, or asymmetric (Martinez 2002; Sexton 2013; Meyer and von Cramon-Taubadel 2004; Litvinov 2025a). This hypothesis follows from the literature on vertical coordination, buyer power, and asymmetric price transmission, but, furthermore, it is motivated by KSE sector evidence on raw-milk shortages, industrial-farm modernization, quality grades, household exclusion from formal processing, collection costs, and processor dependence on high-quality milk (Martinez 2002; Sexton 2013; Meyer and von Cramon-Taubadel 2004; Litvinov 2025a).

Core Hypothesis 2 (H2) is the expectation that processor-level or procurement prices are not transmitted to consumer-facing prices fully, quickly, and symmetrically (Kinnucan and Forker 1987; Loy, Weiss, and Glauben 2016; Loy 2023; Litvinov 2025b). Instead, the literature and Ukrainian institutional evidence imply that procurement contracts, retailer bargaining power, category management, private labels, menu costs, search costs, stock-out risk, and promotions can filter downstream adjustment (Kinnucan and Forker 1987; Loy, Weiss, and Glauben 2016; Loy 2023; Litvinov 2025b). Prozorro and retail discounts are therefore not separate hypotheses, but mechanisms used to evaluate H2 (Loy, Weiss, and Glauben 2016; Loy 2023; Litvinov 2025b).

The novelty of the research has three separate points. First, it reframes Ukrainian dairy price transmission as a market-power question rather than a generic co-movement exercise. Second, it separates farm-gate raw milk, processor-level industrial producer prices, public procurement prices, official consumer prices, and retail Stock Keeping Unit (SKU) observations instead of treating them as one price object. Third, it combines observed State Statistics Service of Ukraine (SSSU) monthly data, cleaned Prozorro records, and short-window Silpo/Novus

real retail layer observations under an explicit evidence hierarchy. However, the observed official monthly data carry the main structural evidence, while procurement and retail data explain mechanisms. During the research monthly time series for farm-gate, processor and consumer prices were reconstructed to high-frequency daily layers, which used additionally only as validated appendix evidence.

This thesis covers dairy consequently and evaluates the timing and strength of each price link. It can show whether there is co-movement between farm-gate raw milk prices and processor dairy-products prices or other price transmission. At the same time, covers processor-level and official consumer prices share a long-run relation in clean product pairs, and whether procurement and retail observations support buffering or promotional management, and how procurement connected to the consumer prices. It cannot estimate confidential margins, fees from retailers, marginal costs, or any bilateral contract terms, and, furthermore, this research cannot and is not aimed to prove any legal conclusions. For that reason, the interpretation describes processes and relations between the layers as whole and tries to find if market conditions are consistent with or compatible with market-power mechanisms.

The main finding is not only that price transmission is layered, but that each layer has different strength of evidence. Because of the farm-gate and processor monthly prices are better long-run evidence and they are official economically reliable data – H1 is strongly supported. Raw milk farm-gate prices are strongly linked with processor prices for drinking milk, hard cheese, sour cream, while kefir, butter, and skimmed milk powder are informative, but weaker because of adjustment signs and product mapping are less stable. H2 is supported through a complementary downstream design: the official processor-to-consumer bridge is strongest for sour cream, drinking milk is supported by processor-to-consumer and Prozorro-to-consumer estimates, and Prozorro-to-retail evidence is used to

identify short-window retail/procurement mechanisms rather than a persistent retail-equilibrium elasticity.

The chain diagram makes the empirical design visible before the models begin. The farm-gate layer is the raw-milk market. The processor layer is measured by industrial producer prices for processed dairy products. The procurement layer is represented by Prozorro contract prices. The retail-consumer layer is measured by official consumer prices plus Silpo and Novus SKU observations. The arrows are admissible analytical links, not a claim that all dairy products are identical across stages (Figure 1).

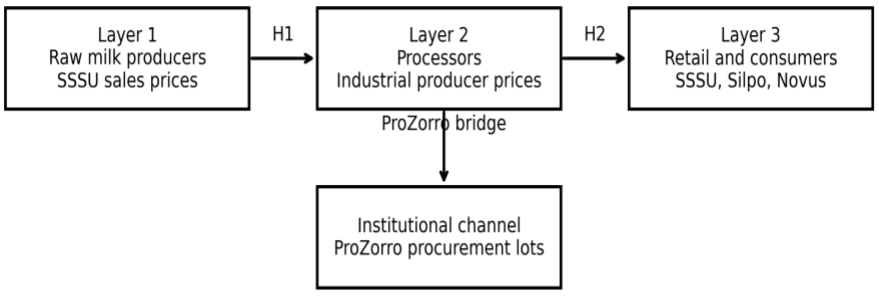


Figure 1. Dairy value chain and empirical hypotheses.

Source: author's design based on the final thesis data architecture.

Chapter 2

MARKET ANALYSIS AND INSTITUTIONAL BACKGROUND

2.1. Dairy in the food economy and the political-social background

Dairy matters because it combines household food security (Cabinet of Ministers of Ukraine 2024), public procurement demand, and business-to-business price bargaining (Litvinov 2025b). Households consume milk, sour cream, kefir, cheese, butter, and other dairy products as regular staples (Cabinet of Ministers of Ukraine 2024), while public buyers purchase dairy for schools, hospitals, military units, and other institutions (Prozorro n.d.). Looking downwards on processors, on their production side, they increasingly depend on regular, documented industrial milk, so the commercial market is narrower than total rural milk production (Litvinov 2025a; Litvinov 2025b). This makes dairy relevant even when its aggregate economic share is smaller than grain or poultry: it is small enough to study carefully, but important enough to matter for food affordability (Cabinet of Ministers of Ukraine 2024), public procurement (Prozorro n.d.), and rural incomes (Litvinov 2025a).

Currently in Ukraine the political-social background around food-economy has operated simultaneously under war and active debates about and between retailers relations with suppliers (Cabinet of Ministers of Ukraine 2024; Filipenko 2023; Litvinov 2025b). That is why food prices, payment discipline, public procurement matter for household welfare, budgets, and the ability of farms and processors to survive under unstable conditions (Cabinet of Ministers of Ukraine 2024; Filipenko 2023). Suppliers worry about delayed payments and stronger bargaining pressure from buyers. Retailers, in turn, argue that they need keep flexibility to keep shelves supplied and prices acceptable for consumers under constant damping with discounts. While processors are between constrained raw-

milk supply and the demand with demands of downstream buyers (Cabinet of Ministers of Ukraine 2024; Filipenko 2023; Litvinov 2025b).

This forms in the empirical design crucial link that the price-transmission is not captured purely by technical modelling. The structure of the chain is the key, so question is where the adjustment happens: who can pass a shock onward, who has to absorb it, and how it forms final consumer price. So the price transmission is formally suitable lens for covering market-power mechanisms in Ukrainian dairy.

2.2. Raw milk production: households, industrial farms, and the commercial milk pool

The duality of the Ukrainian upstream layer is obvious : milk production still has a decreasing, but significant household segment, while the formal processing channel increasingly relies on enterprises and industrial-farms (Litvinov 2025a; MilkUA.info 2025). That create the market division into rural livelihoods and local consumption of the raw milk, and into processed standardized milk products, which serve on public procurement and export level, which require regular volumes, quality, documentation and traceability (Litvinov 2025a). The relevant upstream price for H1 is therefore the enterprise farm-gate raw-milk price, not an undifferentiated measure of all milk produced in the country (Litvinov 2025a; MilkUA.info 2025).

The scale shift is large enough to affect bargaining (Litvinov 2025a). Sector evidence based on SSSU and KSE data places total raw-milk output at about 10.1 million tonnes in 2018 and roughly 6.9 million tonnes in preliminary 2025, while the processing stream increasingly comes from industrial farms and higher-quality milk (Litvinov 2025a; State Statistics Service of Ukraine 2026d). By 2024, Extra-grade milk represented more than half of purchased raw milk for

processing, which means that the commercially relevant supply pool is narrower and more quality-dependent than gross national milk output (Litvinov 2025a; AVM 2025).

The perishability of raw milk makes bargaining conditions strongly local, because no farmer can wait indefinitely for a better buyer. This moves the scope to the local density of processors, collection infrastructure, and quality testing capacity. Thus, national averages may understate buyer power in areas where farmers face not enough accessible processors or storage/colling infostructure (FAO 2013; Litvinov 2025a).

Quality regulation is another layer that deepens the segmentation, since processor operate with raw milk with fat and protein composition, bacterial load, somatic-cell count, traceability, cooling history (FAO 2013; Litvinov 2025a). Aligned food regulation rules with EU therefore improve the commercial value of high-grade milk but, at the same time, smaller household suppliers with lower quality may be exclude. For H1 it concludes that delayed or incomplete farm-to-processor adjustment must understand commercial milk pool: enterprise milk, quality, collection contracts, reliability of regular supply (FAO 2013; Litvinov 2025a).

The decline in household milk output is not just production trend, it changes the practical options available to farmers and processors. In the moment when raw-milk supply becomes thinner and more uneven across regions, farmers can not easily switch. Central regions such as Poltava, Cherkasy, Vinnytsia, and Khmelnytskyi – have major supply areas, but weaker regions have less space to absorb disruptions. As was described previously, perishability makes spatial substitution possible theory, but costly, slow, and dependent in reality. That is why processors or collection intermediaries may gain bargaining strength even while having no visible change in contracts (Figure 2).

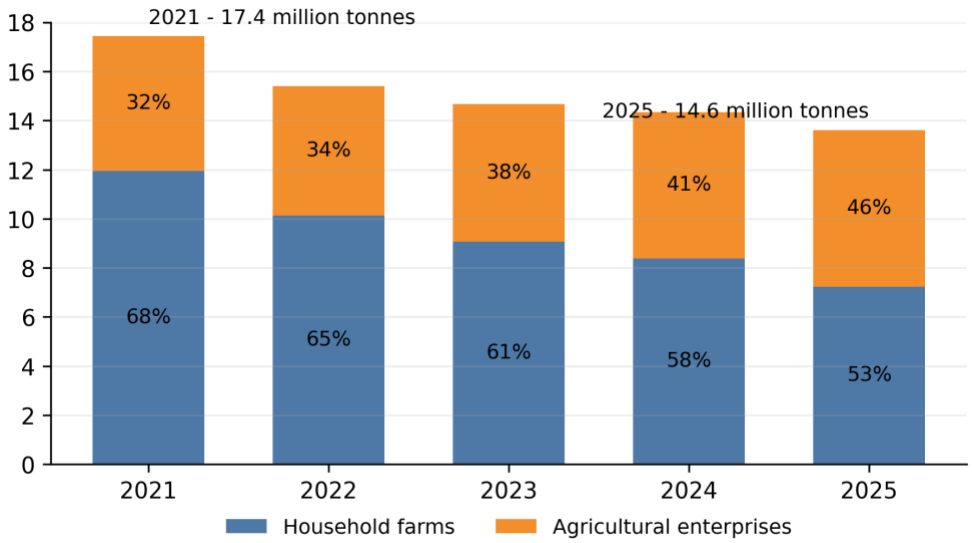


Figure 2. Quantity of raw milk produced in Ukraine (gross milk yield) by source, mln tonnes

Source: SSSU, author's calculations

2.3. Processing: the hinge between raw milk and differentiated dairy products

Processors are the turning point of the dairy chain, because they transform perishable unified input into differentiated products with various economic characteristics. Drinking milk, kefir, sour cream, hard cheese, butter, skimmed milk powder require different technologies, which form different output characteristics like shelf life, storage options, exposure to export markets and internal competition (FAO 2013; FAO 2026c; Fedets and Movchan 2020; Litvinov 2025a; Timlin et al. 2021). This means that processors prices can not be percepted as direct continuation of farm-gate, and any existing effects transmitted product-depending.

This distinction important because the State Statistics Service of Ukraine (SSSU) reports industrial producer prices ("ціни промислових виробників"), which are

the prices for processed dairy products (not wholesale prices , average real market prices) (State Statistics Service of Ukraine n.d.b).

Processing is the most uncertain layer, since it operates in the middle of the market, it can have power relative to farms (FAO 2013; Sexton 2013; Litvinov 2025a). While shelf access, contracts and promotion terms, delayed payment from retailers oblige processors to take the price pressure on them. This is why the thesis strictly divided into H1 and H2, which captures exactly the duality of the processors position and the market power structure (Sexton 2013; Loy 2023; Litvinov 2025b).

2.4. Procurement: Prozorro as an observable institutional channel

Public procurement cannot be treated as retail, because Prozorro records institutional transaction prices for processed dairy products, which captures prices on the gates out from processors with some additional costs capturing specific procurement requirements. At the same time, Prozorro can buffer processor-level pressure because tender rules, budgets, delivery requirements, and lot specifications shape the transaction. Prozorro contracts executed under tender rules, budget constraints, product and delivery requirements, deadlines. They are the alternative direction for processed dairy products outside supermarket shelves.

Procurement either moves the pressure from processors straight to public contract prices, or buffer them. At the same time, when it relays shocks – tender cycles, fixed contracts, budget ceilings, and renegotiation make adjustment slower. This means that Prozorro prices are standalone level, which stands as an institutional transaction channel to consumer prices, and captures processor prices with public procurement spendings (Prozorro n.d.).

For H2, Prozorro evidence is mechanism or bridge evidence. It can help test whether institutional procurement prices for processed dairy products move with official consumer prices, but it cannot be treated as proof of retail market power. The sample is shorter and contract heterogeneity is larger than in the official monthly price series, so Prozorro models are ranked below clean observed national monthly evidence (State Statistics Service of Ukraine n.d.a; State Statistics Service of Ukraine n.d.b).

2.5. Retail: shelf access, payment terms, private labels, and promotions

Retail is the final business interface before consumers, but it is not only a passive outlet. Large grocery chains control shelf space, category assortment, promotional schedules, private labels, consumer-facing price points, and often payment terms (Filipenko 2023; Antimonopoly Committee of Ukraine 2023). This means surplus can shift toward retailers even when the consumer-visible shelf price looks favourable (Loy 2023). A discount can benefit consumers and still move cost or liquidity pressure back to processors when it is linked to contract terms or supplier-funded promotion (Filipenko 2023; Antimonopoly Committee of Ukraine 2023).

Retail prices also vary by products and strategies (Loy 2023). Temporary discounts can be indicator of such these strategies from retailers – chains can use one dairy product as a traffic driver and recover margin elsewhere in the category (Loy 2023; Loy, Weiss, and Glauben 2016). Furthermore, promotions for private-label products may differ from manufacturer brands (Loy 2023). This is where the delay of shelf repricing can arise, when prices on procurement (not only Prozorro) move under the market conditions – but the retailer has ability to keep its private baseline prices. It reflects ability of retailer to benefit from higher prices

of competitors, while, at the same time, staying with option to relay the price shocks upstream to suppliers (Loy 2023; Loy, Weiss, and Glauben 2016).

For H2, retail market power is considered not only as the ability to keep final prices high, but also as the option to manage how price adjustment becomes visible to consumers (Loy 2023; Sexton 2013). Timing of retail-price changes, the placement and choice of promotion products, discounts as temporal repricing, payment terms on suppliers, and the capacity to shift part of the adjustment back onto processors or farmers (Loy 2023; Loy, Weiss, and Glauben 2016). All of that emphasizes the importance of the scraped Novus and Silpo data, which directly observe SKU-level prices and discounts, helping to identify the retail layer effects and tools used to cause them (Silpo 2026; Novus 2026; Loy 2023; Loy, Weiss, and Glauben 2016).

2.6. External and legal environment: European Union integration, war, and regulation

EU integration and global dairy benchmark also shape the Ukrainian dairy market with the changes in the external environment (Litvinov 2025a). EU alignment changes quality standards, food-safety rules, traceability of raw milk, external and internal market opportunities (EC 2025a; EC 2025b; Litvinov 2025a). EU and CME dairy prices provide a broader regional on EU-level and also global reference for Ukrainian prices movements, describing market environment (EC DG AGRI 2026a; EC DG AGRI 2026b; EC DG AGRI 2026c; CME Group 2026).

Under war conditions – cost and expectation must adapt specifically, since attacks on energy infrastructure rise cooling and processing costs (Tarassevych 2024; MilkUA.info 2026). Logistics disruptions enter regional arbitrage and delivery reliability, which affects all and leaves all, but especially household farms without

reserve options (Cabinet of Ministers of Ukraine 2024; Tarassevych 2024). Displacement relocated and reduces demand, while creates labor shortages that affect farms, processors, and retailers differently (Cabinet of Ministers of Ukraine 2024; Tarassevych 2024). These shocks are not direct evidence of market power (Cabinet of Ministers of Ukraine 2024; Tarassevych 2024; MilkUA.info 2026), but clarify relevance of the market power increase within the situations in which stronger actors can choose the direction of transmission and transmission terms (pass, delay, absorb) (Sexton 2013; Litvinov 2025b).

The institutional motivation for the research also taking roots in competition and unfair-trading-practice debates, but they do not themselves estimate market-power in the chain (Boytsun 2016; Directive (EU) 2019/633; Verkhovna Rada of Ukraine 2025). Boytsun (2016) framed retailer–supplier relations as a Ukrainian policy problem, and the AMCU's 2023 review of the retailer memorandum connected to the payments delay issue and EU-style unfair-trading-practice standards (EC DG AGRI 2026d). In the 2025 – draft of the law "6068-д від 15.12.2025" brought the same question back into the legislative agenda (Antimonopoly Committee of Ukraine 2023; Verkhovna Rada of Ukraine 2025; VoxUkraine 2025).

The AMCU milk-procurement cases are crucial example , especially, when limited local suppliers alternatives exist, because they show that buyer's prevailing state in raw-milk purchasing can raise competition concerns (AMCU Northern Interregional Territorial Department 2015; AMCU Western Interregional Territorial Department 2023). Still, these legal and policy materials are case-specific, they justify the importance of the research question, the rest depends on where adjustment power appears in the dairy value chain.

2.7. Non-market-power explanations and identification discipline

The market analysis also has to avoid instant interpretations. A widening spread or delayed correction may be consistent with bargaining power, but it may also be from cost and product factors: higher energy costs, logistics expenses, packaging, labor shortages, credit costs, wartime disruptions, bundle changes, market competition, seasonality, quality upgrading, or mismatch in the compared price series (Vavra and Goodwin 2005; Timlin et al. 2021; Litvinov 2025a; European Central Bank 2025).These alternative explanations are especially relevant in dairy, where raw milk is transformed into products with different fat and protein content, shelf lives, storage options, cost components and exposure to trade (Vavra and Goodwin 2005; Timlin et al. 2021; Litvinov 2025a).

Consequently, the market power is rather a conditional interpretation than an automatic conclusion. A result considered supporting and credible for H1 or H2 only when the product link is economically plausible, prices comparable, unit conversion is clean, the adjustment pattern is persistent enough to matter, and non-market-power explanations do not provide another reading.

2.8. Implications for the empirical hypotheses

For H1, the market analysis implies that the cleanest link is farm-gate raw milk to processor-level dairy prices (Litvinov 2025a; State Statistics Service of Ukraine n.d.b; State Statistics Service of Ukraine n.d.c). The relevant upstream actor is the enterprise/industrial farm channel, because this is the commercially relevant milk pool for formal processing (Litvinov 2025a; State Statistics Service of Ukraine n.d.c). The relevant downstream variables are processed-product industrial producer prices, not retail prices and not external benchmarks (State Statistics Service of Ukraine n.d.b).

For H2, the market analysis implies that downstream transmission is layered (Loy 2023; Litvinov 2025b). Processor prices can reach official consumer prices, but public procurement and retail promotions may filter the signal (Loy 2023). Prozorro should be read as an institutional transaction channel (Prozorro n.d.). Silpo and Novus stock keeping unit data should be read as short-window retail mechanism evidence (Silpo 2026; Novus 2026). While the monthly official data, including official consumer prices is national consumer benchmarks with clean product mapping (State Statistics Service of Ukraine n.d.a).

To finalize, this thesis adds the caution that not every delay is market power. Delays, asymmetry, promotions, and incomplete adjustments can be interpreted as market-power evidence only when they appear within an admissible chain link, pass reliability screening, and match the institutional logic of bargaining in a perishable food chain (Vavra and Goodwin 2005; Meyer and von Cramon-Taubadel 2004).

Figures 3, 4 and 5 show that the trade evidence places the Ukrainian dairy market inside the external corridor without treating foreign partners as domestic chain stages (International Trade Centre 2026; United Nations Comtrade Database 2026). Dairy exports reached about EUR 198.0 million in 2024, while dairy imports reached about EUR 261.2 million in the project trade workbooks. Cheese import exposure, butter and powder export sensitivity, and the roles of Germany, Poland, and Moldova imply that product categories face different competitive corridors (International Trade Centre 2026; United Nations Comtrade Database 2026).

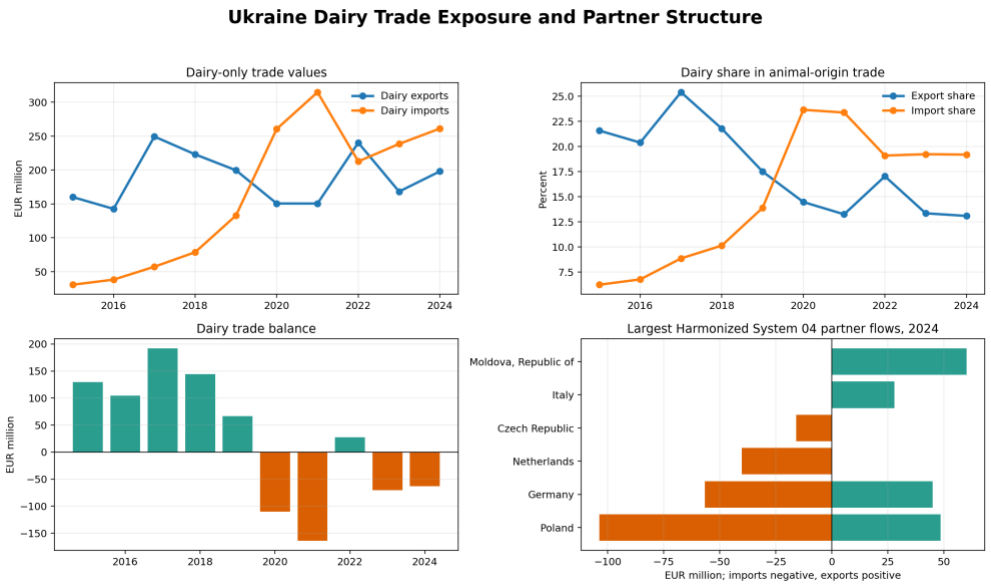


Figure 3. Ukraine dairy trade exposure and Harmonized System chapter 04 partner structure.

Source: International Trade Centre (ITC) Trade Map calculations based on SSSU and United Nations (UN) Comtrade data. Author's processing of project trade workbooks.

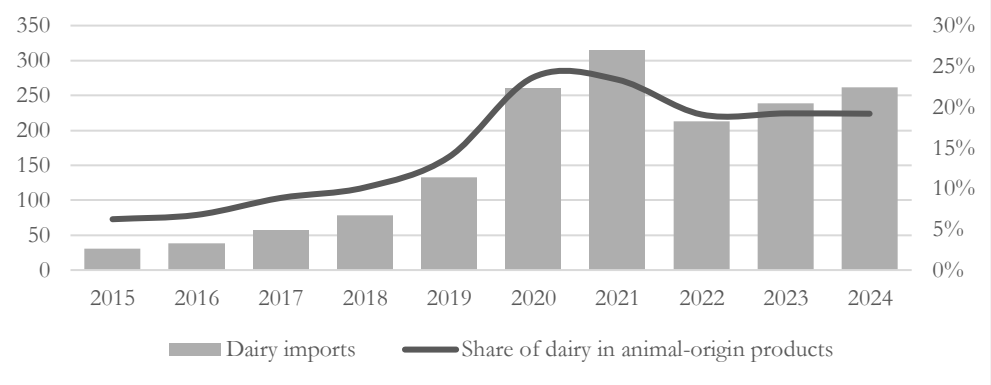


Figure 4. Dairy products imports to Ukraine in EUR million.

Source: ITC Trade Map calculations based on SSSU and UN Comtrade data. Author's processing of project trade workbooks.

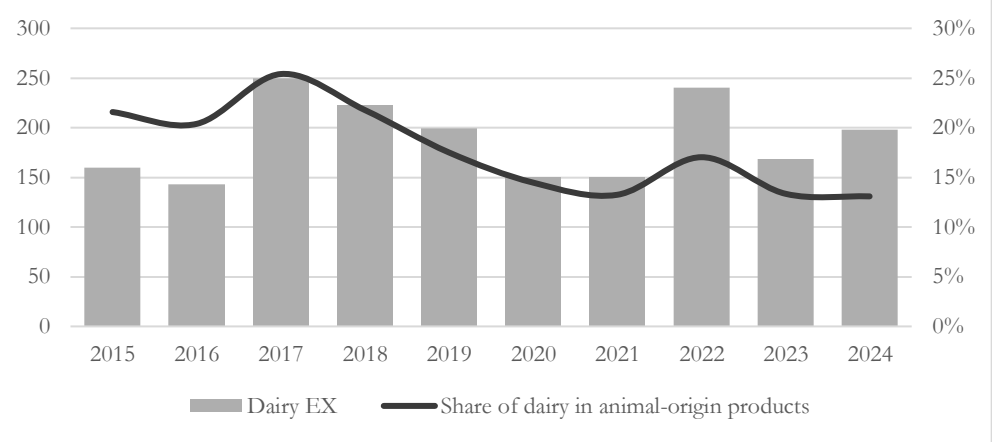


Figure 5. Dairy products exports from Ukraine in EUR million.

Source: ITC Trade Map calculations based on SSSU and UN Comtrade data. Author's processing of project trade workbooks.

A processor of hard cheese, butter, or milk powder therefore faces a different outside market from a processor of fresh sour cream or drinking milk, which is why product-level estimates are more informative than one aggregate dairy coefficient (Figures 3-5).

Regional dispersion shows why the national farm-gate average is useful but not sufficient on its own. The coefficient of variation does not remain flat, but narrows and widens sharply, which suggests that raw-milk prices are adjusted under different conditions across regions. These differences can lay in transportation, local processor's limitation, milk quality, local collection and storage infrastructure, and local bargaining conditions.

Farmers' outside options may be geographically limited even when the national market is balanced, which is valuable for H1. This means that based on Figure 6 – farm-to-processor price transmission should be interpreted with local procurement conditions taken into account.

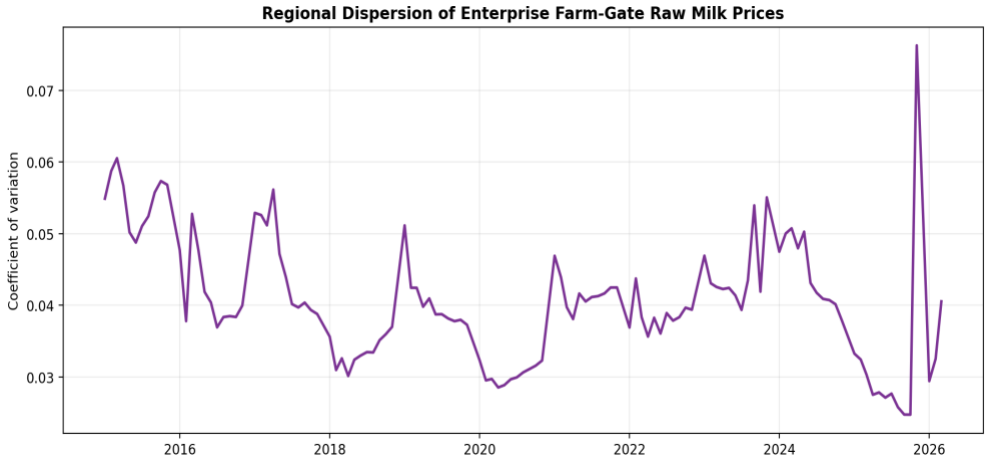


Figure 6. Regional farm-gate raw milk price dispersion.

Source: SSSU agricultural sales data. Author's conversion to Ukrainian hryvnia per kilogram and regional aggregation. Descriptive regional evidence supporting the H1 market-context discussion.

This chain-layer map prevents the main conceptual error in the thesis, which is treating all: raw milk, processed dairy output, procurement contracts, retail SKUs, and official consumer prices, - as if they were the same price object. The table arguments why H1 and H2 must be tested respectively at the farm-to-processor interface, and through processor, procurement, retail, and consumer-facing interface (Table 1).

The enterprise farm-gate raw-milk series is the upstream anchor, the series displays clear seasonality and a sharp 2024-2025 peak followed by partial correction (AgroPortal n.d.; AgroReview n.d.; AVM 2026a; AVM 2026b; AVM 2026c). This is exactly the type of movement that can test whether processor prices adjust fully or only asymmetrically delay (State Statistics Service of Ukraine n.d.c). Besides raw-milk prices follow the EU path, being under external dairy-cycle pressure, but that domestic prices are formed also under local supply tightness (State Statistics Service of Ukraine n.d.c; EC DG AGRI 2026a; EC DG AGRI 2026b; EC DG AGRI 2026c; MilkUA.info 2026).

Table 1. Chain layers and empirical interpretation

Layer	Price object	Observed/reconstructed	Main role
Farm-gate raw milk	Price received by agricultural enterprises	Observed monthly SSSU series	H1 upstream variable
Household raw milk	Household production and lower-grade	Sectoral/statistical context	Explains upstream duality
Processor-side product price	Industrial producer price of processed dairy product	Observed monthly SSSU series	H1 downstream and H2 upstream
Prozorro procurement price	Public procurement unit price after cleaning	Observed lots, aggregated	Relay/buffer mechanism
Retail baseline price	Regular shelf price where identifiable	Observed short SKU window	H2 mechanism
Observed promotional price	Discounted retail price and discount depth	Observed short SKU window	Promotion mechanism
Consumer price	National average consumer price	Observed monthly SSSU series	H2 downstream benchmark
EU/CME benchmark	External dairy-market anchor	External benchmark	Context/control

Source: author's analysis

For this reason, external benchmarks are used as controls, not as substitutes for Ukrainian chain data, so the main conclusive dataset for the farm-gate level is used from official monthly frequency without any synthetically related with EU prices dataset. It shows gradual price-increasing tendency with the crucial peak at the end of 2024, and the significant price-correction period during 2025, reaching in 2026 farm-level prices of the start of 2024. (Figure 7).

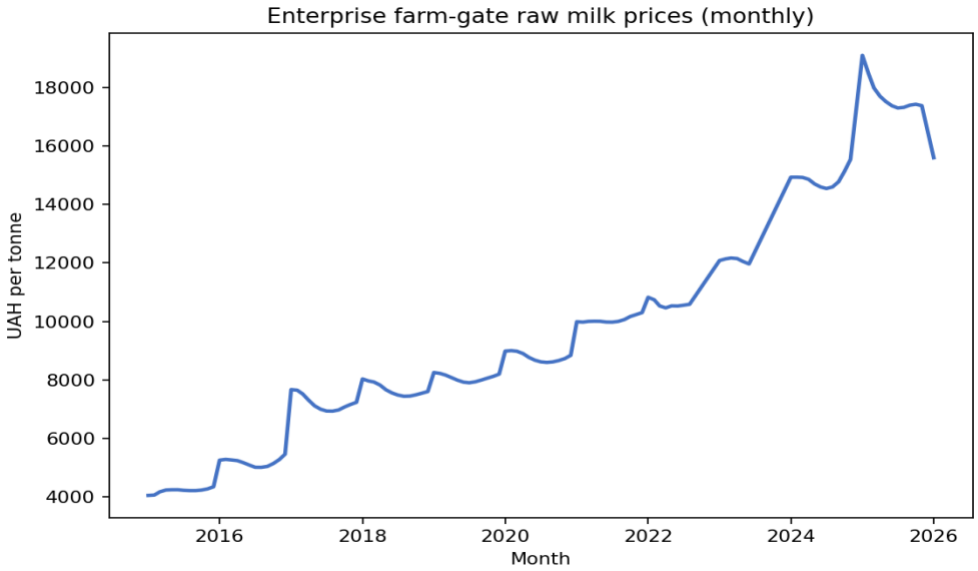


Figure 7. Enterprise farm-gate raw milk prices, monthly, UAH per tonne

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU)

The war disputes with Russia have influenced dairy market since 2014, when Ukraine's dairy trade balance has shifted sharply and product trajectories have diverged. At that point cheese moved from strong surplus to persistent deficit, while butter and powders remained more export-sensitive (Litvinov 2025a; USDA FAS 2025). By 2025, exports of butter exports had recovered strongly, but cheese remained structurally more exposed to import competition on the

retailer's shelves (USDA FAS 2025). This divergence supports the point that research in this thesis must focus on product-specific transmission rather than chain-wide effects (Litvinov 2025a; USDA FAS 2025).

Chapter 3

LITERATURE REVIEW

The literature relevant to this thesis follows the logic of Nivievskyi and von Cramon-Taubadel's supply-chain work, it covers the chain organisation and bottlenecks, only then turns to transmission metrics, retail pricing. In the case of Ukrainian dairy market, all coefficients become meaningful only after the market architecture and institutional frictions are made explicit (Nivievskyi 2012).

The literature review first examines vertical coordination and buyer power, then price transmission and asymmetry, then retail pricing and promotions, and finally transition-economy instability together with the econometric tools used for non-stationary chain data. The chain is defined first, then movement of shocks second, and only then the empirical strategy after all relation are cleared.

3.1. Vertical coordination, buyer power, and how dairy chains work

Prices in dairy are not formed in one market, each stage has its share of influence: farms sell raw milk, processors transform it into final dairy products, and retailers determine shelf access, final prices, and promotional regimes. For this reason, price transmission is tied to vertical coordination, because coordination shapes risk allocation and bargaining power along the chain. Martinez's classic evidence from U.S. livestock and poultry markets shows that contracts and integration often replace spot exchange in order to make supply stabile and solve quality and transaction-cost problems, but, in doing so, they also push bargaining power toward downstream actors that control market access and commercial conditions in front of consumers (Martinez 2002; USDA ERS 1999).

Taken together wider range of literature on vertical coordination brings to the same conclusion that when the control over assets, information or market access is allocated on downstream stages – it can generate gains from efficiency and benefits for consumer, but it can also reshape the surplus distribution (Ba et al. 2019). Especially, in case of this research – dairy is perishable supply chain, where the buyer that has shelf access – shapes adjustment through conditions beyond the price: influencing collection, processing capacity (Sexton 2013).

Perishability is critical factor, since raw milk spoils quickly then quality on market is distributed not evenly , which means that processors can work efficiently only with stable and regular inflows. This makes price-formation tied to logistics and sustainable organisation same mere as to supply and demand (Food and Agriculture Organization of the United Nations (FAO) 2013). In Ukraine, for household and industrial enterprises, milk enters the formal chain on different unequal terms. Logically then for procurement crucial question only about who can supply milk with the necessary scale, cooling, traceability, compliance capacity to meet the requirements of formal processing (Litvinov 2025a).

For the Ukrainian case, Nivievskyi's earlier work is also valuable because it connects the general theory of vertical coordination to the institutional realities of the local dairy sector. Across his work the recurring message is that competitiveness is shaped jointly by farm structure, quality constraints, contracts, trade exposure, and policy settings, not by price incentives alone (Nivievskyi and von Cramon-Taubadel 2008; Nivievskyi 2009; Nivievskyi 2012; Nivievskyi and von Cramon-Taubadel 2015). The research as well follows that same view and treats the dairy chain as coordination problem, and only then treats it as transmission problem.

In the Ukrainian case, revenue concentration and the scale of retail networks create credible conditions for expecting downstream buyer power to matter in dairy (Opendatabot 2025; RAU 2025). The unfairness in trading practices

framework reflects that buyer power in agricultural chains may be appear through payment delays, unilateral contract changes, listing conditions, commercial obligations that shift risk upstream. These practices are connected to absorption shocks in the chain and to where delays and redistributions of adjustment occur. Consequently, a literature review for Ukrainian dairy must go beyond farm-gate and processor prices, covering the contractual and retail institutions that condition them (Directive (EU) 2019/633; Litvinov 2025b).

3.2. Vertical price transmission and asymmetric adjustment

For the further understanding of the topic, the research uses price-transmission to know how changes in prices or costs at one stage of a chain are reflected at other stages. First of all, Vavra and Goodwin's OECD survey shows that transmission reaches long-run relations and short-run adjustment, while that observed patterns depend on technology, margins, market structure, institutions, not only on concentration (Vavra and Goodwin 2005). That is why finding evidence of market power is not equal finding gap between upstream and downstream prices, therefore goal estimate how the system returns to equilibrium after a shock and which stage buffers it.

Meyer and von Cramon-Taubadel make an important correction: asymmetric adjustment is observed often, but it is also easy to overstate when the econometric form does not match the actual adjustment process (Meyer and von Cramon-Taubadel 2004). The broader agricultural pricing literature reaches a similar conclusion from another angle: prices observed along the food chain is not farm value alone, because when product reaches consumer it already incorporates processing, storage, transport, packaging and retail services, each of which can alter the apparent transmission pattern (Koester and von Cramon-Taubadel 2023).

One more important topic is the classic "rockets and feathers" finding of Kinnucan and Forker, which remains influential precisely because it shows that retail dairy prices can move upward faster than they return back when farm prices fall (Kinnucan and Forker 1987). At the same time, Kinnucan and Zhang caution against reading farm-retail coefficients too literally when the stages being compared are built from differently aggregated data and carry different marketing-cost structures, then the coefficients may capture much more than pure transmission alone (Kinnucan and Zhang 2015).

This warning is particularly relevant here because the observed price series refer to different objects: household and enterprise farm-gate prices capture raw milk, but even only upstream prices differ by quality, scale, cooling capacity, traceability, and access to formal collection channels. Processor prices already refer to transformed dairy products , so while procurement and retail prices are shaped by contracts, tender conditions, assortment choices, promotions, chain/store-level pricing. Treating all these series as single milk price would therefore hide the actual structure of vertical price transmission (Meyer and von Cramon-Taubadel 2004; Vavra and Goodwin 2005; Kinnucan and Zhang 2015).

Kinnucan and Zhang's warning is important here because a farm–retail coefficient does not measure pure pass-through with different products, margins, and marketing services: raw milk, processed dairy, procurement contracts, and retail shelf prices (each is different bundles) (Kinnucan and Zhang 2015; Koester and von Cramon-Taubadel 2023). Therefore, asymmetry in this thesis should be interpreted not as effect by itself, but as evidence of where adjustment is transformed inside the chain.

3.3. Retail pricing regimes, promotions, and price rigidity

Using the retail-pricing literature is essential because shelf prices do not behave like simple cost-plus outcomes (Loy 2023; Koester and von Cramon-Taubadel 2023). Retailers sell many products and typically set prices through systematic pricing regimes such as Hi-Lo pricing and everyday-low-price strategies (Loy 2023). Food retailing is concentrated, multiproduct, and promotion-intensive, which means that effective consumer prices can change through baseline repricing, temporary markdowns, assortment strategy, pack-size changes, or the interaction between national brands and private labels (Loy 2023; Koester and von Cramon-Taubadel 2023). Retail prices therefore function as managerial instruments that allow retailers to shape demand across groups of products and over time rather than as passive recordings of upstream costs (Loy 2023; Koester and von Cramon-Taubadel 2023).

This matters directly for interpretation. Observed retail rigidity may reflect menu costs, consumer search, stock-out concerns, category management, or bargaining strength, and different products can display different combinations of these mechanisms (Loy, Weiss, and Glauben 2016; Loy 2023; Nakamura and Steinsson 2008). For this reason, retail prices cannot be treated as if they were homogeneous outcomes with a constant markup (Loy 2023; Koester and von Cramon-Taubadel 2023). In practice, retailers can respond to upstream cost shocks in several ways before changing the baseline shelf price: they can adjust promotions, modify product mix, reallocate shelf space, or shift the intensity of discounts across categories (Loy 2023; Loy, Weiss, and Glauben 2016). Monthly averages or aggregated price data can therefore mask relevant downstream adjustment even when some form of pass-through is already taking place (Loy 2023).

The literature on promotions is especially useful because it shows that markdowns are not merely noise around the 'true' price (Loy 2023; Loy, Weiss,

and Glauben 2016). In many grocery settings, promotions are part of the pricing mechanism itself (Loy 2023). A retailer may defend a regular price point while allowing the effective consumer price to move through temporary discounts (Loy 2023; Loy, Weiss, and Glauben 2016). Any empirical design that ignores this channel risks understating downstream responsiveness or misclassifying it as rigidity (Loy 2023). That is why the present thesis treats promotions as an explicit mechanism rather than as a nuisance feature of retail data (Loy 2023; Loy, Weiss, and Glauben 2016).

Menu costs and price rigidity also matter at the micro level (Nakamura and Steinsson 2008; Loy, Weiss, and Glauben 2016). Retailers often keep posted prices unchanged for extended periods before repricing, even when underlying conditions are moving (Nakamura and Steinsson 2008). Looking at studies that use scanner or store-level data, it becomes clear that price behaviour often changes during predictable demand peaks, promotional cycles, and repeated interactions with consumers (Chevalier, Kashyap, and Rossi 2003; Loy, Weiss, and Glauben 2016). In other words, if the adjustment is not immediately visible in the regular shelf price, it does not mean that no adjustment exists. Experimental and store-level evidence from dairy markets confirms this point (Loy, Weiss, and Glauben 2016). Loy, Weiss, and Glauben find strong rockets-and-feathers behaviour in German milk retailing, but they also show that the degree of asymmetry is not necessarily greater where market concentration is higher (Loy, Weiss, and Glauben 2016). Menu costs, mistake costs, stock-out risks, and reputation concerns can generate similar patterns, which means that asymmetry at retail cannot be attributed to concentration alone.

3.4. Instability, structural breaks, and transition-economy evidence

Instability adds a further challenge to the analysis of price transmission (Brümmer, von Cramon-Taubadel, and Zorya 2009; Dereva and Rajčaniová 2022; Vavra and Goodwin 2005). Transition-economy evidence shows that transmission can become regime-dependent when policy uncertainty, trade disruption, or institutional change alter the way market participants interpret and respond to price signals (Brümmer, von Cramon-Taubadel, and Zorya 2009). In such environments, there may be no single stable adjustment mechanism governing the entire sample period. Instead, the relationship between prices can switch across distinct regimes associated with uncertainty, intervention, or structural change.

Brümmer, von Cramon-Taubadel, and Zorya demonstrate for the Ukrainian wheat–flour market that regime shifts coincide with political and economic events, which affect transmission. It is important not simply because it is related to Ukraine, but because they show that policy and market shocks reshape the transmission process itself, not just circle around a stable long-run path (Brümmer, von Cramon-Taubadel, and Zorya 2009). Although dairy is absolutely different from wheat-flour matket, methodlogically it means that transition economies you can not expect single transmission process across all periods.

The same caution appears in the broader post-socialist and wartime context (Brümmer, von Cramon-Taubadel, and Zorya 2009). The Ukrainian dairy chain has faced repeated trade shocks, regulatory adjustment, damaged infrastructure, blackouts, labour shortages, and changing access to export corridors (Cabinet of Ministers of Ukraine 2024; Tarassevych 2024; Litvinov 2025b). These are not background facts external to the econometric problem (Brümmer, von Cramon-Taubadel, and Zorya 2009; Vavra and Goodwin 2005). They alter storage conditions, transport costs, outside options, contract enforcement, and the time horizon of market participants (Cabinet of Ministers of Ukraine 2024;

Tarassevych 2024; Litvinov 2025b). Delayed adjustment, buffering, and selective asymmetry may therefore be amplified when the chain operates under war conditions and evolving trade rules (Brümmer, von Cramon-Taubadel, and Zorya 2009; Cabinet of Ministers of Ukraine 2024; Tarassevych 2024; Litvinov 2025b).

3.5. Methodological foundations and what this thesis adds

The empirical challenge is that dairy prices at different chain levels are trending, institutionally different, and observed at different frequencies. Simple correlations do not cover when series move together because of a common trend, common inflation, or external dairy cycles rather than because some transition level. Therefore this thesis works with unit-root and cointegration logic, transmission is seen through error-correction models only where a long-run relationship is admissible (Engle and Granger 1987; Johansen 1988).

There is no single model that can cover it all, so Autoregressive Distributed Lag model (ARDL) specifications are useful when adjustment is distributed over several lags and integration orders remain within admissible limits. When the shocks vary by the direction of the correction – Nonlinear Autoregressive Distributed Lag model (NARDL) and threshold-type ECMs are needed. HAC-type inference – in case where serial correlation or heteroskedasticity would otherwise decrease significance (Newey and West 1987). This bring the economic question to which price adjusts, how quickly price iadjusts, and whether the correction differs by sign (Pesaran, Shin, and Smith 2001; Shin, Yu, and Greenwood-Nimmo 2014; Enders and Siklos 2001).

Additionally in this research layer of retail and procurement observations are more frequent than official upstream statistics (State Statistics Service of Ukraine n.d.b; State Statistics Service of Ukraine n.d.c; Prozorro n.d.; Silpo 2026; Novus 2026). Exactly this issue is covered by Chow-Lin and Denton methods that used

to reconcile low-frequency series into weekly upstream layer using supportive EU dairy processors level prices (Chow and Lin 1971; Cholette and Dagum 2006; Denton 1971). These reconstructed data is not reliable and significant enough for argumented and especially product-specific conclusions – used only for validation against monthly models. Similarly EU and CME series help identify external dairy-cycle pressure but they are not Ukrainian chain stages (EC DG AGRI 2026a; EC DG AGRI 2026b; EC DG AGRI 2026c; CME Group 2026).

At this point this thesis adds value, because existing works explains vertical coordination, asymmetric price transmission, retail pricing, and instability. However, they are rarely combined within explicit evidence hierarchy in one Ukrainian dairy setting with official monthly data, Prozorro procurement records, retail SKU observations with promotion variables. The contribution is an evidence-ranked empirical screen showing where dairy price shocks are transmitted, delayed, absorbed, or converted into procurement and retail mechanisms.

Chapter 4

METHODOLOGY

The methodology in this thesis does not impose any universal models, because the data have different frequencies and products. Instead, it uses sequential and layered empirical strategy: it defines chain-stage price objects, audits units and product mappings, screens stationarity and cointegration, estimates long-run links and short-run correction, checks asymmetric and whole-chain mechanisms, coming to the reliable conclusion (Engle and Granger 1987; Johansen 1988; Pesaran, Shin, and Smith 2001; Vavra and Goodwin 2005).

4.1. Model-to-hypothesis map

For H1, the main dependent variables are processed dairy prices, while the key explanatory variable is the single farm-gate raw milk price. The coefficient of interest measures how strongly processed-product prices move with the upstream raw-milk price in admissible product links. The adjustment coefficient shows whether deviations from the long-run relation are corrected quickly, slowly, or not at all.

For H2, the dependent variable is the official consumer price or the observed retail price, depending on the evidence block. The explanatory variable is the processor-level price or the Prozorro procurement price. The coefficient measures downstream pass-through, while discount variables show whether the effective consumer-facing price is managed through promotions rather than through baseline repricing.

For the procurement-consumer extension, processor prices and Prozorro procurement prices are treated as neighboring processor gate-out/procurement

evidence layers because both stand between farm-gate raw milk and consumer-facing prices. This mapping is analytical, not institutional. It does not make Prozorro ordinary retail, and it does not create a third hypothesis. It only allows H2 to test whether institutional procurement prices for processed dairy products move with official consumer prices in a way that supports downstream filtering or buffering.

The mapping rule is therefore fixed before estimation: farm-gate raw milk to processor-level product models test H1. Processor-level, procurement, official consumer, and retail-price models test H2. Discount and procurement-scale models are H2 mechanism checks. Local-projection or Vector Error Correction Model (VECM)outputs are robustness evidence rather than separate hypotheses.

The model-family map shows which model is allowed to support a price-link claim, an adjustment claim, a robustness check, or a mechanism explanation. Error-correction and ARDL specifications carry the main price-link and adjustment logic. While NARDL, VECM, local projections (LPs), discount models, and Loy-style second-stage regressions are used only where their data requirements and interpretation match the chain layer, which makes each conclusion and evidence valuable (Table 2).

For the available public data - direct markup model would not be be credible. Since this thesis can not observe confidential processor or retailer margins, product-level marginal costs, any layer contracts, differ the supplier and retailer motivated promotions, or credible excluded instruments. For those reasons, instrumental variables and Lerner Index discussed as identification boundaries rather than headline estimates. Market power is inferred from the joint reading of pass-through, error-correction speed, asymmetric adjustment, procurement behavior, discount incidence, and source reliability (Sexton 2013; Grau and Hockmann 2017).

Table 2. Empirical model families and interpretation rules

Model family	Hypothesis tested	Price link	Diagnostics/reliability use
ECM / threshold ECM	H1 and H2	Upstream price to downstream price	Main model when product mapping and cointegration logic are acceptable
ARDL	H1 and H2	Same adjacent links	Used for lag-selection and bounds-testing benchmark
NARDL / asymmetric ECM	H1 and H2 mechanisms	Positive vs negative shocks	Supportive when sample and diagnostics allow
Local projection	Robustness	Shock to downstream response over horizons	Supporting only, not a substitute for long-run model
VECM	Whole-chain robustness	Farm, processor, consumer system	Used only where cointegration rank and sample support it
Discount incidence/depth model	H2 mechanism	Procurement/retail and promotion variables	Short-window mechanism evidence
Second-stage Loy-style OLS	Mechanism screen	Speed/asymmetry measures vs product/channel traits	Not causal, not headline identification

Source: author's analysis.

4.2. Core equations

First of all, prices are made comparable, then long-run links are estimated, and only then short-run correction and asymmetric mechanisms are tested. And in the end after all that retail discounts and whole-chain robustness is done. Each equation is always interpreted relative to H1 or H2, so Equations (3)-(6) carry the core H1 and H2 price-link logic, Equation (7) tests asymmetric adjustment, Equation (8) checks timing, Equation (9) tests whole-chain feasibility, and Equation (10) is reserved for the H2 retail-promotion mechanism.

$$u_{i,t} = \frac{P_{i,t}}{q_i^{std}} \quad (1)$$

Equation (1) defines $u_{i,t}$ is the comparable unit price for SKU or product-unit i at date t. $P_{i,t}$ is the observed package or contract price, and q_i^{std} is cleaned package quantity in kilograms or litres. The equation is used only for credible package-size parsing and used primarily for retail and Prozorro prices for H2.

$$pt = ln(Pt) \quad (2)$$

Equation (2) logs the prices. Here P_t is strictly positive, and the transformed price is its natural logarithm. Logging places farm-gate, processor, consumer, procurement, and retail prices on a comparable proportional scale, so coefficient on an upstream log price represents an elasticity-style pass-through measure, not a hryvnia-per-kilogram difference.

$$p_{d,t} = \alpha + \beta p_{u,t} + e_t \quad (3)$$

Equation (3) specifies the long-run pass-through relation used in food-chain and dairy price-transmission researches, and links beta for H1 farm-gate prices to processor prices or H2 processor/procurement prices to consumer-facing prices (Vavra and Goodwin 2005; Kinnucan and Forker 1987). The downstream $p_{d,t}$ and upstream $p_{u,t}$ prices are measured simultaneously, α is the average wedge, β is the long-run pass-through coefficient, and $e_t$is the disequilibrium term. Under H1 $p_{d,t}$ is a processor-level product price and $p_{u,t}$ is farm-gate raw milk. Under H2 $p_{d,t}$ is an official consumer, procurement, or retail price and $p_{u,t}$ is the processor or procurement price.

$$\Delta p_{d,t} = \gamma + \lambda e_{t-1} + \sum_i \varphi_i \Delta p_{d,t-i} + \sum_j \theta_j \Delta p_{u,t-j} + \varepsilon_t \quad (4)$$

Equation (4) is the error correction model (ECM) – it test if deviations from the long-run price relation are corrected. There are the short-run change in the downstream price, and also last period's disequilibrium from (3) , is the coefficient for speed-of-adjustment, captures inertia in downstream changes, captures lagged upstream shocks, and is the unexplained innovation. A negative and economically meaningful λ means that the downstream price moves back toward the long-run relation after a shock. In this thesis, β identifies the price link, while λ identifies whether the chain actually corrects disequilibrium (Engle and Granger 1987; Meyer and von Cramon-Taubadel 2004).

$$\Delta P^{d}_{t} = \alpha + \lambda^{1} EC_{\{t-1\} I(EC_{\{t-1\}} \leq \tau)} + \lambda^{2} EC_{\{t-1\} I(EC_{\{t-1\}} > \tau)} + \Sigma_{i} \varphi_{i} \Delta P^{d}_{\{t-i\}} + \Sigma_{j} \gamma_{j} \Delta P^{u}_{\{t-j\}} + \varepsilon_{t} \quad (5)$$

$$EC_{\{t-1\}} = P^{d}_{\{t-1\}} - \alpha^{0} - \beta P^{u}_{\{t-1\}} \quad (6)$$

Equation (5) extends the ECM into a threshold ECM. Further similar logic extended with the threshold error correction model (TECM), allowing the correction toward the long-run price relation to differ across regimes. In equation (6) the EC_{t-1} is split by the threshold τ: λ_1 measures adjustment when the previous price gap is at or below the threshold, while λ_2 measures adjustment when the gap is above it. β still measures the long-run pass-through between upstream and downstream prices, but both λ terms show symmetry correction or powe in signl regime. In this thesis, TECM is used when the size or direction of the previous disequilibrium matter in price adjustment to define whether adjustment differs across regimes (Enders and Siklos 2001; Meyer and von Cramon-Taubadel 2004).

$$p_{d,t} = a_0 + \sum_i a_i p_{d,t-i} + \sum_j b_j p_{u,t-j} + \varepsilon_t \quad (7)$$

$$LR = (\sum_{j} b_{j}) / (1 - \sum_{i} a_{i}) \quad (8)$$

Equation (7) is the ARDL specification, so the downstream lag coefficients describe persistence in the dependent price, while the upstream lag coefficients cover delayed pass-through, epsilon is the residual, LR is the implied long-run multiplier in equation (8). It is used because interpretation of the market depends on cumulative pass-through, not just lag coefficient. The ARDL is needed for

capturing how dairy prices may adjust over several periods, and it is used as a dynamic benchmark and lag check before selection (Pesaran, Shin, and Smith 2001).

$$p_{u,t}^{+} = \sum_{s=1}^{t} \max(\Delta p_{u,s}, 0), p_{u,t}^{-} = \sum_{s=1}^{t} \min(\Delta p_{u,s}, 0) \quad (9)$$

NARDL on the other side as visible in equation (9) use $p_{u,t}^{+}$ – accumulates only price increases, while the negative upstream partial sum accumulates only price decreases. Replacing single upstream term with two partial sums – give model ability to test on each how price increases/decreases travel through the chain. This part is fundamental for market-power interpretation because asymmetric correction not always can be consistent with bargaining power. It can also reflect cost factors, perishability, promotion strategies. For that reason, the thesis treats asymmetric evidence as mechanism evidence unless the link is otherwise reliable (Enders and Siklos 2001; Shin, Yu, and Greenwood-Nimmo 2014).

$$p_{d,t+h} - p_{d,t-1} = \alpha_h + \beta_h \Delta p_{u,t} + \Gamma_h X_t + \varepsilon_{t+h} \quad (10)$$

In the local projection model h is the response horizon, β_h - estimated downstream response after an upstream price change. X_t collects controls or lagged dynamics, Γ_h is horizon-specific control coefficient vector, and ε_{t+h} - horizon-specific residual (Equation 10). Local projections help show whether adjustment is immediate, delayed, or temporary. They are kept as robustness evidence since horizon-by-horizon responses are informative about timing, and compelements, but not replaces the cointegration and error correction used for the main H1 and H2 claims (Jordà 2005).

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (11)$$

Now working with the Johansen-type VECM – equation (11), and here the price vector y_t contains several linked prices and $\beta' y_{t-1}$ is the cointegrating relation. α is the vector of adjustment coefficients, Γ_i captures short-run dynamics for each lag, and ε_t - the lagged cointegrating relation, which captures the long-run system relation. The VECM is conceptually attractive to use for a chain as whole, but, for the conclusion credibility, the thesis uses it only where product overlap and sample length significant. Since all our price are different economic objects (even with different frequency) - they must not be forced into one artificial equilibrium (Johansen 1988).

$$RetailPrice_{sku,t} = \alpha + \beta + \delta DiscountIncidence_{sku,t} + \rho DiscountDepth_{sku,t} + \gamma' Controls_t + \varepsilon_{sku,t} \quad (12)$$

And as the final estimation used Discount-augmented retail pass-through regression, which has $RetailPrice_{sku,t}$, $\beta ProcurementPrice_{p,t}$ is the matched product-level procurement price, $\delta DiscountIncidence_{sku,t}$ equals one when the SKU is promoted, $\rho DiscountDepth_{sku,t}$ measures the markdown size where available, $\gamma' Controls_t$ collects product and timing adjustments, and the residual $\varepsilon_{sku,t}$. This specification tests whether H2 adjustment appears through discount incidence or depth when baseline retail prices is same. It evaluates whether adjustment for the consumer can occur through promotions and shelf-category management even when the baseline price on retail does not move with upstream prices (Loy 2023; Loy, Weiss, and Glauben 2016).

To conclude, for H1, the upstream price is the observed SSSU enterprise farm-gate raw-milk price and the downstream price is the SSSU processor-level dairy product price. For H2, the upstream price is the processor-level price or cleaned Prozorro procurement price, while the downstream price is the official consumer price or the cleaned retail price. The retail, procurement, discount-incidence, and discount-depth variables use only repaired SKU, lot, unit, and product mappings.

4.3. Reliability and interpretation rules

The reliability hierarchy prevents fragile outputs from driving conclusions merely because they are statistically significant. A model with many observations can still be weak if the series are reconstructed, product match is poor, or the coefficient has no plausible dairy-chain meaning.

The reliability tiers therefore show what each result is allowed to do in the argument. Just a statistically significant coefficient is not enough: result becomes main evidence only when overlap, integration logic, product mapping, diagnostics, economic magnitude – all are defensible. This makes the conclusions narrower but substantially more reliable (Table 3).

The same section applies three interpretation rules. First, price-link evidence means that two prices move together in a statistically and economically meaningful way. Second, adjustment evidence means that deviations are corrected with a plausible speed and sign. Third, market-power interpretation requires the first two elements plus a market structure that makes bargaining asymmetry plausible. Statistical significance alone is never treated as proof of market power, and a coefficient is not interpreted before the chain level, product match, sample length, and reliability tier are clear (Vavra and Goodwin 2005; Meyer and von Cramon-Taubadel 2004).

The pairwise models are therefore a design choice, not a weakness, because they respect the chain structure. Whole-chain models are used only as robustness or boundary evidence because the product links, frequencies, data availability differ across stages. A universal farm-to-retail equilibrium story would be less credible than a layered design that reports which links are reliable and which are only supportive.

Table 3. Reliability tiers used in the thesis

Tier	Definition	Use in conclusions
Reliable evidence	Acceptable overlap, correct integration logic, economically interpretable coefficient, acceptable diagnostics, stable across reasonable variants	Can support a main H1 or H2 statement
Supportive evidence	Directionally useful but weaker overlap, product-mapping limitations, weaker diagnostics, or short institutional/retail window	Can explain a mechanism or qualify a main result
Descriptive evidence	Useful for market context, figures, regional dispersion, or trade/external background but not a hypothesis test	Can motivate or contextualize but not prove H1/H2
Appendix-only evidence	Reconstructed, weakly validated, unstable, implausible, or weakly mapped result	Disclosed for transparency but not used in the main argument

Source: author's analysis.

Before any coefficient is interpreted, the result must pass pre-interpretation filters: source coverage and overlap, stationarity and cointegration where the model requires them, residual diagnostics, product mapping, and the source hierarchy. Observed monthly SSSU evidence is read first. Interpolated, reconstructed, daily, weekly, retail, and procurement layers are used only after these filters and only for validation, timing, or mechanism interpretation.

Chapter 5

DATA

The data chapter documents price series as economic objects, where each variable is named by source, chain level, unit, frequency, transformation, and reliability role before it enters a model.

5.1. Official monthly series from the State Statistics Service of Ukraine

The core monthly price series data is official and taken from the State Statistics Service of Ukraine (SSSU). The upstream farm-gate raw-milk variable is based on the official agricultural sales price series, in Ukrainian “Середня ціна продукції сільського господарства, реалізованого підприємтсвами”, for the product entity “Молоко” (State Statistics Service of Ukraine n.d.c). The thesis calls this the farm-gate raw-milk price because it is the price received by agricultural enterprises for milk sold at the upstream stage (State Statistics Service of Ukraine n.d.c). The term farm gate is therefore an analytical label that identifies the stage level of that prices in Ukrainian dairy chain, not the real SSSU source name (State Statistics Service of Ukraine n.d.c).

The processor-level variables are based on industrial producer prices, in Ukrainian "цін промислових виробників" or "Середні ціни виробників промислової продукції", for processed dairy products (State Statistics Service of Ukraine n.d.b). This layer is called processor-level because it describes processed-product prices at the industrial producer stage (State Statistics Service of Ukraine n.d.b). It is not a wholesale price and not a price received by raw-milk farmers, but price after the raw-milk is processed and diversified dairy products produced (State Statistics Service of Ukraine n.d.b).

The downstream official consumer variables are based on official consumer prices, in Ukrainian "споживчі ціни" or "Середні ціни споживчі ціни на товари" for dairy rows such as drinking milk, soft cheese, and sour cream (State Statistics Service of Ukraine n.d.a). These are national consumer benchmarks, not observations from a specific retail chain, which used for H2 only on economically admissible product matching with processor series (State Statistics Service of Ukraine n.d.a).

The farm-gate series is the observed upstream price series used for H1, and it combines long-run inflation, seasonality, and wartime volatility. This is why the model interprets coefficients as proportional pass-through and not as simple hryvnia-level spreads (Figure 8).

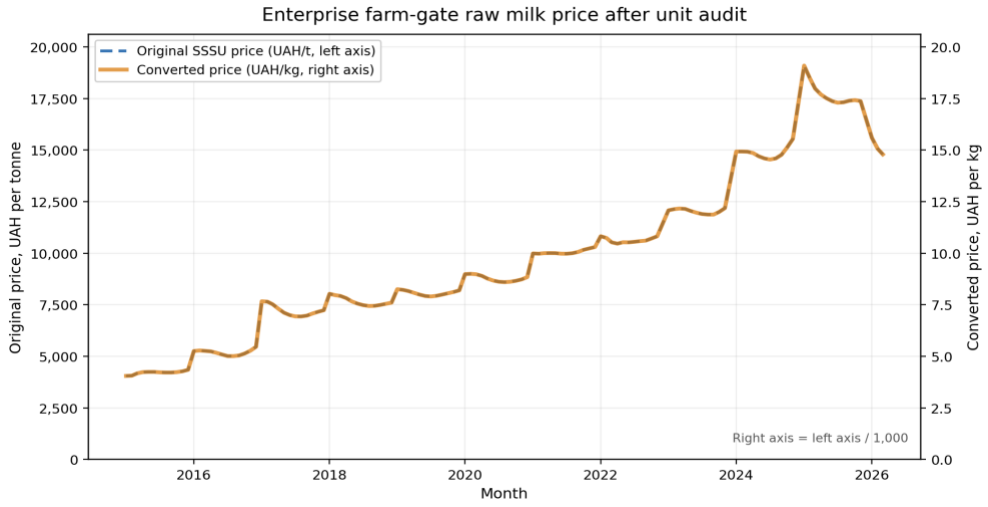


Figure 8. Official enterprise farm-gate raw-milk price after unit audit.

Source: SSSU agricultural sales data. Author's conversion from tonne-level magnitudes to UAH/kg.

The processor series are downstream from raw milk but not identical to it. Drinking milk, hard cheese, kefir, sour cream, butter, and skimmed milk powder

differ in milk content, storability, and exposure to external markets, so the empirical interpretation is product-specific rather than chain-wide (Figure 9). For the support of H2 design to narrow the comparison for link processor-consumer on official monthly data, Figure 10 shows that consumer prices move above and alongside processor.

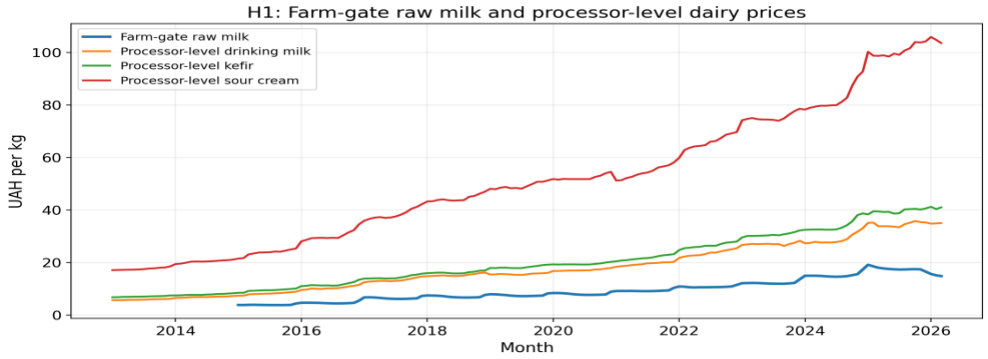


Figure 9. Farm-gate raw milk and processor-level dairy product prices.

Source: SSSU monthly agricultural sales and industrial producer price data. Author's cleaning and conversion to UAH/kg.

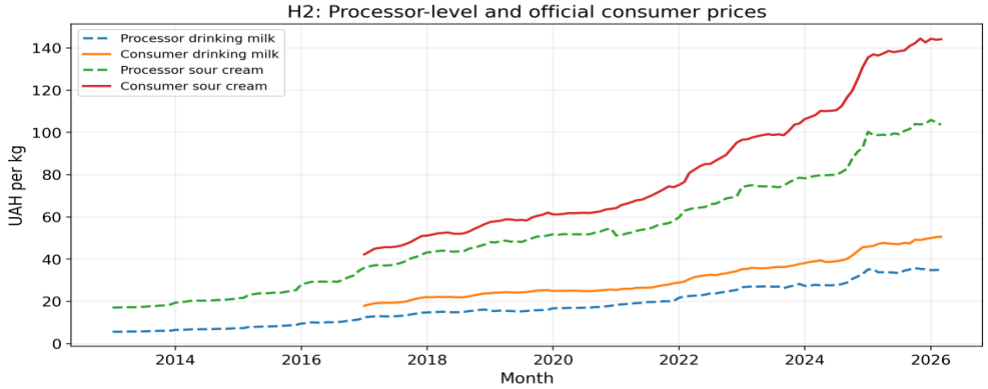


Figure 10. Official processor-consumer bridge for common dairy products.

Source: SSSU monthly industrial producer and consumer price data. Author's cleaning and conversion to UAH/kg.

At the same time, processor have more clear and sharp peaks, so this chain level obviously replicate tendencies from the upstream layers, but with absolutely different speed of correction.

Therefore to separate variables that can support the main H1 and H2 models and those one that are used only as procurement, retail or external-benchmark evidence - shown Table 4 as empirical design map. So each result must be interpreted distinctly, according to the source frequency, coverage period, chain role, guiding further analysis. The official consumer layer is the main downstream benchmark for H2 where product mapping is clean.

5.2. Mandatory data audit before modelling

The most important data work is not estimation, but is preventing unit and product errors from entering the model. The audit identifies five mandatory corrections – one per time series (but execute similarly for all time series of each type – consumer, processor, farm-gate prices have monthly longterm and interpolated for the wartime period datasets). Processor prices are stored as hryvnia per tonne and must be converted to Ukrainian hryvnia per kilogram. Farm-gate raw milk prices use a short unit label, but their magnitudes are tonne-level and must also be converted. Prozorro numerical fields include text numbers and non-breaking spaces. Retail product labels contain classification errors. The combined consumer sheet contains implausible values and must be replaced by cleaned component workbook series. The audit corrections determine whether the econometrics can be trusted (Table 5).

Table 4. Dataset map and source terminology

Thesis variable	Frequency	Period	Status and role
Farm-gate raw milk price	Monthly	2015-M01 to 2026-M03	Observed official series, main H1 upstream variable
Enterprise/industrial raw-milk context	Annual/monthly where available	2018-2025 and model period	Context for H1, not treated as a processed-product price
Processor-level dairy price	Monthly	2013-M01 to 2026-M03	Main H1 downstream and H2 upstream variable
Official consumer dairy price	Monthly	2017-M01 to 2026-M03	Main H2 official downstream benchmark
Prozorro procurement price	Lot/event; aggregated to day/week/month	2023-01-02 to 2026-04-29	Mechanism evidence for procurement as relay and buffer
Silpo and Novus retail prices	Daily SKU	2025-10-21 to 2026-01-08	Short-window H2 mechanism evidence
EU/CME external benchmarks	Weekly/monthly	Overlap varies	Contextual anchor, not a Ukrainian chain stage

Source: author's calculations and analysis.

Table 5. Mandatory data-audit corrections before modelling

Audit item	Risk	Correction	Status
Processor unit	Processor_price is stored as "Гривні за тону".	Divide by 1000 and report as UAH/kg.	Mandatory before modelling
Farm-gate unit	Farm_price uses the short unit label "Гривня", but magnitudes are tonne-level prices.	Treat as UAH/tonne, divide by 1000, and label as UAH/kg.	Mandatory before modelling
Prozorro numeric fields	Cleaned Prozorro records includes text numbers and non-breaking spaces.	Strip non-breaking spaces, normalize decimal signs, and recalculate reliable UAH/kg lot prices.	Mandatory before aggregation
Retail classification	Legacy product labels misclassify some dairy and non-dairy items.	Rebuild product from product_title and product_name; keep a controlled product column in every model-ready table.	Mandatory before H2 retail models
Integrated consumer sheet	Combined Consumer_price sheet contains implausible values above 1000 UAH/kg.	Use the raw Consumer_2017_2026 component workbook and cleaned national and regional series.	Mandatory before official consumer models

Source: author's calculations and analysis.

5.3. Procurement (Prozorro) and retail (Silpo, Novus) data construction

The Prozorro public procurement system, hereafter Prozorro, provides lot-level and contract-level observations for institutional dairy purchases (Prozorro n.d.). The cleaning pipeline repairs text-formatted numbers, normalizes units, assigns controlled dairy-product labels, and aggregates eligible observations into weekly medians. This makes Prozorro useful for institutional transaction evidence, while preserving the distinction between public procurement and ordinary retail.

Prozorro prices are transaction prices for institutional buyers, not supermarket shelf prices. Their value for the thesis is mechanism evidence: they show how processed dairy products are priced in a public contracting channel that can relay or buffer processor-side shocks (Figure 11).

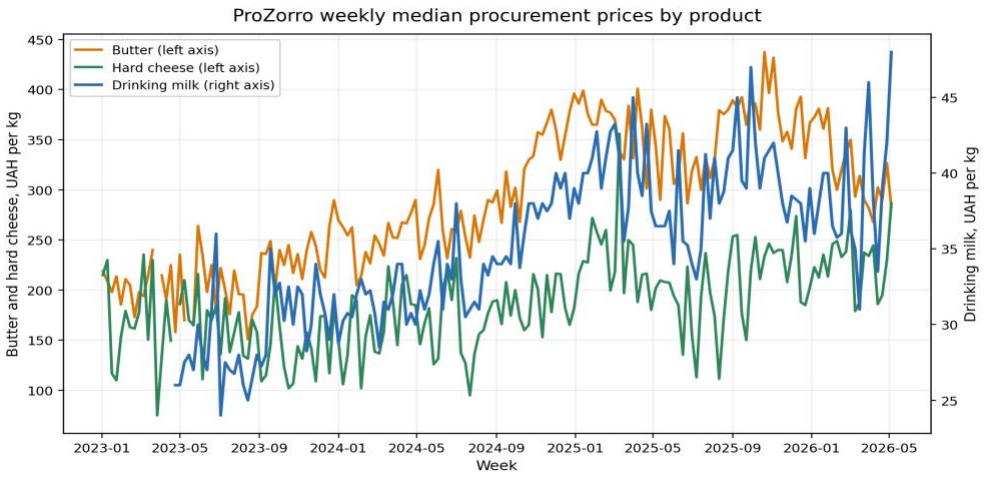


Figure 11. Prozorro weekly median procurement prices by product.

Source: Prozorro public procurement records. Author's product repair, unit conversion, and median aggregation.

Retail observations from Silpo and Novus are constructed stock keeping unit (SKU) data (Silpo 2026; Novus 2026). A SKU is a distinct product item defined by product identity, package size, and sale attributes. Retail prices are standardized into UAH/kg or UAH/litre where package information permits. For Silpo, discount incidence and discount depth are retained so that baseline and promotional prices can be distinguished (Silpo 2026). Retail scraping is not treated as an official source. It is a constructed mechanism dataset.

The retail window is short, but it observes the mechanism that official monthly consumer prices usually hide. Discounts change the consumer-visible price without necessarily changing the baseline price, and this is why the retail layer is used as H2 mechanism evidence rather than as the core long-run proof (Figure 12). Any visible interruption or flat segment in Figure 12 should therefore be read as a limitation of the short retail scrape, not as evidence that retail prices stopped changing.

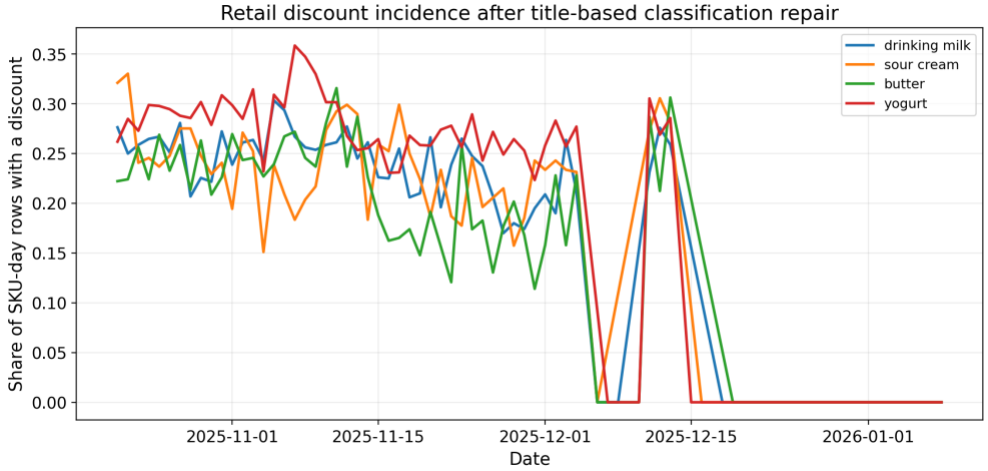


Figure 12. Retail discount incidence in Silpo and Novus observations.

Source: Silpo and Novus SKU-day observations. Author's product-title repair and discount classification.

5.4. External benchmarks and reconstructed layers

External benchmarks are used as context and validation anchors. European Union (EU) dairy market prices, Chicago Mercantile Exchange (CME) dairy benchmarks, and the MilkUA world-price graph are useful because Ukrainian raw-milk and dairy-product prices are exposed to regional and global dairy cycles (EC DG AGRI 2026a; EC DG AGRI 2026b; EC DG AGRI 2026c; CME Group 2026; MilkUA.info 2026). They are not domestic Ukrainian chain stages, and they cannot prove domestic market power by themselves. Their role is to prevent over-domestic interpretation of price movements that may partly reflect common external shocks.

CME Class III milk is retained only as an external benchmark because it reflects a U.S. dairy-pricing reference rather than a Ukrainian chain-stage price. It helps contextualize international dairy-price pressure, but it does not enter the Ukrainian farm-gate, processor, procurement, or retail pass-through interpretation as a domestic price layer.

Reconstructed daily or weekly series are treated carefully, and used only to have supportive proofs of the market power in the analysis of price transmission in the indirect relations. The relevant question is whether aggregation back to the monthly level reproduces observed Ukrainian levels, signs, and product links, which is ensured using the weighted coefficient from the EU dairy products dataset. Linear and shape-preserving variants are therefore sensitivity checks, not alternative official data (Chow and Lin 1971; Denton 1971).

The interpolation logic is most defensible for short high-frequency gaps where an external benchmark follows the same broad dairy cycle as the Ukrainian observed series. In the final evidence hierarchy, however, a benchmark-supported interpolation remains below observed SSSU monthly data. A high correlation between Ukrainian and EU price trends can justify robustness work,

but it cannot identify domestic bargaining power unless the reconstructed series also survives product-level validation and produces the same interpretation as the observed monthly models. In the results chapter, these layers are therefore reported as robustness, timing diagnostics, or mechanism checks, not as the primary identification evidence for either hypothesis.

Official farm-gate, processor and consumer series cover monthly windows in and support long-term analysis, while Prozorro and retail observations are richer institutionally but shorter and more heterogeneous. The evidence ranking therefore follows the structure of the data rather than the attractiveness of any single model output (Table 6).

5.5. Software and reproducibility

Data cleaning, unit conversion, product reclassification, aggregation, visualization, and model estimation are implemented in Python using the author's reproducible analysis files. The reproducible repository contains the integrated workbook, scripts, clean data outputs, model tables, figures, diagnostics, and documentation. The thesis uses the model outputs as the source of truth for empirical claims. Coefficients, p-values, diagnostics, figures, sample sizes are not added unless they appear in the model outputs or final reports.

Table 6. Cleaned dataset descriptive statistics and coverage

Chain layer	Analytical price unit	Period	Observations	Products	Mean	Model role
Farm-gate raw milk	UAH/kg	2015-01-01 to 2026-03-01	131	Raw milk	9.68	Main H1 upstream variable
Processor-level sale	UAH/kg	2013-01-01 to 2026-03-01	954	Six product rows	69.09	Main H1 downstream and H2 upstream
Official consumer sale	UAH/kg	2017-01-01 to 2026-03-01	333	Drinking milk, soft cheese, sour cream	84.50	Main H2 benchmark
Institutional procurement	UAH/kg	2023-01-02 to 2026-04-29	16,531	Eight controlled product groups	193.39	Procurement mechanism evidence
Retail SKU-day sale	UAH/package; UAH/kg subset	2025-10-21 to 2026-01-08	69,308	Eight controlled product groups	75.46	Retail and discount mechanism evidence

Source: author's calculations and analysis.

Chapter 6

ESTIMATION RESULTS

The results chapter is organized by hypotheses and mechanisms, and each result is read through its model family, coefficient, adjustment term, reliability tier, and economic meaning.

6.1. Descriptive evidence and admissibility of the model universe

First of all, screening shows that the models universe is large, but the thesis does not treat all outputs as equal. The highest priority provides the most reliable national monthly models, while Prozorro and retail outputs are used as mechanism evidence, including the promotions analysis. Additionally used reconstructed high-frequency outputs, but only when validation supports them. This screening is essential as the starting point, because various outputs must be interpreted respectively, otherwise they may create false evidences.

Figure 13 summarizes retained estimates, not the whole model universe; the strongest H1 rows remain drinking milk, hard cheese, and sour cream, which stay close to unit pass-through. At the same time, kefir, butter, and skimmed milk powder – useful, but as supportive evidence: kefir and butter have strong-looking coefficients but less consistent diagnostic support, while SMP shows clear transmission below unit pass-through rather than full adjustment. H2 is much narrower, sour cream prices provide the cleanest official downstream link and even exceeds unit pass-through, while drinking milk is positive but weaker and it is significant supportive evidence to the downstream hypothesis.

The direct Prozorro-to-retail estimates are the least clean part of the figure. Their coefficients are close to zero or negative: milk is -0.02, kefir is 0.01, and soft

cheese is -0.2. Since these estimates are not good enough for the reliability and significance, they should be treated as evidence of a noisy, short-window institutional layer (no stable mechanism). Therefore the logic of the results that is presented in this thesis is such: strong upstream evidence, selective downstream evidence, and retail mechanisms that help explain specific adjustment, but, by themselves, are not structural evidence (Figure 13).

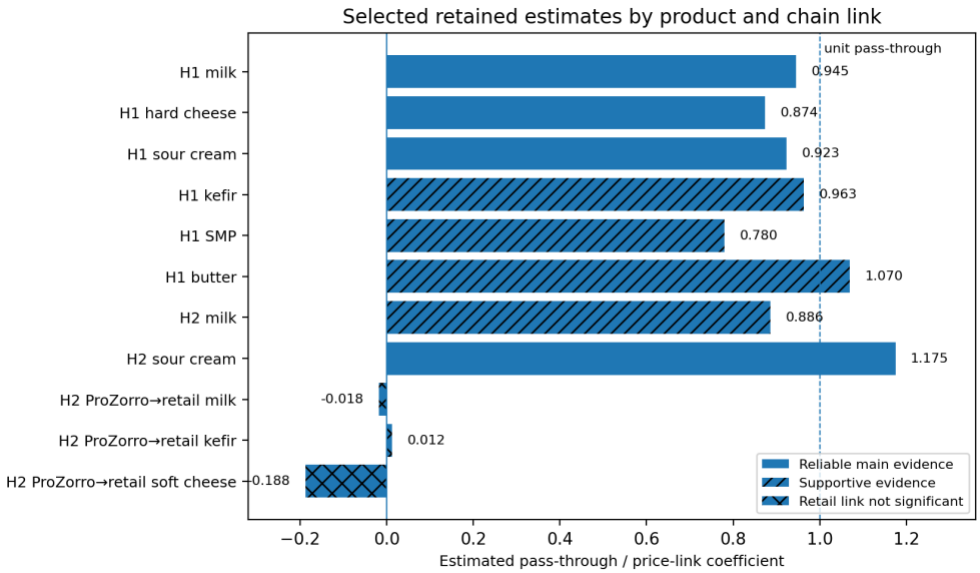


Figure 13. Selected retained estimates by product and chain link.

Source: author's calculations based on retained ECM/TECM, downstream mechanism, and reliability-screen outputs.

6.2. Core Hypothesis 1: farm-to-processor transmission and market power

In this research, as was described previously, the H1 evaluates the expectation that farm-gate raw milk prices are transmitted to processor dairy prices incomplete or asymmetric, or with delay. This is the strongest empirical block

because the farm-gate price and processor-level prices are official national monthly data, with 129 monthly observations, which is enough for long-run analysis with clear separation by chain level (State Statistics Service of Ukraine n.d.b; State Statistics Service of Ukraine n.d.c).

While enterprise farm-gate raw milk and selected processor-level dairy prices have visible co-movement, their paths differ. The raw milk is a perishable upstream input, while processed dairy prices also include different shares of milk-content, processing costs, storage and cooling options, product differentiation, and downstream bargaining pressure. All of it reflected in the fact that more fat-containing products, especially sour cream, have a steeper upward trend, which proves that product differentiation and other additional factors are no less important than input prices on processing stage. Therefore H1 should be read as a chain-stage problem, not as a simple case with single raw-milk price can not be processor price (Figure 14).

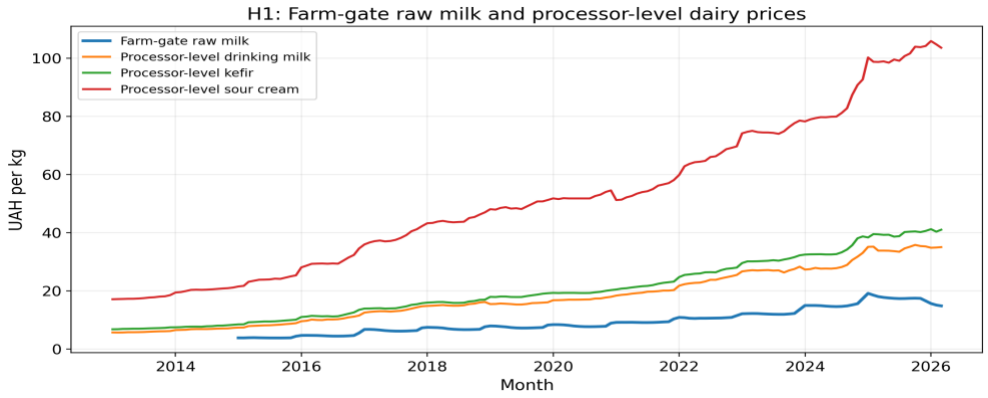


Figure 14. Farm-gate raw milk and processor-level prices in Ukraine.

Source: State Statistics Service of Ukraine monthly data. Author's cleaning and conversion to Ukrainian hryvnia per kilogram. Main observed-data evidence.

The strongest evidence in the thesis comes from the farm-to-processor block. In the retained H1 models, all six product-level price-link coefficients are statistically conventionally significant.

However, only three products are clean enough to serve as headline evidence. Drinking milk, hard cheese, and sour cream have long-run coefficients around 0.9, which shows strong pass-through from the raw-milk environment into processor-level prices, but not identical adjustment across products. Kefir (0.96), skimmed milk powder (0.78), and butter (1.1) are supportive , but still important for the full interpretation, because their adjustment signs, cointegration diagnostics, serial-correlation, or product mapping are less stable (Table 7; Figure 14). In Table 7, Beta is the long-run price-link coefficient and Lambda is the ECM adjustment coefficient, so the thesis reads them together rather than as separate proof of market power.

For farmers, it emphasizes the existing market pressure, since raw-milk price movements do eventually appear in processor output prices, but the adjustment is not immediate or uniform. Hard cheese gives the cleanest H1 result – at the same time, it combines a strong long-run link with statistically meaningful correction. Drinking milk and sour cream also reveal the strong price links, but with slower correction. Because perishable nature of raw milk limits farms' options to local or contract-agreements, slow correction move short-run adjustment risk toward suppliers, even when long-run co-movement strong between upstream and processor prices (FAO 2013; Litvinov 2025a; Sexton 2013).

The next step is executed for the procurement Prozorro, which helps to deeper analyse the farm to processor link, but it does not observe raw-milk bargaining directly – not primary for H1. Still, the retained daily farm-to-procurement models show visible transmission for sour cream, $\beta=2.6$, butter, $\beta=2.3$, cheese, $\beta=1.5$, and cream, $\beta=0.65$, all retained as reliable main-text evidence. There is

also small positive effect for milk – β=0.05, while condensed milk is negative, β=-0.45. H1 is supported by the monthly TECM farm-to-processor results: drinking milk, hard cheese, and sour cream the core evidence (β=0.87-0.94, with the cleanest correction on hard cheese), while kefir has weak correction, SMP reflects export/storability noise, butter shows fat-market volatility.

Table 7. Main Core Hypothesis 1 farm-to-processor model selection

Link	Product	Model / N	Beta (p)	Lambda (p)	Diagnostics and explanation
Farm to proc	Milk	Tecm, N=129	0.945 (<0.001)	-0.044 (0.471)	Coint p=0.026, serial p=0.866. Reliable price link with slow adj.
Farm to proc	Cheese	Tecm, N=129	0.874 (<0.001)	-0.005 (0.090)	Coint p=0.001, serial p=0.329. Reliable price link + adj.
Farm to proc	Kefir	Tecm, N=129	0.963 (<0.001)	0.018 (0.689)	Coint p=0.007, serial p=0.051. Supportive price link only
Farm to proc	SMP	Tecm, N=129	0.780 (<0.001)	-0.012 (0.509)	Coint p=0.306, serial p=0.664. Supportinve, weak diagnostics
Farm to proc	Sour cream	Tecm, N=129	0.923 (<0.001)	-0.065 (0.110)	Coint p=0.006, serial p=0.149. Reliable price link with slow adj.
Farm to proc	Butter	Tecm, N=129	1.070 (<0.001)	-0.026 (0.406)	Coint p=0.892, serial p=0.017. Supportive weak diagnostics

Source: author's calculations and analysis.

Appendix Table A.1 shows that several farm-to-Prozorro supplementary estimates are positive in the DOLS/local-projection checks, but with mixed local-projection horizons. While Appendix Table A.4 also shows that the speed of adjustment and ECT differ by product. Therefore, the farm-to-procurement block is treated as institutional-channel robustness for H1, supporting the official monthly farm-to-processor interpretation where the supplementary estimates remain economically coherent (Appendix Tables A1 and A4).

The H1 conclusion is that reliable farm-to-processor models are consistent with processor bargaining pressure over the commercial raw-milk pool, especially because formal processing depends on regular high-quality enterprise milk while many farms have limited storage and buyer alternatives (FAO 2013; Litvinov 2025a; Sexton 2013). It is not a legal monopsony estimate, and it is not a claim that every processor behaves identically. It is a market-power screening result: the farm-to-processor interface is the strongest observed location where price-link evidence and chain economics point in the same direction. The H1 status is supported with reliable evidence for the core observed monthly farm-to-processor links, while procurement-channel and reconstructed high-frequency checks are supportive rather than primary.

6.3. Core Hypothesis 2: processor/procurement-to-retail transmission and downstream market power

H2 evaluates whether processor-level or procurement price shocks are filtered before they become consumer-facing prices, rather than assuming one stable retail elasticity. The evidence is more heterogeneous than H1 because the downstream chain contains national consumer benchmarks, institutional procurement contracts, and short-window retail observations (State Statistics Service of Ukraine n.d.a; Prozorro n.d.; Silpo 2026; Novus 2026). Official

consumer prices are national monthly indicators (State Statistics Service of Ukraine n.d.a). Retail SKU data are short-window observations from two chains, while rozorro prices are institutional contract prices, not shelf prices.

The official downstream bridge shows related movement for some processor-consumer product pairs, but the relation is visibly less direct than the upstream H1 link. That weaker visual bridge is consistent with the economics of the downstream layer: retail formats, procurement rules, category management, and consumer-facing price strategy can filter processor-side pressure before it becomes visible in final prices (Figure 15).

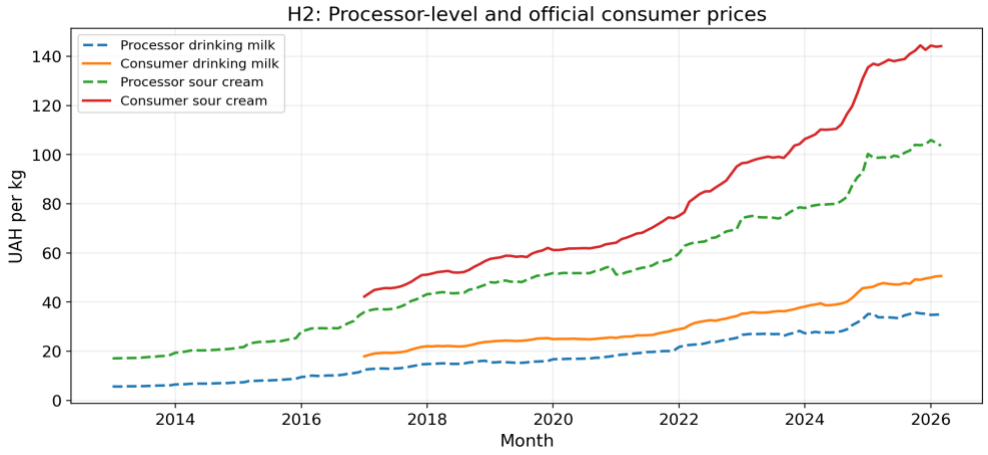


Figure 15. Official processor-consumer bridge for common dairy products.

Source: State Statistics Service of Ukraine monthly data. Author's cleaning and conversion to Ukrainian hryvnia per kilogram. Main observed-data evidence.

The downstream evidence should be read as a layered H2 block. The processor-to-consumer model remains the main official bridge: sour cream has a core official monthly coefficient of 1.174 with cointegration support, but the correction term is very slow. Drinking milk is supporting official evidence, with an ECM long-run coefficient of 0.868 but weak cointegration. The new Prozorro-

to-consumer weekly extension adds an institutional bridge: drinking milk has a smoothed ECM coefficient of 0.796 with statistically visible correction, while cheese is retained only as approximate supportive evidence because the product mapping is broader and cointegration is weak. Together, these estimates show that processor and procurement prices matter, while downstream pass-through remains filtered rather than cleanly complete (Table 8 and Figures 15-16, and Appendix Table A.2).

Table 8. Main Core Hypothesis 2 processor/procurement-to-consumer model selection

Link	Product	Model / N	Beta (p)	Lambda (p)	Diagnostics, tier, reading
Official processor -> Consumer	Drinking milk / fermented milk	ECM, N=96	0.868 (<0.001)	-0.038 (0.318)	Coint p=0.890, serial p=0.597. supporting official H2 evidence. Official consumer bridge, processor-side upstream.
Official processor -> Consumer	Sour cream	ECM, N=109	1.174 (<0.001)	-0.008 (0.815)	Coint p=0.019, serial p=0.866. core official H2 evidence. Official consumer bridge, processor-side upstream.
Procurement -> Consumer	Cheese	ECM, N=164	0.423 (<0.001)	-0.0 (0.876)	Coint p=0.340, serial p=0.300. supportive institutional bridge. Supportive institutional bridge, not retail resale pass-through.
Procurement -> Consumer	Drinking milk / fermented milk	ECM, N=149	0.796 (<0.001)	-0.004 (0.010)	Coint p=0.452, serial p=0.529. supportive institutional bridge. Supportive institutional bridge, not retail resale pass-through.

Source: author's cleaning, modelling, and analysis.

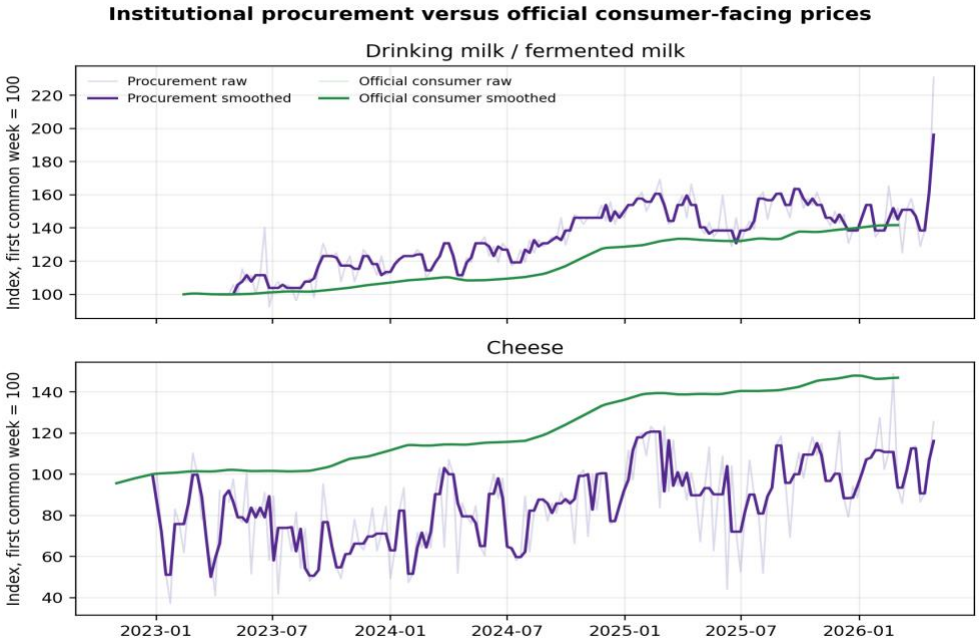


Figure 16. Institutional procurement and official consumer-facing price movement.

Source: author's calculations from cleaned Prozorro procurement records and official SSSU consumer-price data.

To understand why marginal downstream estimates are treated as sensitivity evidence, Appendix Table A.3 adds borderline screened results, where near-threshold coefficients and cross-mixed downstream links remain informative but too weak.

For consumers, this means that processor-side pressure can reach shelf-relevant official prices, but through product-specific and institutionally filtered paths. For processors, slow downstream correction matters because cost pressure may be recovered gradually or converted into procurement terms, promotion schedules, or category-level price management. For retailers and public buyers, the evidence points to timing and channel control rather than a simple final-price markup. The

primary H2 path is therefore the observed official monthly processor-to-consumer bridge, with Prozorro-to-consumer as a supporting institutional channel and retail-promotion models as mechanism evidence, so Figure 16 summarizes this procurement-consumer bridge.

To conclude, monthly ECM processor-consumer models and weekly ECM procurement-consumer models identify downstream pass-through mainly for sour cream as slow correction and weaker for drinking milk, but still interpreted as procurement price correction. At the same time, the retail-support regressions, screened NARDL/ECM checks, and Loy-style second-stage mechanism model identify discounting, tender timing and category-management effects without any stable retail elasticity (Table 8; Figures 15-16; Table 9; Figure 20; Appendix Tables A.2, A.3, and A.5; Appendix Figures A.1-A.2).

6.4. Procurement as relay and buffer

The procurement channel becomes informative only after product repair, unit conversion, admissibility checks, and weekly aggregation. Its value is that it records institutional transaction prices for processed dairy products outside supermarket shelves. In the H2 extension, these prices are compared with official consumer-facing prices as a downstream bridge, not as a retail resale chain.

The weekly Prozorro-to-consumer extension is retained as supportive institutional evidence. Drinking milk is the clearest bridge: the smoothed ECM coefficient is 0.796 with visible correction, while the lag profile points to the strongest correlation when procurement leads official consumer prices by about six weeks. Cheese is weaker because the mapping is approximate and cointegration is not strong, so it is retained only as supportive bridge evidence (Figures 16, 18, and 19).

Daily procurement-consumer estimates are not promoted to main evidence, but useful as conditional mechanism support. The overlap is adequate for milk and cheese, but the daily official consumer layer is frequency-bridged and diagnostics are weaker. Figure 20 therefore keeps the hierarchy explicit: official processor-consumer evidence is the core H2 bridge, procurement-consumer evidence is supportive institutional bridge evidence, and procurement-retail or retail-promotion evidence remains mechanism-only. Prozorro error-correction coefficients are timing evidence, which is displayed on Appendix Figure A.3.

6.5. Retail promotions, baseline prices, and category-specific adjustment

Therefore, the retail evidence should be analysed with a mechanism test, not as a repeated discount-incidence time path. In the common retail-to-Prozorro link, milk, butter, and cheese discounts are compared with the previous week's procurement-price movement. The model screen summarizes whether discount strategy is explained by persistence, retail gaps, or procurement-linked pressure. It shows that promotions belong in H2 as a tactical adjustment channel: effective shelf prices react through discounts even when baseline prices and official monthly averages move much slower (Figure 18).

Figure 17 is a timing diagnostic, not a same-horizon ranking. It applies the same zero-to-eight-week procurement-lead window to milk and cheese, showing that milk has the stronger bridge and peaks around six weeks, while cheese is weaker and closer to contemporaneous movement.

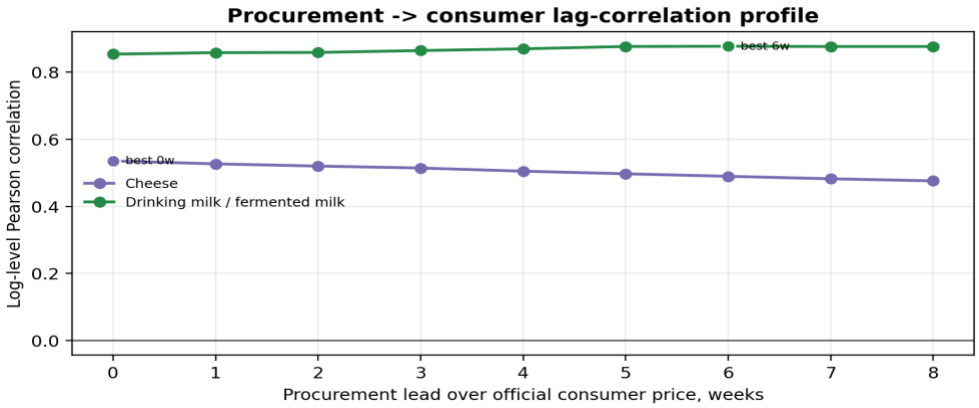


Figure 17. Procurement-consumer lag-correlation profile.

Source: author's calculations from cleaned Prozorro procurement records and official SSSU consumer-price data.

The retained weekly coefficients for the procurement-consumer block is shown on Figure 18. Milk is the clearer supportive bridge, while cheese is retained only as approximate support. Neither row is interpreted as retail resale pass-through.

For clear conclusions, it is important to refer to the evidence hierarchy used in H2 (Figure 20). Official processor-consumer rows remain the core layer, procurement-consumer results add a bridge, and Prozorro-retail plus promotion evidence remains mechanism-only.

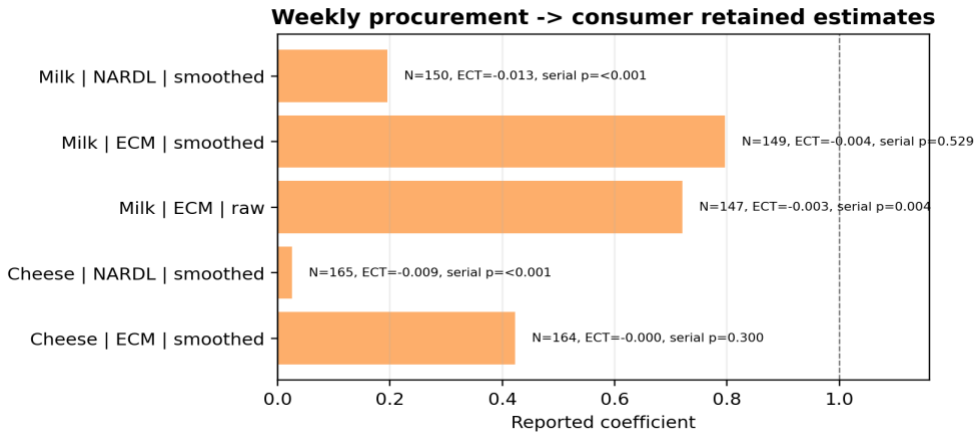


Figure 18. Weekly procurement-consumer retained estimates.

Source: author's ECM and NARDL calculations from cleaned Prozorro procurement records and official SSSU consumer-price data.

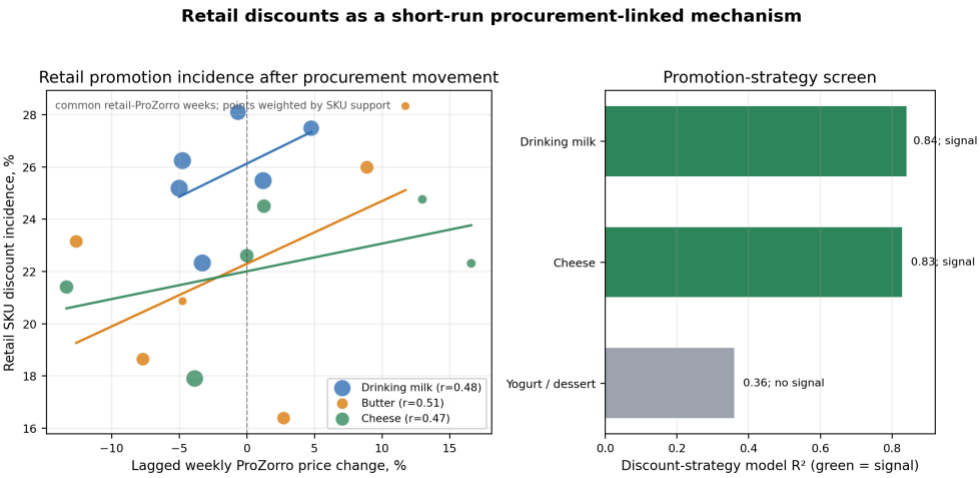


Figure 19. Retail discounts as a procurement-linked short-run mechanism.

Source: Silpo and Novus SKU-day observations, Prozorro procurement records, and author's discount-strategy model screen.

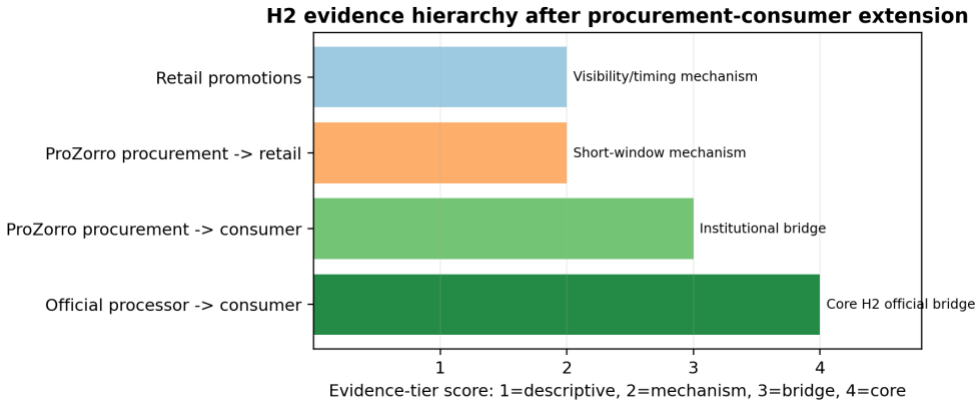


Figure 20. H2 evidence hierarchy after the procurement-consumer extension.

Source: author's synthesis of official processor-consumer, procurement-consumer, procurement-retail, and retail-promotion evidence tiers.

The retail-support evidence is intentionally bounded. The cleaned direct Prozorro-to-retail rows do not establish a stable one-for-one pass-through relation, and that result is informative: the retail layer is not merely a continuation of procurement prices. At the same time, the short-window retail/procurement models capture product-specific effects in discounts, timing, and category adjustment. These effects require a mechanism interpretation rather than a headline structural retail-equilibrium claim (Table 9). There is also further support for the H2 mechanism interpretation in Appendix Table A.5: the retail-link term is associated with adjustment speed, while the weaker asymmetry measure suggests timing adaptive changes.

Table 9. Core Hypothesis 2 retail-support evidence

Link	Product	N	Coefficient	P-value	Use	Interpretation
Prozorro to Retail	Drinking milk	55	-0.0177	0.9431	Supporting	Short window, no direct pass-through claim
Prozorro to Retail	Kefir	52	0.0119	0.8285	Supporting	Short window, no direct pass-through claim
Prozorro to Retail	Soft cheese	53	-0.1881	0.3303	Supporting	Short window, product matching risk

Source: author's calculations and analysis.

Large or negative short-window retail coefficients are not read as literal elasticities. Fragile cheese, cream, yogurt/dessert, discount, or procurement-scale outputs are interpreted only when they clarify a mechanism: category-specific retail nonlinearity, promotion management, or procurement buffering. This means the retail block is useful but bounded: it shows weekly mechanisms, not headline proof of downstream market power.

For public procurement buyers, the mechanism is contract design, tender timing, lot composition, and budget discipline, which can smooth or delay price pressure. For retailers, the mechanism is SKU selection, promotion depth, category strategy, and timing of baseline repricing rather than one stable elasticity. For consumers, the observed discount can be real, but it may also make the upstream burden of adjustment less visible.

A limited Loy-style second-stage mechanism points in the same direction but remains supportive. In the models, across 27 first-stage estimates, retail-linked pairs are associated with faster correction (coefficient 0.3, $p = 0.05$), while perishability and asymmetry-measure regressions are not statistically strong in the short-run mid-downstream data. Appendix Figure A.1 visualizes the first-stage mechanism metrics behind this interpretation, while Appendix Figure A.2 shows why the second-stage check remains supportive rather than a separate downstream conclusion.

This interpretation follows the logic of Loy, Weiss, and Glauben: retail asymmetry or rigidity can reflect market power, but it can also reflect menu costs, search costs, mistake costs, perishability, stock-out risks, and promotional strategy (Loy, Weiss, and Glauben 2016). The policy-relevant conclusion therefore concerns risk allocation and transparency, not only final shelf prices (Loy, Weiss, and Glauben 2016; Loy 2023). H2 is therefore supported as a layered downstream mechanism: official monthly evidence supports filtering for sour cream and drinking milk, the Prozorro-to-consumer model adds an institutional procurement bridge, and Prozorro-to-retail plus discount models show how consumer-visible adjustment can be managed in the short retail window.

6.6. Whole-chain and robustness evidence

Whole-chain evidence is used only as a boundary check. The product-level VECM confirms why the thesis uses a layered design: for drinking milk, the farm-gate-processor-consumer system has 107 observations but no cointegration rank, so it cannot support a full-chain equilibrium claim. For sour cream, the same system and same amount of observations with one cointegrating relation, with adjustment coefficients of -0.025 for farm-gate, 0.02 for processor, and 0.019 for

consumer prices. This means sour cream is the clearest full-chain case, but it is not stronger than the core monthly pairwise models.

The same direction is shown by aggregate weekly models. The farm-gate-to-producer index supports the H1 conclusion that upstream shocks reach processors, since long-run coefficient around 0.88 and statistically significant ECT near -0.046 to -0.049. The producer-to-procurement index is also strong but shorter (37-39 observations), long-run coefficients around 0.88 in ECM and 1.27-1.43 in NARDL, and fast correction between -0.57 and -1.32. This indicates that processor-level and procurement prices are significantly tied, while procurement rules, volumes, and timing can still shape the observed price. Prozorro prices can react strongly to processor-side price pressure, but the short sample makes it mechanism evidence.

Downstream robustness is more mixed, and the farm-gate-to-downstream aggregate extension has a long-run coefficient around 1.16 and significant correction between -0.153 and -0.213, while producer-to-downstream NARDL gives long-run coefficients around 1.5 with correction around 0.3. These results show that the broader chain is connected as well. However, what should not be read as literal negative pass-through, it is procurement-to-downstream NARDL with negative long-run coefficients around -1.2. Economically, it indicates that procurement and downstream prices can be moved in different direction by contract timing, product composition, public-budget constraints and retail strategy.

Local-projection checks reinforce this hierarchy: farm-gate-to-producer responses are the most stable with the mean coefficient is 0.93, the median is 0.95 across 20 models. By contrast, Prozorro-to-retail links are weak: retail-baseline and retail-observed variants have mean coefficients around -0.06, median coefficients around -0.04, and zero significant share. This also supports the main result: the upstream chain transmits price pressure more reliably than the retail-

facing chain. To support use of these outputs as validation checks (not new equilibrium claims), Appendix Table A.6 and Appendix Figure A.4 cover reconstruction and retail-holdout diagnostics.

The global context matters for interpreting these findings, because dairy is exposed to import competition (Litvinov 2025a; USDA FAS 2025), EU market cycles (EC DG AGRI 2026a; EC DG AGRI 2026b; EC DG AGRI 2026c), wartime logistics, energy costs, and product-specific tradability factors (Tarassevych 2024). Therefore, any Ukrainian full-chain model cannot be expected to behave like one closed domestic equilibrium. The robust conclusion is narrower and stronger: H1 is supported because farm-gate and processor prices move together consistently, while H2 shows that downstream transmission exists but is filtered through official consumer prices, procurement timing, product matching, retail promotion, and institutional constraints.

The consequence is clear for Ukrainian dairy: market power should be interpreted as control over adjustment and risk allocation, not only as markup in final price. Whole-chain and robustness models confirm that the chain is economically connected, but they also explain why official monthly pairwise evidence must remain primary and why procurement and retail evidence should be treated as mechanism evidence.

Chapter 7

CONCLUSIONS

This thesis began from a practical policy problem: in a wartime food economy, bargaining power in dairy is not visible only in final consumer prices (Cabinet of Ministers of Ukraine 2024; Filipenko 2023; Litvinov 2025b). It can appear in the timing of adjustment, the distribution of risk between farms, processors, public buyers, and retailers, and the channel through which shocks become visible (Sexton 2013; Loy 2023; Litvinov 2025b). The empirical answer is therefore deliberately precise. Ukrainian dairy price transmission is real, but it is not a single farm-to-retail pipeline. It is strongest at the farm-to-processor interface and more heterogeneous downstream, where procurement and promotional mechanisms partly determine when and how shocks become visible.

The first contribution of the thesis is to turn the sector diagnosis from KSE's work on dairy work into an econometric chain-layered evaluation (Litvinov 2025a; Litvinov 2025b). This thesis covers the structural transformation of Ukrainian dairy comparing short-term and long-term data on different chain stages. Taking into account the key market-defining facts from the first volume KSE Eurointegration 2.0: the decline of household milk, the growing importance of professional farms, quality and safety pressure, processing constraints, regional concentration, and EU-alignment needs (Litvinov 2025a). While the second volume identifies bottlenecks in transparency, delayed retail payments, unstable contracts, underinvestment, and fragmented state support (Litvinov 2025b). This thesis adds more narrow, but also more empirical point: each of those bottlenecks

matter because they shape how price shocks are passed, delayed, absorbed, or transformed along the chain (Litvinov 2025a; Litvinov 2025b).

H1 is supported with the strongest evidence in the thesis: in observed national monthly data, farm-gate raw milk prices are closely linked to processor-level dairy prices. For H1, the decisive evidence is the monthly ECM/TECM almost complete long-run elasticity in economically admissible farm-to-processor link. Drinking milk, hard cheese, and sour cream are the reliable core results, which are large enough (long-run coef. around 0.9) to reject the idea that raw-milk prices and processor prices are unrelated. These products form the core H1 evidence because their processor prices depend closely on regular, quality-controlled raw milk. Taken together, the ECM/TECM, asymmetric, and robustness results show that the farm-to-processor link is the main point where price shocks are absorbed and reallocated, so H1 reflects not only co-movement but also the market position of processors in managing raw-milk adjustment.

The economic interpretation of H1 is not that processors always exploit farmers or that every shock is fully shifted in one month. The more defensible conclusion is that the farm-to-processor interface is the clearest location where bargaining conditions are visible in prices. Raw milk is perishable, local buyer alternatives are limited, and formal processing increasingly depends on stable high-quality enterprise milk. When processor-level prices move strongly with farm-gate prices but adjustment is slow or product-specific, short-run risk can remain with farms even when long-run co-movement exists. This directly complements the KSE bottleneck argument about weak contracting and the difficulty of building predictable investment incentives upstream (Litvinov 2025a; Litvinov 2025b; FAO 2013).

For H2, the clearest downstream evidence comes from official processor-to-consumer models, especially sour cream, while Prozorro-to-consumer milk results show an institutional procurement bridge rather than ordinary retail pass-

through. Official processor-to-consumer evidence is strongest for sour cream, where the retained coefficient is 1.2 but correction is slow. Drinking milk provides supporting downstream evidence through the official processor-consumer coefficient of 0.9 and the new Prozorro-to-consumer weekly coefficient of 0.8, which captures an institutional procurement-consumer bridge over 2023-2026. The asymmetric, procurement, retail-promotion, and VECM results make the conclusion more market-specific: downstream power appears mainly through timing, contract design, tender structure, promotion strategy, and baseline repricing, not through one stable retail elasticity. (Appendix Tables A2, A3, A5, and A6; Appendix Figures A1, A2, and A4).

This distinction makes the final finding more useful for applied interpretation. The thesis does not show a simple markup story. It shows a chain-governance problem. Upstream, the relevant issue is whether farms have enough bargaining space, contract stability, cooling capacity, and buyer alternatives to avoid absorbing price risk (FAO 2013; Litvinov 2025a; Litvinov 2025b). Downstream, the relevant issue is whether payment terms, procurement design, promotion funding, and retail category management shift liquidity and risk back to processors and farms while keeping consumer prices apparently stable (Litvinov 2025b; Loy 2023).

The thesis does not prove unlawful conduct, observe confidential margins, marginal costs, bilateral contracts, listing fees, supplier-funded promotions, payment schedules, or firm-level dominance, so it can be used only as supporting evidence for the AMCU case (Antimonopoly Committee of Ukraine 2023; AMCU Northern Interregional Territorial Department 2015; AMCU Western Interregional Territorial Department 2023). Its clearest product-level conclusion is that farm-to-processor market-power-consistent price adjustment is most visible for drinking milk, hard cheese, and sour cream. Downstream, procurement and retail evidence is more mechanism-based and product-specific.

Market power in this dairy chain should be interpreted as control over adjustment. At the farm-to-processor interface, control appears through the speed and completeness with which raw-milk pressure becomes processed-product prices. At the procurement interface, control appears through contract timing, delayed payment, and tender design. At the retail interface, it appears through discounts and the choice between baseline repricing and promotional repricing. This is why a market-power thesis should not look only at consumer price inflation. It must also look at who finances the delay (Sexton 2013; Loy, Weiss, and Glauben 2016; Litvinov 2025b).

The main economic conclusion is that price formation in the dairy chain is not separated from investment incentives. If farms face unstable procurement, weak pricing formulas, delayed adjustment, and few outside buyers, they have less reason and less capacity to invest in herd quality, cooling equipment, productivity, and EU-standard compliance (Litvinov 2025b; Nivievskyi 2012). If processors face delayed downstream payments, stronger retail bargaining, and uncertain pass-through to final prices, they also have weaker capacity to finance modernization and long-term raw-milk contracts (Litvinov 2025b; Nivievskyi 2012). This is where the thesis adds to the existing analysis discussion of dairy-sector bottlenecks: weak coordination is not only a general competitiveness problem. Since shocks do not move neutrally through the chain, but are redistributed between farmers, processors, procurement buyers, retailers, and consumers while the chain is adjusting – it reveals price transmission.

Together, the upstream adjustment reveals through slow, product-specific farm-to-processor correction — drinking milk, hard cheese, and sour cream with reliable near-unit pass-through. The downstream adjustment happens through selective pass-through, where sour cream is strongest, milk is supportive, and procurement and retail mechanisms remain weak. The contribution is a disciplined price-transmission map of Ukraine's dairy chain, where market power

is a conditional interpretation supported only when all factors align. The results indicate that drinking milk and sour cream exhibit the strongest and most policy-relevant price transmission across the dairy chain, hard cheese primarily reflects processor bargaining power, while kefir, SMP, and butter provide procurement-channel sensitivity evidence (Tables 7–9; Figures 14–20; Appendix Tables A.2–A.5; Appendix Figures A.1–A.2).

The final conclusion is therefore not that Ukraine's dairy-sector problem is only production decline, import pressure, or EU compliance. These factors matter, but they do not fully explain how value is created and redistributed inside the chain. The deeper problem is coordination under asymmetric bargaining conditions. Risks are distributed unevenly: farmers face perishability and limited local outside options, processors face product transformation and delayed downstream payments, while retailers and procurement buyers can influence when and how price changes become visible. The thesis contributes by identifying the price-adjustment channels through which these structural bottlenecks become economically costly. It moves the discussion from describing weaknesses in the dairy sector to showing where those weaknesses appear in prices, which products reveal the clearest transmission, and which chain levels absorb shocks before they reach the final consumer (Litvinov 2025a; Litvinov 2025b).

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APPENDIX

Table A.1. Appendix-only DOLS and local-projection robustness checks

H	Link	Product	Model		n	Coef	p	Coint p	R2
1	FG -> Prozorro	butter	DOLS		33	1.480	3.15e-63	0.084	0.868
1	FG -> Prozorro	butter	LP month	h=1	33	-0.026	0.935		0.040
1	FG -> Prozorro	butter	LP month	h=3	31	-0.095	0.647		0.014
1	FG -> Prozorro	butter	LP month	h=6	28	-1.149	2.58e-05		0.164
1	FG -> Prozorro	condensed milk	DOLS		31	0.545	3.46e-07	0.024	0.481
1	FG -> Prozorro	condensed milk	LP month	h=1	31	0.480	0.011		0.156
1	FG -> Prozorro	condensed milk	LP month	h=3	29	0.175	0.463		0.199
1	FG -> Prozorro	cottage cheese	DOLS		33	0.324	0.023	2.06e-04	0.213
1	FG -> Prozorro	cottage cheese	LP month	h=1	33	0.084	0.761		0.024
1	FG -> Prozorro	cottage cheese	LP month	h=3	31	0.035	0.914		0.064

Table A.1 - Continued

H	Link	Product	Model	n	Coef	p	Coint p	R2
1	FG -> Prozorro	cottage cheese	LP h=6 month	28	-0.702	0.058		0.111
1	FG -> Prozorro	drinking milk	DOLS	33	0.852	1.76e-34	0.086	0.858

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series and Prozorro public procurement records.

Table A.2. Significant appendix-only screened outputs

H	Link	Product	Model	n	Coef	p	ECT	ECT p
2	FG UA -> Prozorro	condensed milk	LP linear	266	18.52	0.038		
2	FG UA -> Prozorro	cottage cheese	LP linear	254	25.76	4.70e-04		
1	long eq.	sour cream	extra long equi.	209	0.995	0.000		
1	long eq.	milk	extra long equi.	209	0.974	0.000		
1	long eq.	hard cheese	extra long equi.	209	0.980	0.000		
2	Retail comb -> Prozorro	cream	NARDL	83	-0.170	0.010	-0.199	0.010
2	Retail comb -> Prozorro	cheese	NARDL	83	-0.922	0.005	-0.169	0.005
2	Prod -> Retail comb	milk	NARDL	83	-23.61	0.018	-0.428	0.018
2	Retail comb -> Prozorro	milk	ECM	83	0.003	0.003	-0.205	0.003
2	Prozorro -> Retail comb	milk	ECM	83	0.017	0.012	-0.426	0.012

Table A.2 - Continued

H	Link	Product	Model	n	Coef	p	ECT	ECT p
2	Prozorro -> Retail comb	cream	NARDL	83	-3.628	0.023	-0.126	0.023
2	Prod -> Retail comb	cheese	NARDL	83	-22.17	0.026	-0.202	0.026

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series, Prozorro public procurement records, and author-scraped Silpo/Novus retailer web-widget datasets.

Table A.3. Borderline non-headlined screened outputs

H	Link	Product	Model	n	Coef	p	ECT	ECT p
2	Prod UA -> Prozorro	cheese	LP linear	261	19.77	0.051		
2	Prozorro -> Silpo	butter	LP linear	42	0.134	0.054		
2	Prozorro -> Retail comb	cheese	NARDL	83	-0.228	0.054	-0.173	0.054
2	Prod UA -> Prozorro	milk powder	LP linear	59	0.337	0.055		
2	FG UA -> Prozorro	cream	LP linear	264	25.92	0.055		
2	FG UA -> Prozorro	hard cheese	LP linear	260	-10.30	0.058		
2	Silpo -> Prozorro	cottage cheese	LP linear	47	-0.732	0.058		
2	Prozorro -> Novus	hard cheese	LP linear	39	1.431	0.058		
2	Prozorro -> Retail match	milk	LP linear	62	0.508	0.060		
2	Retail+Cons -> Prozorro	sour cream	LP linear	60	-1.294	0.061		
2	Retail comb -> Prod	cheese	ECM	69	-0.063	0.061	-0.023	0.061

Table A.3 - Continued

H	Link	Product	Model	n	Coef	p	ECT	ECT p
2	Silpo -> Prozorro	sour cream	LP linear	47	-0.879	0.064		

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series, Prozorro public procurement records, and author-scraped Silpo/Novus retailer web-widget datasets.

Table A.4. Appendix-only first-stage threshold mechanism metrics

Link	Product	n	Speed	Asym	Pos ECT	Pos p	Neg ECT	Neg p
FG -> Prozorro	butter	34	0.489	0.460	-0.259	0.550	-0.719	0.154
FG -> Prozorro	condensed milk	32	0.799	-0.224	-0.911	8.89e-05	-0.687	0.027
FG -> Prozorro	cottage cheese	34	0.693	0.207	-0.589	0.007	-0.796	0.009
FG -> Prozorro	drinking milk	34	0.405	0.480	-0.165	0.594	-0.645	0.024
FG -> Prozorro	hard cheese	34	0.695	-0.755	-1.073	1.28e-07	-0.318	0.370
FG -> Prozorro	kefir	32	0.747	-0.856	-1.175	2.16e-09	-0.319	0.113

Table A.4 - Continued

Link	Product	n	Speed	Asym	Pos ECT	Pos p	Neg ECT	Neg p
Prozorro -> Cons	drinking milk	37	0.147	0.295	0.003	0.956	-0.292	0.001
Prozorro -> Retail	butter	46	0.710	0.730	-0.345	0.161	-1.075	0.018
Prozorro -> Retail	butter	52	0.510	-0.079	-0.549	0.015	-0.470	0.227
Prozorro -> Retail	condensed milk	46	1.206	0.272	-1.070	4.83e-04	-1.343	5.47e-05
Prozorro -> Retail	condensed milk	50	0.158	0.316	0.149	0.812	-0.167	0.804
Prozorro -> Retail	cottage cheese	46	1.031	-0.513	-1.287	3.30e-05	-0.774	0.001

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series, Prozorro public procurement records, and author-scraped Silpo/Novus retailer web-widget datasets.

Table A.5. Loy-style second-stage and VECM numeric checks

Block	Target	Term/status	n	Coef/rank	p	alpha FG	alpha Proc	alpha Cons/R2
Loy stage2	speed measure	const	27	0.403	6.98e-04			0.151
Loy stage2	speed measure	perishable	27	-0.150	0.355			0.151
Loy stage2	speed measure	retail link	27	0.299	0.047			0.151
Loy stage2	asymmetry measu.	const	27	-0.044	0.737			0.029
Loy stage2	asymmetry measu.	perishable	27	-0.043	0.805			0.029
Loy stage2	asymmetry measu.	retail link	27	0.145	0.413			0.029
VECM	drinking milk	no cointegration ra.	107	0				
VECM	sour cream	estimated	107	1		-0.025	0.020	0.019

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series, Prozorro public procurement records, and author-scraped Silpo/Novus retailer web-widget datasets.

Table A.6. Reconstruction validation and holdout diagnostics

Block	Comparison	n	Corr	MAE	RMSE	MAPE/ Act	Sign/Pred
Val.	FG(prior) vs observed Farm milk 2015	46	0.963	1.397	1.665	9.498	0.733
Val.	Prod(prior) vs Proc price: butter	50	0.886	23.82	38.27	10.11	0.653
Val.	Prod(prior) vs Proc price: drinking.	50	0.839	2.184	3.863	7.402	0.653
Val.	Prod(prior) vs Proc price: hard che.	50	0.783	15.73	23.52	7.933	0.673
Val.	Prod(prior) vs Proc price: kefir	50	0.912	1.878	3.007	5.599	0.694
Val.	Prod(prior) vs Proc price: skim mil.	50	0.512	7.699	11.31	7.917	0.755
Val.	Prod(prior) vs Proc price: sour cre.	50	0.898	5.655	9.446	6.832	0.612
Val.	Cons(prior) vs Cons 2017 2026: drin.	50	0.882	3.103	4.975	7.685	0.653
Hold.	Hard cheese Novus	19		0.398	0.545	0.041	0.002
Hold.	Hard cheese Silpo	2		0.074	0.100	0.046	-0.021
Hold.	Milk / fermente. Novus	20		0.222	0.294	-0.003	-0.013
Hold.	Milk / fermente. Silpo	2		0.052	0.058	0.007	-0.019
Hold.	Sour cream Novus	15		0.078	0.097	0.008	-0.053

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series and author-scraped Silpo/Novus retailer web-widget datasets.

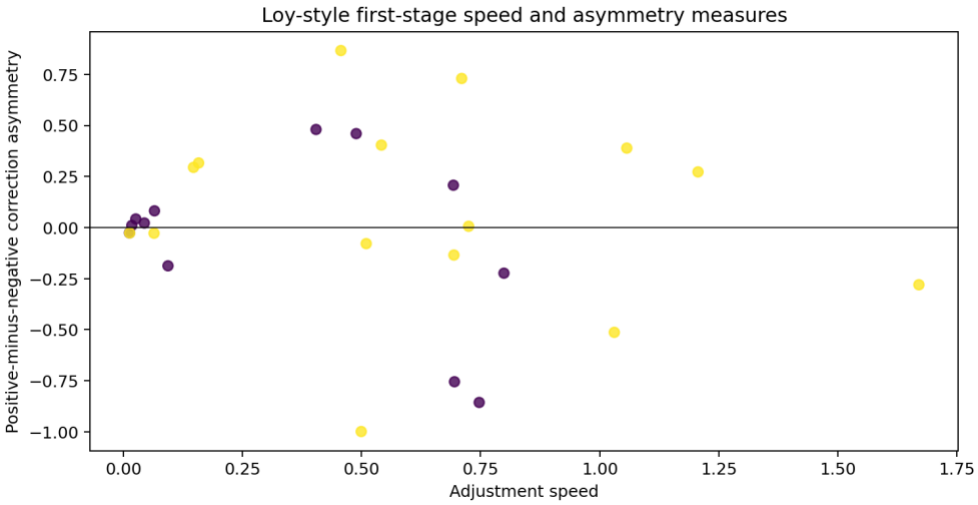


Figure A.1. Loy-style first-stage mechanism metrics.

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series, Prozorro public procurement records, and author-scraped Silpo/Novus retailer web-widget datasets.

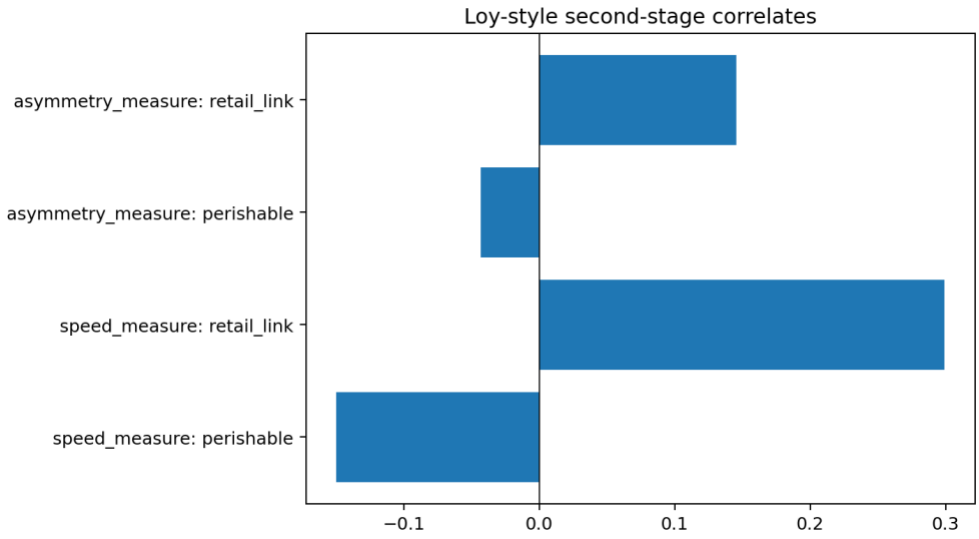


Figure A.2. Loy-style second-stage mechanism check.

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series, Prozorro public procurement records, and author-scraped Silpo/Novus retailer web-widget datasets.

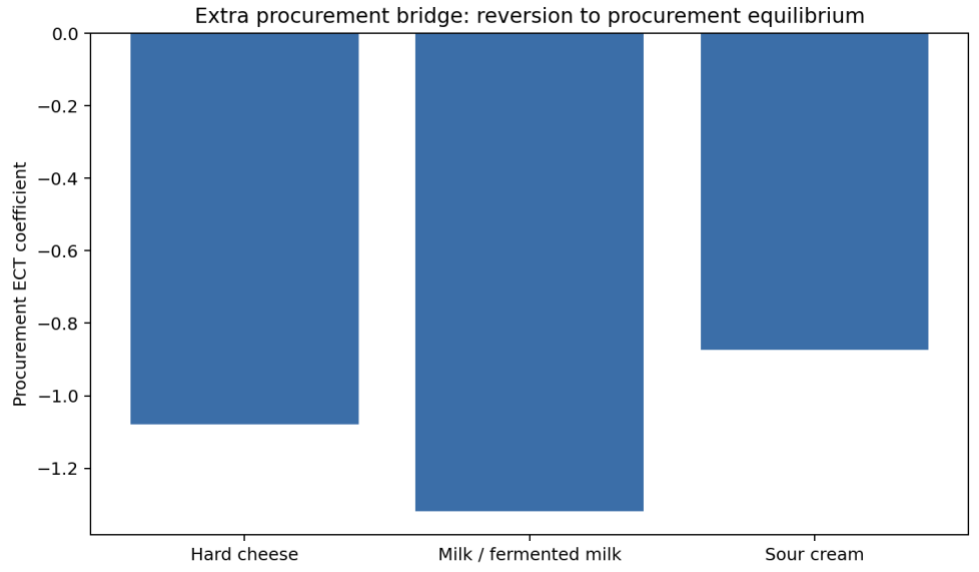


Figure A.3. Reconstructed Prozorro bridge error-correction coefficients.

Source: Author's calculations based on State Statistics Service of Ukraine (SSSU) official price series and Prozorro public procurement records.

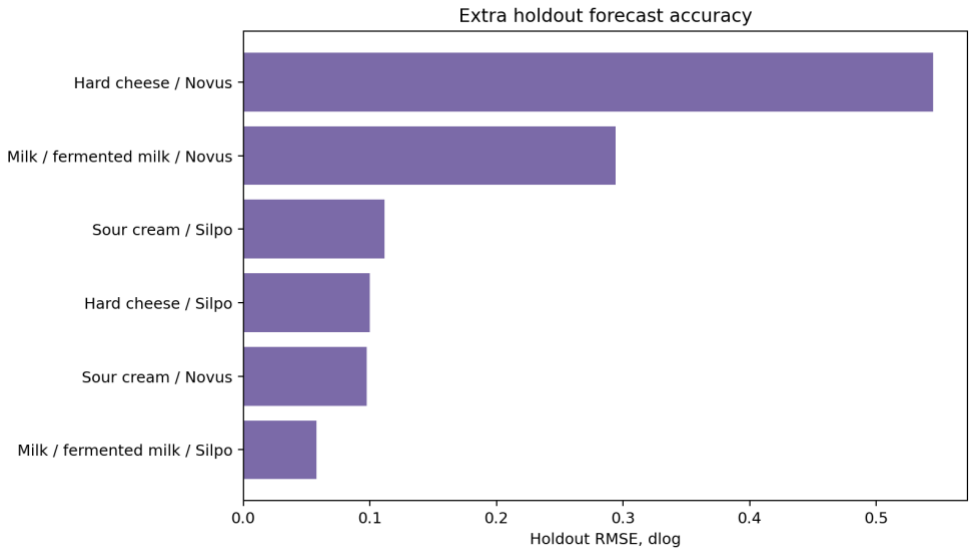


Figure A.4. Retail holdout forecast RMSE.

Source: Author's calculations based on author-scraped Silpo/Novus retailer web-widget datasets.