An Unpleasant Inflationary Dynamics

M. Ege Yazgan
Department of Economics, Istanbul Bilgi University, Türkiye
ege.yazgan@bilgi.edu.tr

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Abstract

This article analyzes the Turkish economy, which has faced significant exchange rate shocks since late 2018, resulting in concerning inflation trends. We utilize a time-varying coefficient vector error correction model that examines both service and goods inflation, as well as the long-run relative price ratio. Our findings suggest that, initially, service inflation was primarily driven by its own persistent effects. However, it has increasingly been influenced by goods inflation, fluctuations in exchange rates, and imbalances in the long-term relationship between relative price levels. In contrast, goods inflation has consistently been affected by its own inertia and exchange rate shocks, showing notable increases in both of those coefficients during this period.

In this new environment, where exchange rate shocks affect both sectors, the disproportionate pass-through effects can disrupt the long-run equilibrium of relative prices. As a result, service inflation may overshoot in an effort to correct the resulting imbalance, complicating the dynamics of inflation. This new interdependence also makes it more challenging to control overall inflation and hinders disinflation efforts.

Service Inflation; inflation; exchange rates; monetary policy; cointegration
E31; F31; E52; E58; C32

1 Introduction

For many decades, one of the significant problems in the Turkish economy has been high and chronic inflation. Following the severe economic crisis of 2001, the policies implemented afterward succeeded in reducing inflation to single-digit levels by 2003. From 2003 onward, Türkiye maintained inflation around single-digit levels in a relatively stable manner. However, starting in mid-2018, inflation gradually began to rise again. This increase was primarily due to an abrupt exchange rate shock that hit the economy after a brief political tension between the United States and Turkey, in September, 2018. Following this shock, a series of subsequent exchange rate fluctuations and an unconventional monetary policy experiment pushed inflation higher, exceeding 80 percent.

After implementing an unconventional monetary policy characterized by extremely high real negative interest rates for 1.5 years, during which inflation continued to rise, Türkiye began adopting a conventional disinflation program in June 2023. This new program gradually increased interest rates, achieving positive real interest rates similar to those seen in traditional disinflation programs. However, despite being in place for more than 1.5 years, this disinflation program resulted in inflation only decreasing to around 30 percent by December 2025.

During this period, concerning inflationary dynamics also emerged. There was a noticeable increase in the way exchange rate changes affected both service and goods inflation. Additionally, over the long term, service prices began to catch up with goods prices. Both of these factors contribute to the persistence of headline inflation, making it challenging to implement the ongoing disinflation program.[1]. In this article, we analyze these unpleasant dynamics of inflation in Turkey.

The article argues that these dynamics can largely explain the ongoing inflation and the slow progress of the disinflation program. We also present econometric evidence using a time-varying coefficient vector error correction model (TVC-VECM), which supports our proposed dynamics. Section 2 provides an overview of the inflationary episode; Section 3 illustrates the time-series model and estimation process; and Section 4 concludes the discussion.

2 An overview of Türkiye's Inflation

As illustrated in Figure 1, in September 2018, an exchange rate shock abruptly pushed inflation to around 25 percent, up from 10 to 12 percent. However, the Central Bank's interest rate hikes and the subsequent recession brought inflation under control. After this episode, inflation remained in single digits for only a few months. Influenced also by the COVID-19 pandemic, inflation fluctuated within the 10–20 percent range until the end of 2021.

Figure 1 here

With another exchange rate shock in December 2021, inflation began to rise again and rapidly exceeded 80 percent. Despite this surge, the Central Bank resisted raising interest rates and instead opted to cut them. This experiment in monetary policy takes an unconventional approach, with the expectation that lower interest rates will help control inflation by influencing supply-side factors. Policymakers believed that interest rates set well below inflation would stimulate investment and production, thereby reducing inflation. Although the anticipated supply-side increase did not materialize, inflation initially shot up. After peaking in October 2022, it declined until mid-2023 as the Central Bank managed to contain the rise in the exchange rate.

[1]See [3] for a similar emphasis on increasing pass-through effects of exchange rates on service inflation in Türkiye

In mid-2023, the Central Bank abandoned this radical monetary policy stance and began to raise interest rates gradually. However, at this stage, a new exchange rate shock emerged, pushing inflation upward once again. Although higher interest rates were used in an attempt to bring inflation under control, only limited success was achieved. By the end of 2025, inflation had fallen to around 30 percent.

This period was also marked by frequent changes in Central Bank governors, which made it difficult to establish a consistent and stable policy framework. Figure 1 illustrates the Central Bank's policy rate, the year-on-year (YoY) Consumer Price Index (CPI) inflation rate, and the nominal exchange rate growth (YoY).[2], along with the names and periods of the Central Bank governors.[3]

Numerous academic studies indicate that exchange rate depreciation has significantly influenced inflation in Türkiye.[4] However, the impact of the exchange rate on inflation is not uniform across all components of the Consumer Price Index (CPI). Generally, the effect is more pronounced for traded goods, while it tends to be much weaker for services that are less involved in or not exposed to international trade. However, as mentioned previously, new inflationary dynamics has changed this situation, and service inflation has also become sensitive to exchange rate fluctuations. Figure 2 illustrates the trends in inflation for goods and services alongside changes in the exchange rate.

Figure 2 here

There are four noticeable exchange rate shocks that appear in Figure 2: September-October 2018 (USA-Türkiye political tension); November 2020 (exchange rate shock and COVID); January 2022 (unconventional monetary policy); mid-2023 and the beginning of 2024 (monetary policy change and exchange rate shock). In 2018 the rise in the exchange rate influenced both services and goods inflation, with a noticeably stronger effect on goods inflation. Despite this, the pass-through effect for both inflation measures was incomplete; the impact on services inflation was significantly more limited compared to that on goods inflation. A similar trend was observed in 2020, where the rising exchange rate did not lead to an increase in services inflation, while the pass-through to goods inflation remained limited.

In contrast, the exchange rate shock at the January 2022 resulted in a full pass-through to goods inflation. Additionally, there was a substantial, albeit not complete, pass-through effect for services inflation as well. The exchange rate shock in 2023 exhibited full pass-through to goods inflation once again, and surprisingly, the pass-through to services inflation occurred at a larger level than in exchange rate depreciation.

This figure clearly shows that whereas exchange rate shocks in the past were reflected in inflation only in a limited manner and primarily through goods prices, successive large shocks caused this effect to spread to services inflation, ultimately leading to a services inflation pass-through coefficient exceeding 100 percent. In this article, we examine this surprising inflation dynamic using an econometric model illustrated in the subsequent sections.

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[2]All data are sourced from the Turkish Statistical Institute.

[3]The nominal exchange rate represents the simple average of Euro/TL and USD/TL rates, while the policy rate refers to the average funding rate of the Central Bank. Governor Fatih Karahan continues in his role, and it should be noted that none of the previous governors depicted in Figure 1 completed their terms.

[4]See [3], [1], [8], [11] among others.

3 Price of Goods and Services TVC-VECM Analysis

In this section, we first shift our analysis from inflation in goods and services to the price levels of these items. Our focus will be on the long-term trends of these price indices and their relationship over time. Figure 3 illustrates the long-term movement of price levels for goods (P_t^g) and services (P_t^s) on the left axis, alongside their ratio (P_t^s/P_t^g) on the right axis, covering the period from January 2005 to December 2025.

Figure 3 here

As shown in Figure 3, until the exchange rate shock in January 2022, the relative prices of goods and services (P_t^s/P_t^g) appeared stable, fluctuating between 1.2 and 1.0 with a slight linear negative trend. This negative trend can be partially attributed to the Balassa-Samuelson effect[5] and the limited impact of exchange rate shocks on the prices of goods in 2018 and 2020.

At the beginning of 2022, an exchange rate shock caused a complete pass-through effect on the prices of goods, while the impact on services was not as thorough. Consequently, the ratio of goods prices to services prices decreased significantly to 0.75. This event marked the most substantial exchange rate shock affecting the relative prices of goods and services, establishing a new low for this ratio. Since then, relative prices have started to rise again, fueled by stronger pass-through effects and higher inflation rates in services compared to goods prices.

3.1 TVC-VECM

In this section, we estimate the following TVC-VECM:

$$\begin{aligned}
\Delta p_t^s &= \beta_{0,t}^s + \beta_{1,t}^s \Delta p_{t-1}^s + \beta_{2,t}^s \Delta p_{t-1}^g + \beta_{3,t}^s \Delta e_t \\
&\quad + \lambda_{t-1}^s \big[p_{t-1}^s - \alpha_1 p_{t-1}^g - \alpha_2 (t-1)\big] + \epsilon_t^s, \\
\Delta p_t^g &= \beta_{0,t}^g + \beta_{1,t}^g \Delta p_{t-1}^s + \beta_{2,t}^g \Delta p_{t-1}^g + \beta_{3,t}^g \Delta e_t \\
&\quad + \lambda_{t-1}^g \big[p_{t-1}^s - \alpha_1 p_{t-1}^g - \alpha_2 (t-1)\big] + \epsilon_t^g,
\end{aligned} \tag{1}$$

where p_t^g, p_t^s, and e_t represent the logarithms of the price indices for goods and services, and the nominal exchange rate, respectively. The variable t denotes the linear trend term, while ϵ_t is the standard disturbance term. The symbol Δ indicates the difference operator.

The expression $(p_{t-1}^s - \alpha_1 p_{t-1}^g - \alpha_2 t)$ describes the long-run relationship between the price levels of goods and services. In Equation (1), all coefficients are time-varying except for the long-run coefficients α_1 and α_2.

We adopt a two-stage estimation approach for Equation (1). In the first stage, we estimate the time-invariant long-run components, and in the second stage, we estimate the time-varying short-run coefficients using rolling regressions.

3.1.1 Long-Run Estimation

To analyze the long-run relationship between goods and service price levels, we first test whether the price indices p_t^g and p_t^s contain a unit root. Our findings indicate that both indices are indeed

[5] The Balassa-Samuelson hypothesis suggests that if a country experiences higher productivity growth in its tradable sector compared to its non-tradable sector, the real exchange rate (P_t^s/P_t^g) will appreciate. This means that services, which typically have lower productivity, will become more expensive relative to goods, which have higher productivity. In this context, the price of goods is associated with tradables, while the price of services is linked to non-tradables, (see [7]).

$I(1)$.[6]

Next, we apply Johansen ([4], [5]) cointegration tests and estimation, by incorporating a restricted linear trend term into the cointegration space and leaving the intercept as unrestricted.[7] Additionally, we include the growth rate of the exchange rate, Δe_t, as an exogenous variable in the short-term component of VECM as in Equation (1). The results are presented in Table 1.

Table 1: Likelihood Ratio Cointegration Tests

	Trace Test		Maximal Eigenvalue Test	
Hypotheses	Statistic	p-value	Statistic	p-value
$H_0 : r = 0$ vs $H_1 : r \geq 1$	76.323	0.000	75.163	0.000
$H_0 : r \leq 1$ vs $H_1 : r = 2$	1.161	0.998	1.161	0.998

Both Likelihood Ratio (LR) tests reject the null hypothesis that the cointegration rank is zero ($r = 0$) in favor of the alternative hypothesis, which suggests the presence of one cointegration vector.[8]

Having established that p_t^g and p_t^s are cointegrated, the Johansen method is used to estimate the following long equation:

$$p_t^s - \underset{(0.047)}{1.436} p_t^g + \underset{0.0005}{0.0041} t \sim I(0) \tag{2}$$

The values in parentheses below the parameters α_1 and α_2 refer to the standard errors. Since we have only one cointegration vector we do not have an identification issue and we normalize the cointegration vector on p_t^s.[9]

Although α_1 is estimated as -1.436, we want to test the over-identifying restrictions on this coefficient. While we do not have a theoretical value for this relationship, we believe that a value lower than -1.436 may be more reasonable. Therefore, we conducted a grid search and discovered that imposing the value $\alpha_1 = -1.35$ resulted in a LR test statistic of $\chi^2(1) = 2.259$ with a p-value of 0.133. This p-value indicates that we can proceed to the second step of our estimation using the following long-run relationship:

$$p_t^s - 1.35 p_t^g + \underset{0.0002}{0.0033} t \sim I(0) \tag{3}$$

3.1.2 Rolling Estimation of Time Varying Coefficients of VECM

In the second step, we estimate equations in (1) by imposing the long-run parameters obtained from Equation (3) and conducting rolling OLS regressions with a fixed window size. Since we set the window size to 7 years (84 months), the initial rolling regression spans from March 2005 to January 2012. As a result, the time-varying parameter estimates begin from February 2012 and continue until December 2025.

[6] We employed several unit root tests, including the Augmented Dickey-Fuller (ADF) test, the Dickey-Fuller GLS (ERS) test, and the Elliott-Rothenberg-Stock Point Optimal test statistics. The detailed results are available upon request to save space.

[7] See also, [6], [2].[10] and [9] also suggest that this specification should be preferred when there is an apparent trend in the data, which applies to both price levels in our analysis.

[8] The hypothesis of $r \leq 1$ cannot be rejected has a p-value equal to 0.998, as expected, since both of p_t^g and p_t^s are found $I(1)$

[9] There is no a priori theoritical reason, but the following empirical results support this choice. We present evidence on the long-run weak exogeneity of p_t^g., see Figure 5.

The parameter estimates and their 2 times standard error bands of $\beta^s_{1,t}, \beta^s_{2,t}, \beta^s_{3,t}$, and λ^s_t of Δp^s_t equation are illustrated in Figure 4.[10]

Figure 4 here

All the parameter estimates for the equation Δp^s_t, presented in Figure 4, demonstrate significant changes at the times of exchange rate shocks and resemble step functions. The coefficient representing the effect of lagged service inflation (Δp^s_{t-1}), indicates significant persistence or inertial effects observed before 2018, prior to the large exchange rate shocks that impacted the Turkish economy. This coefficient had the greatest influence in terms of magnitude compared to the other three variables in this period; however, its effect diminishes over time and does not consistently appear to be significant in more recent periods, particularly following the last exchange rate shock that occurred in mid-2023.

In contrast, the coefficient which is associated with lagged good inflation (Δp^g_{t-1}), jumps abruptly and becomes statistically significant right after the exchange rate shock of January 2022. A similar sudden increase occurs in the coefficient of exchange rate growth (Δe_t). Its parameter also experiences a jump at the beginning of 2022 and becomes statistically significant.

Additionally, the jump at the beginning of 2022 is apparent for λ^s_t, which represents the error correction coefficient. This coefficient indicates the speed of adjustment for service inflation and shows a significant increase with the correct sign after the exchange rate shock in January 2022. The negative sign of the error correction coefficient reflects that service inflation responds to long-run disequilibrium in a corrective manner once it is disturbed.

Figure 4 demonstrates the intriguing dynamics of service inflation over time in response to various exchange rate shocks. These shocks seem to have transformed service inflation from being primarily inertial—dependent only on its own past values—into being influenced by exchange rate fluctuations, either directly or indirectly through changes in goods prices. Furthermore, service inflation has shown increased sensitivity to deviations from long-run equilibrium, indicating that its catching-up behavior has become more significant in shaping its trends.

Similarly the parameter estimates for $\beta^g_{1,t}, \beta^g_{2,t}, \beta^g_{3,t}$, and λ^s_t in the Δp^g_t equation are illustrated in Figure 5.

Figure 5 here

The coefficient $\beta^g_{1,t}$, which reflects the impact of lagged service inflation (Δp^s_{t-1}) on goods inflation (Δp^g_t), consistently shows no significance. This suggests that service inflation does not affect goods inflation. Similarly, the error correction term, λ^g_t, has never been statistically significant, indicating that goods inflation is weakly exogenous in the long run.

On the other hand, the coefficient estimates of Δp^g_{t-1} and Δp^e_t exhibit increases, similar to the equation for Δp^s_t, and have become highly significant in recent periods. It appears that goods inflation is primarily influenced by its lagged inflation and exchange rate growth, and this dependency has intensified over time, especially following the exchange rate shocks that occurred after the end of 2018.

[10] The estimates of intercept terms, $beta^s_{0,t}$ and $beta^g_{0,t}$ are excluded from Figure 4 and 5.

4 Conclusions

In this article, we demonstrate that the Turkish economy, which has experienced a series of severe exchange rate shocks since late 2018, has developed concerning inflationary dynamics. Initially, service inflation was primarily driven by its own inertial effects. During this period, exchange rate shocks could be contained within goods inflation, and services did not respond to exchange rate fluctuations. However, services inflation has now also become influenced by goods inflation, exchange rate fluctuations, and imbalances in the long-term relationship of relative price levels. This new interdependency complicates efforts to control headline inflation, as exchange rate shocks impact both service and goods inflation.

Furthermore, as these exchange rate shocks disturb the long-run equilibrium of relative prices, service inflation overshoots to adjust the long-run equilibrium. This adjustment further complicates the inflationary dynamics and undermines disinflation efforts.

Given this concerning dynamics is in action, policymakers must implement delicate disinflation programs that avoid exchange rate shocks, as these impact both service and goods inflation together. However, the program should also take into account that excessively controlling exchange rate depreciations, should not lead to a sudden change in exchange rates in the future, as this could trigger another disproportionate increase in headline inflation. Under these circumstances, policymakers should manage the exchange rate over the long term until service inflation is no longer affected by exchange rate movements.

Figures

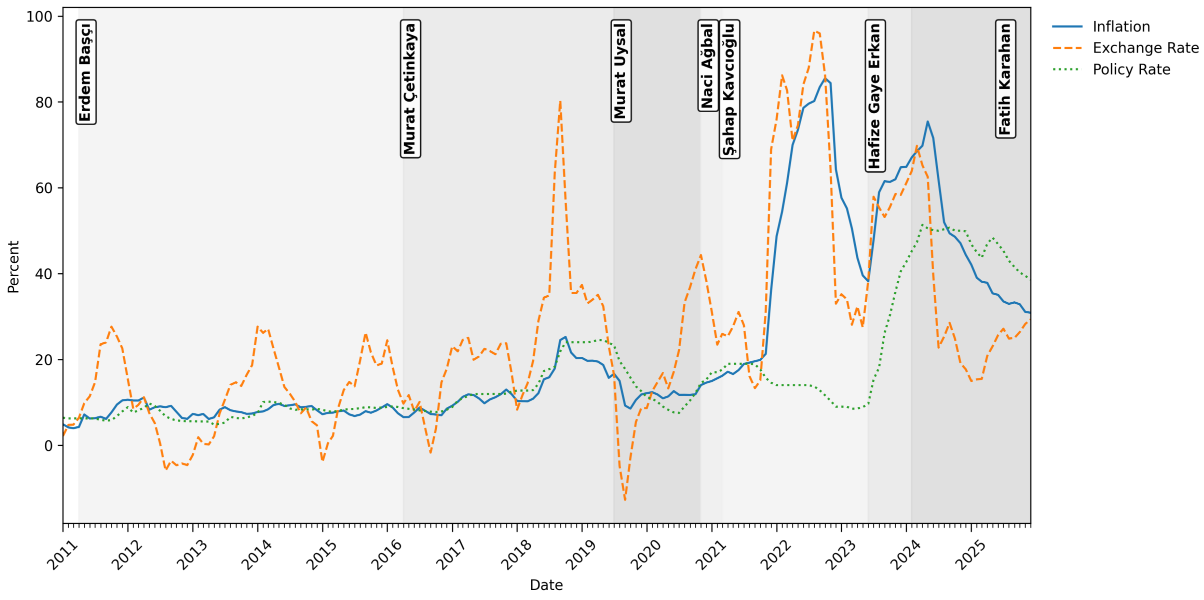

Figure 1: Inflation, Policy Rates, Exchange Rate and CB Governors

Figure 2: Good and Services Inflation and Exchange Rates

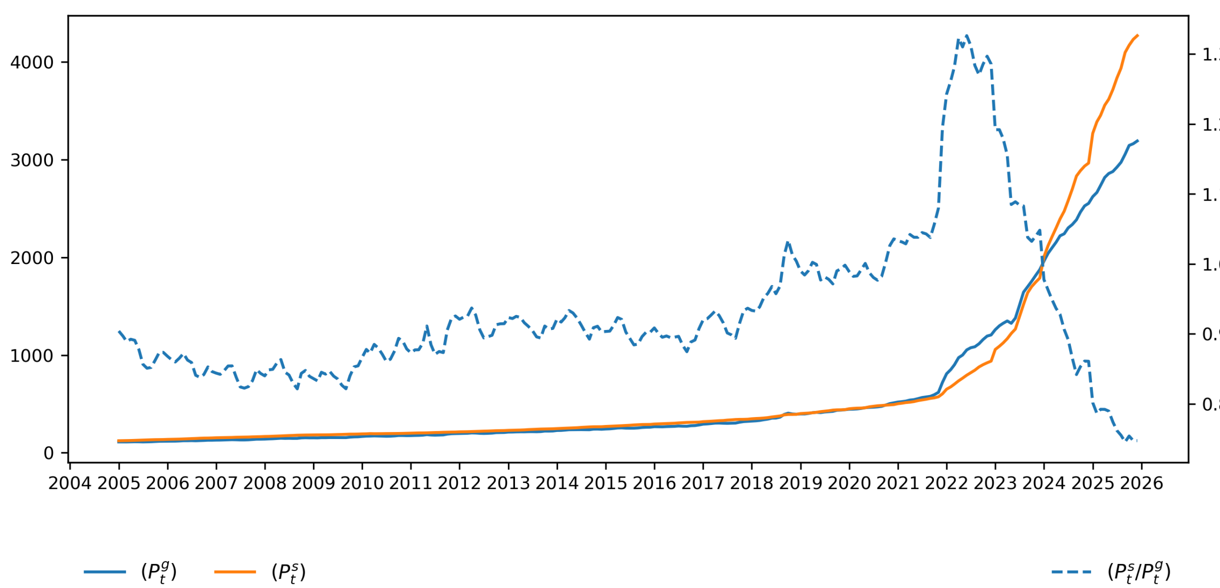

Figure 3: Good and Services Price Levels and Relative Prices

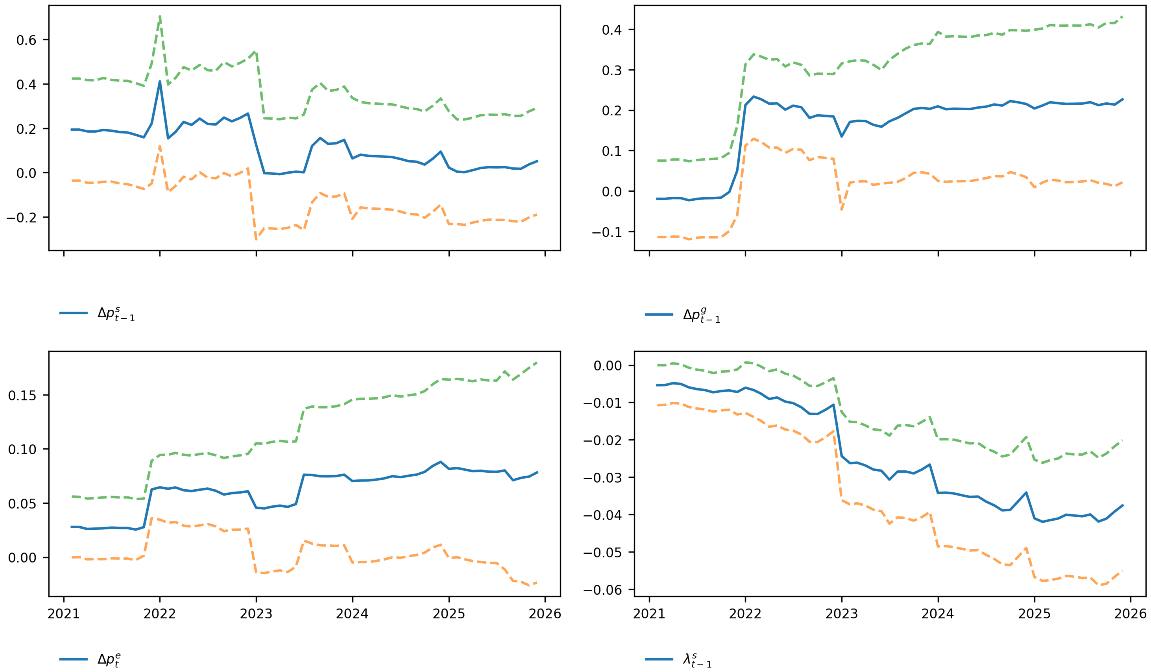

Figure 4: Time varying coefficients of Δp^s_t

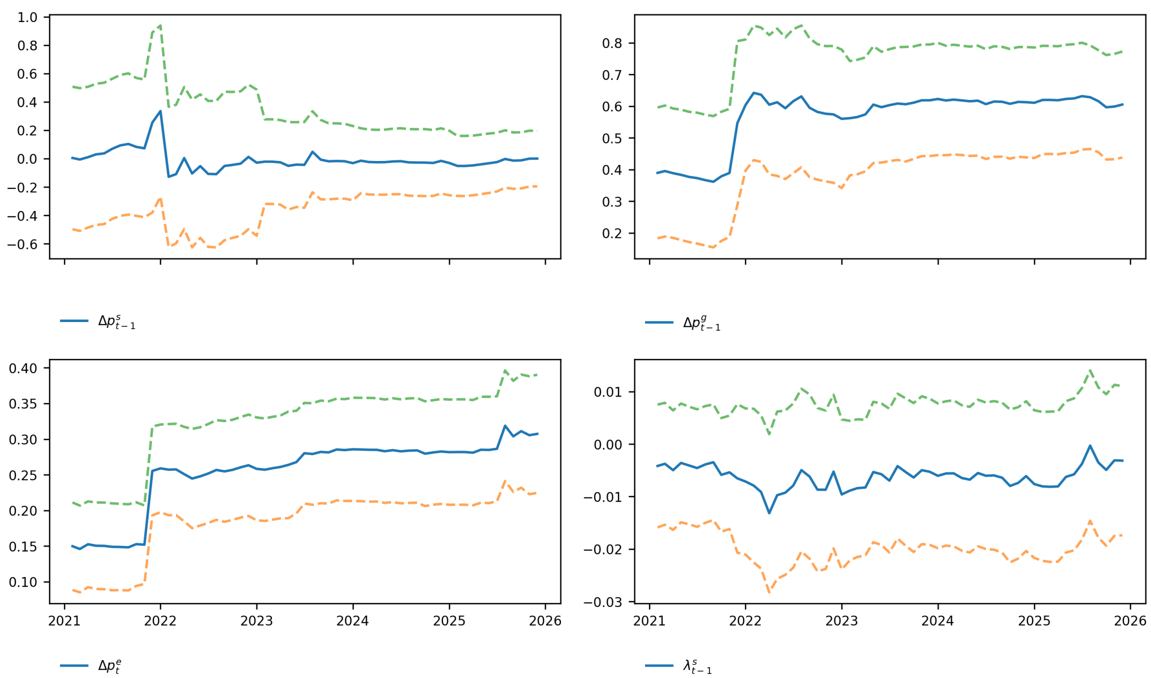

Figure 5: Time varying coefficients of Δp^g_t

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