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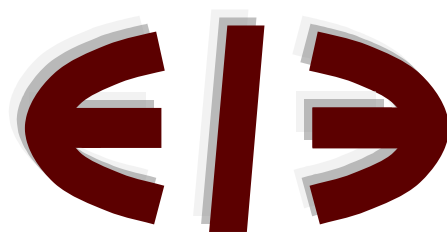
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Estimating the New Keynesian Phillips Curve in Vietnam

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Abstract

This research aimed to identify existence of a New Keynesian Phillips Curve in Vietnam. The examined period was 2012Q2 – 2025Q2, using secondary macroeconomics data and the Generalised Moments Method at 95% level of confidence. The dependent variables were price inflation and wage inflation, while the independent variables were the expected future inflation, three proxies of real marginal cost (the output gap, unit labour cost and labour income share), and the long-short interest rate spread. Findings from the research confirmed the existence of the traditional NKPC in Vietnam, with inflation positively influenced by the real marginal cost. Among the proxies, the conventional output gap is not totally outdated, having a positive, weak but statistically significant impact on wage inflation. Still, proxies related to the labour market were much stronger, positive determinants of both price and wage inflations. The inclusion of the interest rate spread made the effects of the proxies (on inflation) slightly stronger. A positive relationship was also found between current and expected future inflation, and inflation persistence in Vietnam was witnessed. Compared to some other emerging, open economies in the world, the Phillips curve in Vietnam in the period was flatter. The research wrapped up with some implications for academic researchers and Vietnam's central bank, specifically regarding the cautious application of the structural NKPC model to explain short-run inflation dynamics in monetary decisions in Vietnam.

Keywords: New Keynesian Phillips Curve (NKPC), price inflation, wage inflation, output gap, unit labour cost, labour income share, Generalised Moments Method (GMM)

1. INTRODUCTION

This introductory section is composed of four sub-sections: Background of the research (1.1), research rationale or existing gaps in the literature making the realisation of this research worthwhile (1.2), research aim, questions and objectives (1.3), and structure of the research (1.4).

1.1. Background of the research

Inflation plays an essential role in macroeconomic stability, with high growth of gross domestic products (GDP) and inflation stability key objectives of any macroeconomic policy in the world (Ly, 2022). Inflation stability, necessary for a high, sustainable economic growth, requires an appropriate combination of fiscal and monetary policies. Regarding price stability, there are moderate, galloping inflations, and hyperinflation. Moderate inflation is the target one, being able to stimulate economic activities with a moderate price increase which encourages production; a low inflation rate will hinder economy growth. The two others – galloping inflation and especially hyperinflation – have negative effects on the economy. Galloping inflation, or temporary, very short-term surging inflation rates, is particularly harmful to low- and middle-income classes, and can accelerate economic depression. Hyperinflation, referring to very high and increasing inflation rates, impedes growth as real value of the local currency is eroded, price stability is lost (goods price increases), and the population prefers holding more stable foreign currencies (Nguyen, Phan and Tran, 2022). Therefore, price stability and inflation dynamics have always unsurprisingly been an appealing topic to academic researchers and policy-makers. In particular, short-run dynamics of inflation is about critical determinants of the inflation rates in a short period of time, whose understanding is crucial for central banks to make decisions towards achievement of their inflation objectives (including inflation stability) (Jorgensen and Lansing, 2022). Theoretical modelling of short-run inflation dynamics has developed considerably in the past two decades, and nowadays, the New Keynesian Phillips Curve (NKPC) is the core framework in modern research on this issue.

The Phillips curve is a fundamental macroeconomic concept which describes a trade-off or a reverse relationship between inflation and unemployment in an economy. First introduced by Phillips (1958) based on a dataset of nominal wage growth/ wage inflation and unemployment

in the UK, the theory was developed and generalised into its current version after Samuelson and Solow (1960)'s validation of the curve in the US, using price inflation and unemployment records. The curve is explained by the following chain of reactions: A lower unemployment rate implies that more people are joining the workforce, and/or demand for labour is high. This creates an upward pressure on wage (causing wage inflation), increases production cost and accordingly, employees/ firms have to raise product (service) prices (causing price inflation) (Constancio, 2015).

However, the Phillips curve was not always empirically validated, and research continued in the 1980s and 1990s, in order to better understand inflation dynamics. Taylor (1980), Calvo (1983) and Fisher (1997) were remarkable researchers who empirically tested new models to explain inflation rates in the short-term, based on microeconomic principles of utility maximizing by forward-looking firms. As a result, the NKPC was formulated, derived from the assumptions of sticky prices, and rational and forward-looking price setting behaviour of firms (Arlt and Plasil, 2005). It is loosely related to the (original) Phillips curve: Both theories (curves) were developed from micro-foundations – aggregated individual and firms' decisions drive macroeconomic changes (here, short-term inflation rates) (Mazumder, 2010). The difference is that according to NKPC, the current inflation rate can be better interpreted by structural parameters – past inflation, expected future inflation, and real marginal cost (originally the output gap, and later expanded to more measures over the years) (Belinga and Doukali, 2019). A consensus is reached among researchers after the literature review: The Phillips curve and NKPC are useful as reference frameworks and monetary policy tools towards inflation targets (Volha and Jan, 2024).

1.2. Rationale of the research

A review of the literature on the research topic pointed out several emerging and persisting gaps, which inspired the realisation of this study. The two key reasons were (1) A call to verify validity of the NKPC with recent, real economic data, especially when the model has failed several times previously, and (2) The shortage of empirical evidence for NKPC and/or short-term inflation dynamics in small, developing economies.

Firstly, this research answered the call of previous researchers for more validity assessments of the NKPC. As the NKPC is the primary macroeconomic model used by the Federal Reserve

of the US (Fed), a regular evaluation of the model validity is necessary for an (US) effective monetary policy. Changes in the way inflation rates interact with its determinants (parameters in the NKPC model) must be promptly and periodically considered in order to make corresponding changes in monetary objectives and policies (Haschka, 2024). The model applicability is certainly not limited to the US, helping central banks to estimate relative costs of adjusting inflation rates to their target ones. In open economies, an estimation of structural parameters of the NKPC can also help policy makers to evaluate the extent to which current inflation rate is affected by domestic factors and by global ones (Szafranek, 2017).

The urge to assess empirically the validity of the NKPC also comes from the difficulty that economists continue to encounter when applying the model into real-world data, due to several limitations, including unavailability of data, variable choices, drawbacks of statistical estimation methods, to name a few (Belinga and Doukali, 2019). Another crucial motivator is recent significant changes in the global economy: The Covid-19 pandemic and its consequences, contributing to the risk of stagflation (a combination of high inflation, stagnant economic growth, and unemployment surge) (Ly, 2022), and the actual, recent economic recession caused by the Ukraine war. In such situations, it is highly possible that the NKPC fails to explain the short-run inflation dynamics. Additionally, there is the necessity to have a model to improve transparency of monetary policies, especially when de-anchored inflation expectations (long-term inflation rates expected to be sensitive to short-term ones and near-term macroeconomic shocks) are potential (Volha and Jan, 2024).

Specifically, post-pandemic, there has not yet been an agreement among researchers about whether the model is still valid in the modern context. The repeated failure of the curve(s) in some recent empirical studies alone was sufficient as a reason for the making of this research. On the one hand, it had been seen before the Covid-19 pandemic that the labour market was not an effective determinant of inflation (Del Negro et al, 2020). The inverse relationship was not seen in several months following the start of the pandemic, either, when unemployment rate was exceptionally high, but inflation did not reduce as much as expected. As the original Phillips curve failed, an examination whether its modern, predominant upgrade – the NKPC – was still valid (Haschka, 2024). On the other hand, there is evidence in the US, Europe, and OECD countries, with post-pandemic data, that the model remains valid (Baba et al, 2023; Hobijn et al, 2023). Such a contradiction was a gap that this research wanted to reduce.

Secondly, the research also aimed to narrow down another gap which is scarcity of empirical evidence of the NKPC validity, and/or of determinants of short-term inflation rates in emerging, small economies such as Vietnam. Theoretical modelling of short-term inflation dynamics in small economies is difficult which may require adaptive changes to NKPC, argued Arlt and Plasil (2005); the authors found it hard to prove validity of this fundamental model in the Czech economy. There are differences between big economies and small ones which potentially make inflation movements resistant to parameters in the model (past inflation, expected future inflation and real marginal cost) such as foreign relations, infrastructure/technological development, social and cultural factors. There are also problems of small, younger economies such as the more recent opening of the economy, transition from a centralised economy to a market (free-market) one, and devaluation of the currency (compared to the US dollar) to curb inflation. All of these three problems actually occurred in Vietnam (market opening and economic renovation in/since 1986; three currency devaluations during 1984-1986, and the lift of the US's embargo in 1994). The lack of historical data is another issue, leaving researchers with only short time periods to evaluate the model. Altogether, they complicated the evaluation and explained the evidence scarcity. Findings from this research would be among the pioneers to test the NKPC model in Vietnam using recent, post-pandemic data and the Generalised Method of Moments (GMM) estimation. Commonly used in similar studies on the NKPC worldwide and increasingly considered the standard estimation method, however, no NKPC-related research using GMM in Vietnam was detected in the literature.

Among small, emerging economies worldwide, Vietnam was selected for the interesting evolution of its inflation rates in the past two decades. During 2004-2008, inflation rates were high and increased considerably year-on-year due to high foreign investments and increasing spending of state-owned companies. During 2007-2013, Vietnam had inflation rates and volatility much higher than most other developing countries; there were times during 1986-2013 when inflation rates surpassed 7% and became harmful to the economic growth and stability (Le and Pham, 2015). However, since 2015, Vietnam has successfully kept inflation rates under 4.5%, while maintaining a high GDP growth rate at averagely 6.4% for 1990-2020 (including even the pandemic period) (Ly, 2022). Given these records, Vietnam seemed to be an interesting case for this study focusing on inflation dynamics and monetary policy.

1.3. Research aim, questions and objectives

This research aimed to examine the validity of the NKPC in the Vietnam economy. The research objectives are:

- ✓ To examine validity of the traditional, forward-looking price-setting NKPC
- ✓ To assess whether unit labour cost and/or labour income share perform better than the traditional output gap, as proxies for real marginal cost in the NKPC model
- ✓ To make recommendations to monetary policy-makers in Vietnam based on findings on short-run inflation dynamics in this research

The research questions were generated to achieve the research objectives as follows:

- ⌘ Is the traditional NKPC model valid in the case of the Vietnam economy?
- ⌘ Can unit labour cost and/or labour income share - proxies for real marginal cost - perform better than output gap in the model estimation?
- ⌘ Having better understanding of the short-run inflation dynamics in Vietnam based on the NKPC validity assessment, what recommendations can be made for monetary policy in the economy?

1.4. Structure of the research

This research followed a typical, five-chapter structure: After the first, introductory chapter, the second chapter provides a review of the literature, including the key concepts (traditional and hybrid NKPC models), previous empirical evidence on the validity of the two NKPC models in other economies in the world, problem of weak identification of parameters in empirical research, and an overview of inflation evolution and determinants in Vietnam in the last decade. The third chapter described and justified methodological choices to collect and analyse data, in order to reach the research objectives presented above. The fourth chapter is where research findings (from data analysis) are presented and discussed. The fifth and last chapter concludes on achievement of the research objectives, and discusses some implications.

2. LITERATURE REVIEW

This section has four sub-sections, which build a theoretical background and empirical references for the research: Two first sections on the models of interest – Traditional NKPC (2.1) and Hybrid NKPC (2.2), then worldwide empirical evidence on the validity of the models, followed by the frequent problem in empirical research on this topic – specifications/ parameter identification (2.3). The last section (2.4), an overview of inflation rates in Vietnam in the last decade, wraps up the chapter.

2.1. Structural (traditional) New Keynesian Phillips Curve

2.1.1. Model building

The model is founded with the (first) assumption of monopolistic competition (imperfect competition) in the economy: Firms compete against each other; their products are differentiated from each other so that there is not perfect substitution, so each firm has the power to set its price.

These firms follow a time-dependent price-setting rule (the second, forward-looking assumption, or the assumption of price-setting constraints, or nominal rigidities) (Mihalache and Bodislav, 2019): In every period t , a fraction $1/X$ of firms can set their prices ahead of time, for X periods; for instance, if the time unit is a quarter, it is assumed that $\frac{1}{4}$ of the firms in the economy will set expected prices for 4 quarters (one year) ahead. Other firms keep their prices fixed. Every firm keeps its price fixed until it sees a random chance, a signal encouraging/ allowing it to change price. It will consider prices of other companies (competitors) to set the best expected/future price (price optimisation), as the price cannot be changed until the next period/price-change signal (Walsh, 2017).

Using the Calvo (1983)'s pricing rule to simplify the aggregation issue, it is posited that for any given period, for a single firm, there is a fixed probability $(1-\theta)$ that the firm will adjust its price in this period. The structural parameter $\theta > 0$ is the measure of *price rigidity* in that period. Consequently, the time over which the price is fixed is: $1/(1-\theta)$.

The constant price elasticity of demand curve is another assumption of the model. With this assumption, Gali and Gertler (1999) proposed that the aggregate price level at time period t (p_t)

is dependent on the lagged price level (p_{t-1}) and the optimal reset price (p_t^*). Combining with Calvo's pricing rule, we have Equation (1) of the pricing rule:

$$p_t = \theta p_{t-1} + (1-\theta)p_t^* \quad (1)$$

The firm's marginal cost(s) (a percentage deviation from the steady state, bounded in each time period) in the period t is denoted as mc_t^n , and the discount factor is β . As the firm pre-set a price at t to maximise its discounted profit under the constraint of Calvo's pricing rule, the optimal reset price is calculated as per Equation (2):

$$p_t^* = (1 - \beta\theta) \sum_{k=0}^{\infty} (\beta\theta)^k E_t\{mc_{t+k}^n\} \quad (2)$$

Where: k is the elasticity of the marginal cost, and $E_t\{mc_t^n\}$ refers to the expected value of marginal cost, conditional on information set at time t (based on the assumption that firms make rational expectations when price setting).

Now with the following equations for the inflation rate (π) and λ :

$$\pi_t = p_t/p_{t-1}$$

$$\lambda = (1-\theta)(1-\beta\theta)/\theta$$

Equations (1) and (2) were combined by Galí and Gertler (1999) to achieve the equation for the traditional NKPC (or the traditional equation of short-run inflation dynamics):

$$\pi_t = \lambda mc_t + \beta E_t\{\pi_{t+1}\} \quad (3)$$

Therefore, briefly speaking, the traditional NKPC model states that the current inflation rate is determined by real marginal cost and the future value of inflation (expected value for the next period $t+1$).

When iterated forward, the authors obtained the following Equation (4), which implies that inflation is a discounted stream of expected future marginal costs:

$$\pi_t = \lambda \sum_{k=0}^{\infty} \beta^k E_t\{mc_{t+k}^n\} < \infty \quad (4)$$

In the traditional NKPC model, the proxy for real activity or marginal cost is the output gap, the difference between the actual output (GDP) and the potential one; in empirical research, it is the GDP series less of a trend, a percentage deviation from the steady state. Real marginal

cost proxied by the output gap is: $mc_t = kx_t$. The Equation (3) for the traditional NKPC becomes:

$$\pi_t = \lambda kx_t + \beta E_t\{\pi_{t+1}\} \quad (5)$$

2.1.2. Marginal cost proxies

It is widely known in the literature that the using the traditional output gap as a proxy for firms' real marginal cost is not ideal, causing measurement error (counter-intuitive sign of coefficients estimated from the model equations). Because the theoretical output gap is not observable, it is calculated by subtracting a smooth deterministic trend from the GDP series (to see the output gap as a percentage deviation from the steady state); such treatment causes measurement error (Vasilev, 2015). The choice of which indicator to use for real activity, firms' marginal cost, and inflation is important as it can affect the estimated slope of the curve as well as statistical significance of coefficients of other parameters (Rubbo, 2023; Hasenzagl et al, 2022). Therefore, other proxies for marginal cost have been developed, whose performance was considered in this research in comparison with the conventional output gap.

Based on the A Cobb-Douglas production function, Gali and Gertler (1999) proposed another proxy for real marginal cost: Labour income share (S_t). The A Cobb-Douglas production is:

$$Y_t = A_t K_t^{\alpha_k} N_t^{\alpha_n}$$

Where: A_t is the total factor productivity, K_t capital, and N_t labour. The equations of the labour income share and real marginal cost (the ratio of the real wage to the marginal product of labour) now are:

$$s_t = W_t N_t / P_t Y_t$$

$$mc_t = (W_t / P_t) (\partial Y_t / \partial N_t) = S_t / \alpha_n = s_t$$

where: s_t is the percentage deviation from the steady state of S_t . When incorporating the new proxy as real marginal cost in Equation (3), we have Equation (6) of the NKPC:

$$\pi_t = \lambda s_t + \beta E_t\{\pi_{t+1}\} \quad (6)$$

2.1.3. Summary

According to the traditional NKPC, the dynamics of firms' current and future marginal costs is essential to the one of inflation, as current inflation is determined by the firms' real marginal costs and expected (future) inflation.

The influence of real marginal costs on the current inflation – illustrated by the curve slope λ or the coefficient of real marginal costs – is dependent on two structural parameters: Discount factor β and the measure of price rigidity θ ($\lambda = (1-\theta)(1-\beta\theta)/\theta$). When β or θ goes up, λ goes down. When β increases, it implies that firms find future profits more important than the current one. When θ increases, meaning price adjustment becomes more limited/ less frequent, it may imply that firms focus more on future marginal cost (when they can reset the prices) than the current marginal cost (Mihalache and Bodislav, 2019).

The traditional proxy for real marginal cost – output gap – has limitations, leading to proposal and application of other proxies such as the labour income share.

2.2. Hybrid New Keynesian Phillips Curve

In the traditional (or baseline) NKPC, past information is assumed unimportant to firms and their price-setting practice. Information about the future is more important. There is no inflation inertia, as inflation is fully determined by present and future economic conditions. This is a critical difference between the traditional NKPC and the hybrid one, as well as between the traditional NKPC and the former concept of the Phillips curve (Arlt and Plasil, 2005). Consequently, the traditional NKPC was criticised by economics (including Keynesians) for being too forward-looking and ignorant of the reality of inflation, resulting in failures when applied to real-world data. Therefore, it was recommended that the 'rule of thumb' (backward-looking) also be considered, which gave birth to the more empirically-feasible hybrid NKPC model. The adding of the backward-looking price-setting behaviour would correct the sign of the estimated coefficients from the model, for example (Roberts, 1997; Fuhrer, 1997). Nowadays, both the traditional and hybrid forms of the NKPC are widely used in modelling of short-run inflation dynamics (Volha and Jan, 2024).

2.2.1. Model building

In the hybrid NKPC model, the original Calvo's pricing rule is extended, and it is assumed that there is inflation inertia (π_{t-1}). Inflation inertia or lagged inflations are what drive inflation, not the forward-looking element (expected future inflation) in the model (Fuhrer, 1997).

Now, in the economy, there are two groups of firms: Those adopt forward-looking price setting, and the remaining others who practice backward-looking one. The latter group use a rule of thumb, adapting prices based on historical data, whose share is denoted by ω (so the share of forward-looking firm is $(1-\omega)$).

The assumption of firms being fully rational in price setting of the traditional NKPC is not applied to the hybrid NKPC model; instead, given that they are not fully rational, current inflation can be affected by past inflation via their expectations (Gati, 2023). The inclusion of backward-looking behaviour is realistic, empirically supported (firms actually set price for the future based on current and past prices), and matches the stickiness of inflation observed in real data (Volha and Jan, 2024). It was also believed to improve strength of the NKPC model, making estimated coefficients or the inflation dynamics proposed by the model more helpful to long-run simulations (Fuhrer, 1997). The statement of Fuhrer (1997) is agreed with by most economists so far (Szafranek, 2017; Mihalache and Bodislav, 2019).

Equation (1) of the pricing rule, describing the aggregate price level now becomes:

$$p_t = \theta p_{t-1} + (1 - \theta) \underline{p}_t^* \quad (7)$$

Where: \underline{p}_t^* is an index of the prices reset in period t . Now with p_t^f the price set by a forward-looking firm, and p_t^b the price set by a backward-looking firm, the index of the newly set prices is:

$$\underline{p}_t^* = (1 - \omega) p_t^f + \omega p_t^b \quad (8)$$

Following Equation (2), p_t^f can be expressed as:

$$p_t^f = (1 - \beta\theta) \sum_{k=0}^{\infty} (\beta\theta)^k E_t \{ mc_{t+k}^n \} \quad (9)$$

Using the rule that firms set price based on recent pricing behaviours of competitors, an extension of Calvo (1983)'s model, Gali and Gertler proposed the expression of p_t^b as follows:

$$p_t^b = \underline{p_{t-1}^*} + \pi_{t-1} \quad (10)$$

π_{t-1} is also called the ‘inflation inertia’. By combining the Equations (9) and (10), the authors proposed the Equation (11) of the Hybrid NKPC as follows. This equation is also frequently called the “semi-structural” specification, showing a deeper micro-founded structural model (Belinga and Doukali, 2019).

$$\pi_t = \lambda mc_t + \gamma_f E_t\{\pi_{t+1}\} + \gamma_b \pi_{t-1} \quad (11)$$

Where:

$$\Phi = \theta + \omega[1-\theta(1-\beta)]$$

$$\lambda = (1-\omega)(1-\theta)(1-\beta\theta)\phi^{-1}$$

$$\gamma_f = \beta\theta\phi^{-1}$$

$$\gamma_b = \omega\phi^{-1}$$

In addition to the traditional output gap, similar to the case of the traditional NKPC, another proxy of the marginal cost can be used (the labour income share). In this case, Equation (11) becomes:

$$\pi_t = \lambda s_t + \gamma_f E_t\{\pi_{t+1}\} + \gamma_b \pi_{t-1} \quad (12)$$

When $\omega = 0$, all firms are forward-looking in price setting, and the Hybrid NKPC becomes the traditional NKPC.

In Equation (12) of the hybrid NKPC model as well as Equation (3) of the traditional NKPC one, λ , γ_f and γ_b are expected to share the same sign and be positive, implying that their increases will lead to an increase in current inflation (Haschka, 2024): When firms’ marginal cost or expectations of future inflation is high, the firms will increase product (service) prices to maintain profit, and this will contribute to an inflation increase. Using the rule of thumb, firms pre-set prices based on past inflation will rationally set a higher price if the past inflation is high.

2.2.2. Summary

The Hybrid NKPC was developed from the traditional one to correct the limitations of the latter, including also inflation inertia for better fit with real-life data. Being broader and more flexible, this new form has gained wide popularity in empirical modelling for short-run inflation. In the hybrid NKPC model, current inflation is explained by current real marginal cost, expected future inflation as well as past inflation. The model is not free from criticism, including the problem of weak parameter identification that the traditional NKPC suffers from, which is even stronger for the hybrid one. However, so far there has not been a better alternative for central banks and economists, explaining the continuing pillar role of these two models (Mihalache and Bodislav, 2019).

2.3. Empirical evidence on the validity of the New Keynesian Phillips Curve

2.3.1. Recent empirical evidence

Previous studies on the validation of the traditional and/or hybrid NKPC are reviewed here, which were officially published in English, after 2015 for recentness of evidence. It is obvious that there is a lack of empirical evidence for the NKPC worldwide and in Vietnam, which was one reason for the realisation of this research.

Volha and Jan (2024) conducted a meta-regression analysis of the literature worldwide and concluded on the continuing validity of the NKPC models based on empirical results in the past two decades. They also found that on average, two-thirds of the influence on current inflation come from the forward-looking behaviour/share, while one-third is contributed by the backward-looking element. However, the importance of the backward-looking behaviour has increased in more recent works when inflation persistence increases. Relevant empirical findings were obtained in Central and Eastern economies.

The research by Kurozumi and Oishi (2022) examined and compared the baseline and hybrid forms of NKPC in Japan and the U.S post the Global Financial Crisis, in the period of 2010-2019. The specification of sticky information was selected for the U.S and the one with variable elasticity of demand for Japan. The curves were estimated using quarterly time series (price inflation based on Consumer price index (CPI) changes, long-term inflation expectations, wage inflation, and the output gap as real marginal cost) and the Bayesian VAR-GNIM estimation method. It was found that trend inflation is lower and persistence of inflation expectations is

higher in Japan than in the US. In Japan, consumers are very sensitive to price increases, so firms have cautious price-setting behaviour. Combined with the high persistence of inflation expectations, this results in low expected future inflation and low trend inflation in Japan.

Gabrielvan (2019) verified the validity of the NKPC to forecast inflation (one-year ahead) in Sweden, Canada and New Zealand. The similarity among these three economies is an inflation-targeting regime. The data period was 1983-2016. It was confirmed that when the central banks used explicitly an inflation-targeting policy, the curve can produce better inflation forecasting than the random walk and autoregressive models' benchmark. However, in earlier periods when this inflation-targeting regime had not been adopted, results varied among the economic specifications and sample periods used.

Belinga and Doukali (2019) tested whether the two NKPC models can describe the inflation dynamics of the Moroccan economy using GMM and TJIVE estimation methods. Two proxies for marginal cost were used, which were the (conventional) output gap, and the labour income share. The J-test rejected the traditional NKPC form while approving the hybrid one. The inclusion of additional lags of inflation and the output gap made the results robust ($L = 4, 8$ and 20). It is confirmed that the short-run inflation dynamics of Morocco can be well-explained by the hybrid NKPC at lag = 8, $\lambda = 0.12$, $\gamma_f = 0.674$ and $\gamma_b = 0.277$, at 95% confidence level. The influence of the expected future inflation was the highest, followed by the past inflation, while firms' marginal cost had the smallest effect. All influences (coefficients) were positive, implying that their increases will drive up the current inflation.

In Poland, another small open economy, Szafranek (2017) examined the validity of the traditional and hybrid curves, and additionally, the evolution of the curve slope in two comparative periods – 2002 – 2011 and 2002 – 2015. The models' specifications including λ and structural parameters were estimated using GMM (four types of GMM, and Ordinary Least Square – OLS) at 95% confidence level. The author validated the applicability of the hybrid NKPC. Furthermore, she also noticed the flattening of the Phillips curve (slope/ coefficient 39% smaller in the second period), due to under-use of labour, and the indirect effects of global/ external factors on inflation (via imported food and energy). Such a flattening change makes it more costly for the Polish central bank to stabilise inflation. λ and the γ were all positive, with γ_f weaker than γ_b (so the backward-looking behaviour had a stronger effect on inflation). λ of the output gap varied by the GMM method used, ranging from 0.37 to 0.58.

In Hungary, Vasilev (2015) examined whether a traditional or hybrid NKPC existed, using data of the period 1981 – 2006. Three proxies for the marginal cost were used (output gap, labour income share and labour unit cost), with two types of inflation (price and wage inflation). The models were estimated by GMM. The author confirmed the presence of a traditional (forward-looking) NKPC in which the new proxies of real marginal cost had significant impacts. In both models, the problem of weak parameter identification persisted.

2.3.2. Problem in specification identification

Vasilev (2015), similar to other researchers including Mavroeidis et al (2014) and Belinga and Doukali (2019), noticed the problem of weak identified parameters in the NKPC models. Specifically, he found the measure of price rigidity θ to have an upward bias (close to 1) and the coefficient λ of real marginal cost mc to have a downward bias (towards 0) and have statistical insignificance. The first possible reason is the unobservable nature of marginal cost, so proxies of real marginal cost are used, causing measurement error. The use of labour income share, instead of the ‘outdated’ output gap by some researchers, was still criticised by others claiming this was not a good proxy for economic activity, nor driver of inflation as it moved inversely to inflation in recessions (Rudd and Whelan, 2007). The findings were obtained from their empirical study in the US. The second reason comes from multiple assumptions of the NKPC models, especially the constant increase of price over mc . In real life, prices may change over a business cycle, and as prices are less sensitive to mc , λ is biased downwards and insignificant.

Other researchers also provided some explanations for the weakening of the parameters in the models (leading to the flattening of the Phillips curve). First, changes in unemployment or the labour market (labour cost, labour income share) have been seen to have smaller impact on inflation in the past two decades (compared to earlier). Reasons include the globalisation, technological advance (making price more stable via higher efficiency and competition), employees’ weaker bargaining power (Ratner and Sim, 2022; Ahn and Lee, 2023). Globalisation also influences local prices via imported goods, the spill-overs of inflationary or deflationary shocks, which results in inflation increase unrelated to the domestic labour market (Hałka and Szafranek, 2016; Bianchi and Civelli, 2015). The larger the price shocks, the more rapidly inflation increases (such as the double-digit in Europe in 2022-2023 caused by the energy shock from the Ukraine war) (Cavallo et al, 2023). This effect is even amplified in

small, open economies where food and energy share account for much more in the household consumption compared to the ones in developed economies (Volha and Jan, 2024).

Haschka (2024) generalised that the strength and sign of specifications and structural parameters in the NKPC models are affected considerably by different measures of inflation (survey-based, model-based), expected future inflations, unemployment and marginal cost. Szafranek (2017) added that the choice of the estimation method also matters to the identified inflation dynamics – this is discussed in more details in the next chapter of Methodology. Policy-makers must be aware that inflation forecasts can differ greatly when different measures or estimation methods are used. However, it is still difficult to determine the most appropriate measures to employ, as real inflation dynamics vary and requires corresponding adaptive selection of the measures. In order to overcome this drawback of specification instability, Bobeica and Hartwig (2021) proposed a “thick-modelling” approach in which average values are calculated from various specifications to define the inflation dynamics.

2.4. An overview of inflation rates in Vietnam in the past decade

This section summarises monetary tools of the State Bank of Vietnam (SVB), inflation rate pattern in Vietnam in the past decade and potentially influential factors, and findings from recent studies on the inflation dynamics under the use of such tools in this emerging, small economy. This overview set the context and can be used for discussion of findings from this research.

2.4.1. SVB’s monetary tools

SVB has a broad set of instruments to conduct monetary policy in order to achieve its inflation target, divided into four groups (IMF, 2024):

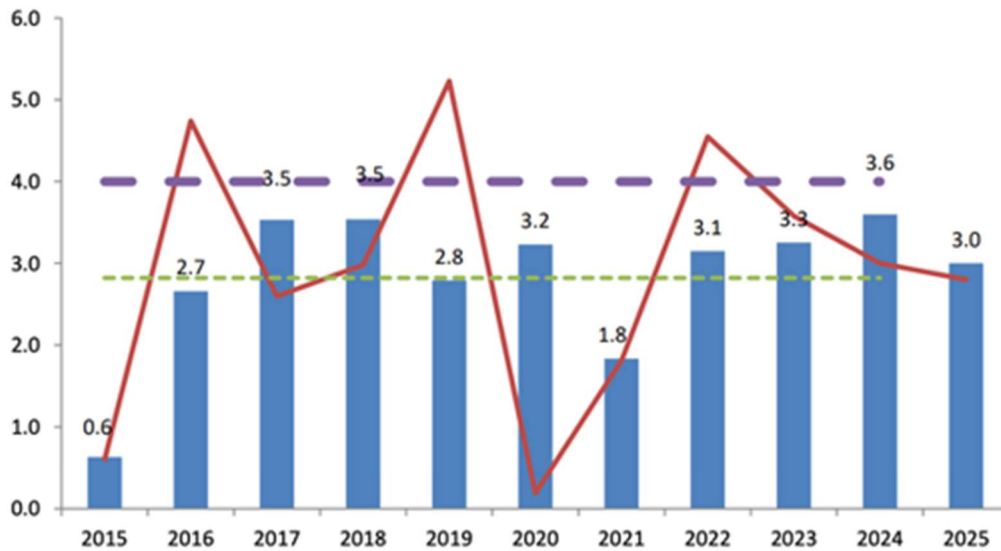
- *Controlling policy rates*: Refinancing rate (rarely used, dedicated to weak banks and policy lending), Discount rate (unused for years), Overnight Electronic Clearing Rate (used occasionally for foreign banks), and Reserve Requirement Ratio (3% for short-term VND deposits and 8% for foreign currencies deposits, unchanged since 2011). Refinancing rate and Discount rate are grouped into Policy rates.

- *Open Market Operations (OMOs)*: Repo (used often during 2022-2023), SVB Bills (to withdraw liquidity in the system, used occasionally). Together they form “OMO Rates” which are more frequently used than Policy rates.
- *Caps and Ceiling on Banks’ activities*: Caps on Deposit Interest Rate, Caps on Lending Interest Rate, and Credit Growth Ceiling; the two formers are applied to all banks while the latter is set annually and bank-by-bank
- *Exchange Rate Arrangement*: Reference Rate/Band, FX Interventions (variations allowed among banks in the market: +/-5% since 2022)

The co-existence of various tools allows SVB to address different goals, but makes it difficult to assess the effectiveness of each tool, and the effectiveness and transparency of monetary policy (IMF, 2024).

2.4.2. Inflation rate pattern in Vietnam in the past decade and potentially influential factors

2004-2008 was a period of high inflation due to high inflows of foreign investments and large spending of state-owned companies (Nguyen, Phan and Tran, 2022). 2008 – 2012 was another period of high inflation post the Global Financial Crisis, with the average inflation rate of 10.2% during 2005-2014. Inflation rates reduced to a moderate level during 2013-2023, staying in or below the target range of 4-4.5% annually. Inflation rates have been below the target range since the peak of 4.45% in May 2024, estimated to be 2.5-3.6% in 2024-2025 depending on the data sources (IMF, 2024; Tung Linh, 2025) (**Figure 1**). So far the inflation rate of the first 8 months of 2025 is 3.19% (CSPL, 2025). Vietnam/ SVB keeps a de facto stabilised currency (benchmark: US dollar).



(Blue columns: Average annual inflation rates; red lines: inflation in December month-on-month; green dashes: Average of the period 2015-2024; purple dashes: Inflation target 4%)

Figure 1 – Inflation in Vietnam during 2015-2024 and forecast for 2025

(National Statistics Office of Vietnam (NSO), 2025).

As for the coming years and specifically 2025-2026, there are many geopolitical and economic factors which can explain the predicted inflation increase (potentially surpassing the target 4%) in Vietnam:

- Externally: Political conflicts in Ukraine and the Middle East; Slow and unstable recovery of the world economy and commerce; volatility in FX and interest rates worldwide; the tendency of interest rate cut by central banks; Trump’s tax policy and potential revenge from other economies. All of these factors can lead to more commercial obstacles, interrupted supply chains, and consequently, higher inflations and unemployment globally (QDND, 2025).
- Domestically: The pressures from higher energy prices, transport costs and strengthening of the USD (in other words, weakening of the VND) (Tung Linh, 2025). These mean higher prices for imported materials, production and transport, which in turn drive up consumer price and inflation. At the same time, upwards price pressure also comes from the government’s plan to transform state-financed services into

market-run ones including electricity, schooling and medical services. Fewer foreign investment inflows are also recorded (CSPL, 2025).

- The government/ SVB has improved investment spending, proposed demand-stimulating packages, credit expansion, and reductions in interest rate and tax (environmental tax, VAT). Such increase in money supply can intensify pressures on prices without effective control

2.4.3. Findings from recent studies on inflation and monetary policies in Vietnam

Using inflation and economic growth data for the 1986-2013 period, Le and Pham (2015) concluded that passing the threshold of 7%, inflation is high and harmful to economic growth of Vietnam.

Using real data for the period of 1997-2000 and the VAR modelling method, Nguyen, Phan and Tran (2022) compared effects of fiscal and monetary tools on inflation in Vietnam. It was found that Vietnam's inflation is positively influenced by the government expenditure (coefficient 8.35), followed by interest rate (coef. 3.19), a fiscal deficit (coef. 2.94) and finally money supply (coef. 2.67). The researchers therefore argued that inflation in Vietnam is affected by both fiscal and monetary aspects, and more impacts came from fiscal policy so inflation is cost-push. The positive sign of the impacts is reasonable. Fiscal policy had stronger impact because monetary policy is dependent greatly on fiscal one and government spending is huge in Vietnam (Nguyen and Nguyen, 2017).

Using a dataset of quarterly inflation rates (divided into core inflation, food inflation and energy inflation), Ly (2022) found that food inflation is the main cause of inflation in Vietnam. The impacts of globalisation or external shocks on this small, open economy was seen via changes in food and energy inflations to match those in the world market; consequently, food inflation and energy inflation suffered from higher volatility, compared to the relatively stable core inflation (**Figure 2**). The average stability of the core inflation and the economic growth (higher than the inflation rates and averaged 7-8%) showed effectiveness of Vietnam's monetary policy, according to the author.

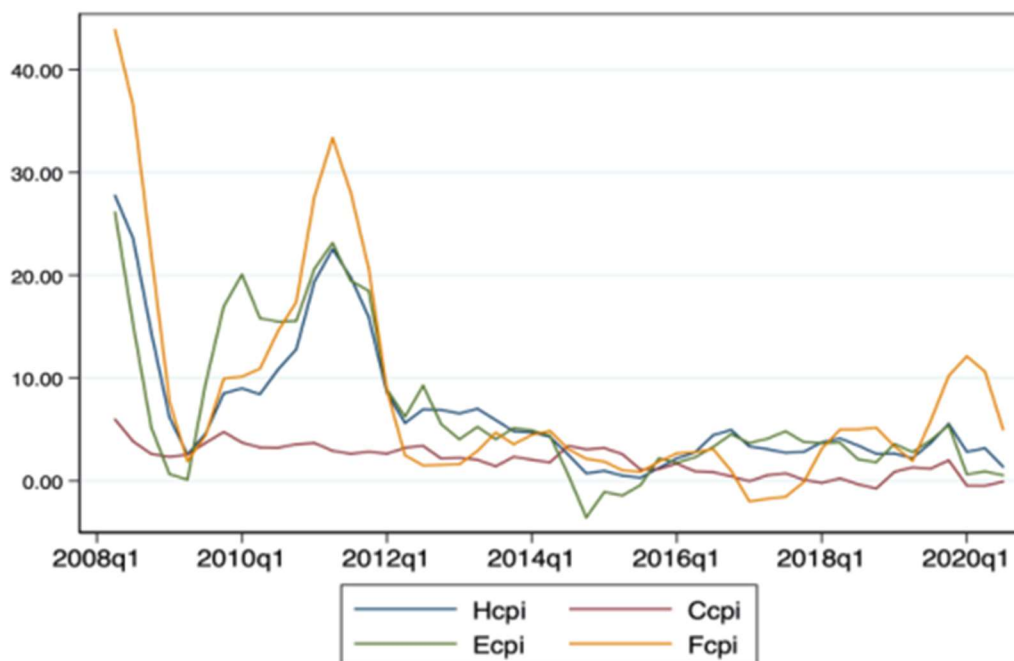


Figure 2 – The patterns of inflation (Hcpi), Core inflation (Ccpi), Energy inflation (Ecpi) and Food inflation (Fcpi) in Vietnam during 2008-2020

(Ly, 2022, p5)

Tung Linh (2025) analysed money supply, interest rates, USD/VND exchange rate in Vietnam during 2014-2023. They were more stable than those in the 10 earlier years, and money supply reduced compared to the 2004-2013 period. He agreed with Ly (2022) that most inflation fluctuations were due to drastic changes in the external markets, specifically energy and material price surges. Domestic contributor to inflation increase was the government's decision to use market prices (rather than the lower state-supported ones) for education and medical services.

In a study by IMF (2024) about SVB's use of monetary tools, it was found that during the period of high inflation rates (2008-2012), policy rates increased remarkably before becoming stable since 2023. The same pattern is seen for banks' lending and deposit interest rates (determined by the SVB). OMO rates, in contrast, have been more volatile and fluctuated closer to the inflation pattern (**Figure 3**). The headline inflation rates in this Figure also matched

previous statements by Nguyen et al (2022) and Tung Linh (2025) about the averagely low inflation rates in Vietnam since 2013.

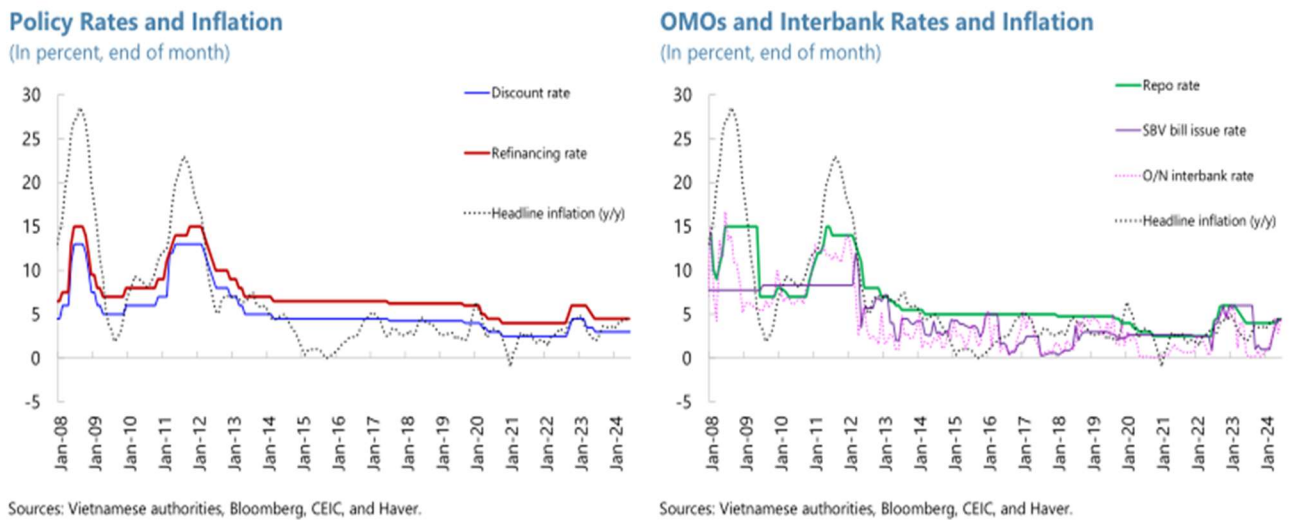


Figure 3 – Patterns of inflation, SVB’s Policy rates and OMOs during 2008-2024

(IMF, 2024, p6)

In this report, IMF (2024) examined impacts of monetary shocks on other rates (interest rate, credit growth, industrial production and particularly, inflation) in Vietnam in this period (2008-2023). Findings were as expected: OMO rates have positive effects on production and inflation, showing the SVB’s effort to tighten or loosen policy rates to reach inflation target. As coefficients of inflation and production are bigger for next-year forecast of the policy rates, IMF (2024) argued that SVB uses a forward-looking mindset in policy rate setting. The coefficients are still smaller than those found in other economies, so it was suggested that the co-ordination among SVB’s used tools, and transmission channel for monetary policy is quite weak. It was recommended that the SVB’s monetary toolkit be modernised, with more tools integrated to improve overall transparency and effectiveness of the monetary policy.

2.4.4. Summary

In summary, inflation rates were high during 2004-2013 and ever since, have been stable and below the target (4-4.5%). Inflation can potentially increase in the coming years given negative

geopolitical and economic shocks worldwide, and the government's decision to make traditionally state-subsidised services (education and medical services) more market-based. Empirical evidence showed that inflation in Vietnam is cost-push, driven heavily by fiscal spending/ deficit and by food inflation (then energy inflation, while headline or core inflation remain quite stable) which were affected by the world market. Monetary policy in Vietnam generally and inflation specifically is managed by SVB via a wide toolkit, from Refinancing rate, Discount rate, OMOs to Caps on Lending rate, Credit Growth and FX Interventions. Policy, bank lending and deposit rates were stable, while OMOs fluctuated more and in accordance to the inflation pattern during 2008-2024.

Macroeconomic data used by the above researchers was obtained from well-known databases such as World Bank, NSO, Bloomberg, CEIC and Haver. Therefore, they were also favoured data sources for the dataset of this research.

3. METHODOLOGY

This section describes and justifies methods selected to conduct data collection and analysis in order to achieve the research objectives. It is composed of the following sections: A short description of the traditional NKPC model to be tested (3.1), The dataset and variables (raw data, data sources, initial treatment and coding of raw data) (3.2), Data analysis (GMM estimation method, reduced-form and full-form equations for GMM estimation, other relevant tests) (3.3) and finally, Ethical considerations (3.4).

3.1. The NKPC model

This research aimed to identify existence of a traditional NKPC in Vietnam. The equation of the traditional, forward-looking NKPC (taken from the Literature Review) is:

$$\pi_t = \lambda mc_t + \beta E_t\{\pi_{t+1}\} \quad (3)$$

The influence of real marginal costs on the current inflation – illustrated by the curve slope λ or the coefficient of real marginal costs – is dependent on two structural parameters: Discount factor β and the measure of price rigidity θ ($\lambda = (1-\theta)(1-\beta\theta)/\theta$). When β or θ goes up, λ goes

down. Thus, a verification of the validity of the traditional (baseline) NKPC model was the first objective of this research.

In order to reduce the problem of weak/statistical insignificant estimated specifications associated with output gap (Vasilev, 2015; Rubbo, 2023), two more proxies for real marginal cost were considered for the NKPC model – labour unit cost (mc_2) and labour income share (mc_3). They can measure the effect of productivity gains on inflation, which the output gap cannot (Vasilev, 2015). So far, there has been no consensus among economists yet about the optimal measure for the unobservable real marginal cost (Mavroeidis et al, 2014; Belinga and Doukali, 2019); for example, researchers such as Rudd and Whelan (2007) did not accept labour income share as a driver of inflation. Therefore, the employment (and comparison) of multiple indicators is recommended (Jarocinski and Lenza, 2016). The inclusion of two more proxies of real marginal cost instead of pure dependence on the output gap is a strength of this research which was inspired by gaps in the literature. The second research objective was to evaluate whether these two variables performed better than the output gap (mc_1) as proxies for real marginal cost in the model.

The choice of measure for inflation expectations is also a crucial determinant of the strength and sign of estimated specifications (Szafranek, 2017). In addition to the conventional price inflation (percentage change in CPI), wage inflation was also included in this research for robustness (Vasilev, 2015; Kurozumi and Oishi, 2022).

On the right side of the Equations, beside mc , long-short interest spread was also included to capture capital costs (Vasilev, 2015).

3.2. The dataset and variables

3.2.1. Raw data and their sources

The research clearly adopted a mono-quantitative method where data was numerical and data analytical techniques are statistics-based. The research approach was deductive: The existing models (traditional NKPC) was verified with recent, real-life data in order for the model to be validated, or rejected, or expanded (Saunders et al, 2019).

This research used purely secondary, macroeconomic data which was obtained from official, reliable databases similar to those favoured by previous empirical researchers for NKPC testing

(see **Table 1**). Collected data is quarterly, for the period of 2012Q2 – 2025Q2. The minimum period for NKPC testing in previous empirical research is 10 years (Szafranek, 2017; Kurozumi and Oishi, 2022), so this research sample was acceptable.

Table 1 – Raw secondary data collected for this research and their sources

Data name	Source
CPI	National Statistics Office of Vietnam: https://www.nso.gov.vn/en/cpi/
Wage inflation	https://tradingeconomics.com/vietnam/wages
Output gap	https://www.theglobaleconomy.com/Vietnam/
Labour share, labour cost	Firms' financial reports: https://vicostone.com/en/Financial%20Reports https://finance.vietstock.vn/ANV/tai-tai-lieu.htm?languageid=2 https://finance.vietstock.vn/FPT-ctcp-fpt.htm
Interest Spread	CEIC database, also used by IMF (2024): https://www.ceicdata.com/en/vietnam/interest-rates/vn-interest-rate-spread
Unemployment	https://www.theglobaleconomy.com/Vietnam/ https://tradingeconomics.com/vietnam/wages
Economic Growth	https://www.theglobaleconomy.com/Vietnam/

3.2.2. Variables of the models – Initial treatment and coding

The raw data in **Table 1** needed initial treatment and coding in order to be usable in economics model testing (see **Table 2**).

Table 2 – Initial treatment and coding of variables for the NKPC model testing

Data/ variable	Code name	Initial treatment (from raw data)
Price inflation	<i>CPI</i>	Log of percentage change in CPI, differenced, lagged (1 lag) (Szafranek, 2017)
Wage inflation	<i>Wageinflation</i>	Raw data was used
Output gap	<i>mc₁</i>	Log of economic growth (GDP), differenced, Hodrick-Prescott filter applied (Vasilev, 2015; Szafranek, 2017)
Unit labour cost	<i>mc₂</i>	Log of cyclical component of unit labour cost, Hodrick-Prescott filter applied (Vasilev, 2015)
Labour income share	<i>mc₃</i>	Log of the cyclical component of labour income share, Hodrick-Prescott filter applied (Vasilev, 2015; Szafranek, 2017; Belinga and Doukali, 2019)
Long-short interest spread	<i>Interestsread</i>	Raw data was used

3.3. Data analysis

3.3.1. GMM estimation method

The equation of the traditional NKPC (Equation (3)) is a rational expectations model:

$$\pi_t = \lambda mc_t + \beta E_t\{\pi_{t+1}\} \quad (3)$$

So, the expected value of π_{t+1} is unrelated to other variables in time t or earlier and we have the following moment condition:

$$E_t\{(\pi_t - \lambda mc_t - \beta \pi_{t+1})z_t\} = 0 \quad (4)$$

Where: z_t is a vector made from variables taken from the information set, orthogonally positioned to the inflation surprise. This moment condition (4) is employed to estimate the NKPC model using the one-step GMM estimation method in Stata at 95% level of confidence.

Nowadays, GMM and VAR are the two most widely used methods to estimate specifications of the curve (Kurozumi and Oishi, 2022). GMM estimation of variables in the NKPC model is favoured by empirical researchers for various reasons:

- GMM can produce less biased and more consistent estimates than Ordinary Least Square (OLS) and Non-linear Least Squares (NLLS). Assumptions of the two latter are frequently violated in NKPC model testing (Vasilev, 2015).
- GMM is suitable to deal with common issues of the model: measurement error associated with measures of inflation, with the output gap and other proxies of marginal cost (Szafranek, 2017).

Therefore, GMM estimator have been validated by several researchers earlier as an efficient tool for NKPC testing (Gali and Gertler, 1999; Vasilev, 2015; Szafranek, 2017; Belinga and Doukali, 2019; Kurozumi and Oishi, 2022).

However, this method is not free from drawbacks, which can affect sign and significance of the estimated specifications:

- GMM estimation use large-sample estimators, so there is doubt that results from GMM estimation for small samples in NKPC testing (datasets containing quarterly data of 10 to 35 years) are reliable. Estimates from GMM are very sensitive to the choice of variable measure (choice of inflation, output gap, marginal cost, and interest spread) and the GMM estimator/version (Arlt and Plasil, 2005; Szafranek, 2017)
- Problem of weak specification identification (Belinga and Doukali, 2019)

It is not yet possible to find a persuasive alternative for GMM, so one way to improve robustness of estimates from this method is by using various GMM versions – Szafranek (2017), for instance, used Two-step GMM (Hansen, 1982), Iterative GMM, Continuous updating estimator GMM (CUE GMM) (Hansen et al, 1996) and Two-stage Least Squares GMM (GMM TSLS).

3.3.2. Reduced form and full-form cases for GMM estimation of the traditional NKPC

In the reduced-form case, only λ and β are considered (not the structural parameter θ / measure of price rigidity). The reduced-form case is:

$$\begin{aligned}
g_t(\delta) &= z_t(\pi_t - \lambda mc_t - \beta E_t \pi_{t+1} + \lambda_0 mc_t + \beta_0 E_t \pi_{t+1} - \lambda_0 mc_t - \beta_0 E_t \pi_{t+1}) \\
&= z_t \varepsilon_t - z_t(\lambda - \lambda_0) mc_t - z_t(\beta - \beta_0) E_t \pi_{t+1}
\end{aligned}$$

$$E(g_t(\delta)) = 0 \text{ iff } \lambda = \lambda_0 \text{ and } \beta = \beta_0$$

The full-form/ structural parameter case uses non-linear GMM estimator with two alternative specifications as follows. In this case, θ was also estimated beside β and λ . The first minimises non-linearities, while the second restricts the coefficient of inflation in the $(t+1)$ period. These are taken from Galí and Gertler (1999):

$$E_t\{(\theta\pi_t - (1 - \theta)(1 - \beta\theta)mc_t - \theta\beta\pi_{t+1})z_t\} \quad (5)$$

$$E_t\{(\pi_t - \theta^{-1}(1 - \theta)(1 - \beta\theta)mc_t - \beta\pi_{t+1})z_t\} \quad (6)$$

The estimation was done with mc being each time mc_1 , mc_2 and mc_3 (one out of the 3 proxies), and inflation being price inflation (*CPI*) and wage inflation (*wageinflation*). Afterwards, the interest spread (*interestspread*) was also included in the model to capture capital costs.

Data interpretation did not stop after the GMM estimation: The research findings are further discussed to not only point out similarities and differences with previous empirical evidence on the validity of the NKPC model in Vietnam versus other economies. They also allow the student (researcher) to make implications about the existence of a hybrid NKPC in Vietnam, and what the curve slope may say about the inflation dynamics in Vietnam (comparison of the slope of the NKPC in Vietnam with those elsewhere (flatter or steeper), and possible reasons for such a slope).

4. FINDINGS AND DISCUSSION

This section is composed of two sub-sections: (4.1) provides specifications of the NKPC model estimated by the GMM method, and (4.2) Discussion of findings in (4.1). Each section has multiple sub-sections: Identified short-run inflation dynamics for price inflation and wage inflation (4.1.1 and 4.1.2), and the discussion regarding the identified NKPC and cautions in application in Vietnam, proxies of marginal cost, slope of the curve, influence of the interest rate spread, and some final thoughts on the hybrid NKPC and money supply as an inflation measure (sub-sections 4.2.1 to 4.2.5).

4. FINDINGS AND DISCUSSION NKPC model specifications estimated by GMM

This section is composed of two sub-sections: (4.1) provides specifications of the NKPC model estimated by the GMM method, and (4.2) Discussion of findings in (4.1). Each section has multiple sub-sections: Identified short-run inflation dynamics for price inflation and wage inflation (4.1.1 and 4.1.2), and the discussion regarding the identified NKPC and cautions in application in Vietnam, proxies of marginal cost, slope of the curve, influence of the interest rate spread, and some final thoughts on the hybrid NKPC and money supply as an inflation measure (sub-sections 4.2.1 to 4.2.5).

4.1 NKPC model specifications estimated by GMM

To remind: The NKPC emerges from Calvo-style sticky-price models, where each firm faces a constant probability $(1-\theta)$ of resetting its price in any period. Under monopolistic competition, an optimizing firm chooses its optimal reset price to maximize intertemporal profits, leading to a forward-looking relation where current inflation depends on expected future inflation and contemporaneous marginal costs. In reduced-form estimation, the NKPC takes the form:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda mc_t + \varepsilon_t$$

where π_t is inflation, $E_t\{\pi_{t+1}\}$ is expected future inflation, mc_t represents real marginal-cost proxies, β denotes the discount factor, and λ measures the slope of the Phillips curve; $\lambda = (1-\theta)(1-\beta\theta)/\theta$

However, empirical applications of the NKPC often reveal persistence in inflation not accounted for by forward-looking terms alone. The hybrid NKPC addresses this by introducing a backward-looking component:

The NKPC model was estimated by system one-step GMM with one lag of inflation as instrument for the level equation, and lags of the differenced variables for the differenced equation.

4.1.1. Short-run dynamics of price inflation

First, the estimation was conducted with price inflation (change in CPI, coded as *CPI*) the dependent variable. On the right side of the equation, real marginal cost was either the output gap (mc_1), or labour unit cost (mc_2) or labour income share (mc_3). The reduced-form case was estimated with and without the long-short interest rate spread (*interestspread*). Estimates of the model corresponding to the use of mc_1 , mc_2 , and mc_3 , with and without *interest spread* are presented in **Figures 4, 5 and 6**, respectively.

```

System dynamic panel-data estimation
Group variable: Firmid
Time variable: quarters
Number of instruments = 306
Number of obs = 156
Number of groups = 3
Obs per group:
    min = 52
    avg = 52
    max = 52
Wald chi2(2) = 343.21
Prob > chi2 = 0.0000
One-step results

```

CPI	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
CPI L1.	.6739497	.0363948	18.52	0.000	.6026171	.7452822
mc1	.001973	.0015561	1.27	0.205	-.0010769	.0050229
_cons	.0097687	.0016045	6.09	0.000	.006624	.0129133

```

Instruments for differenced equation
GMM-type: L(2/.)CPI
Standard: D.mc1
Instruments for level equation
GMM-type: LD.CPI
Standard: _cons
System dynamic panel-data estimation
Group variable: Firmid
Time variable: quarters
Number of instruments = 306
Number of obs = 156
Number of groups = 3
Obs per group:
    min = 52
    avg = 52
    max = 52
Wald chi2(3) = 341.51
Prob > chi2 = 0.0000
One-step results

```

CPI	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
CPI L1.	.6754235	.03658	18.46	0.000	.6037279	.747119
mc1	.0021719	.0015918	1.36	0.172	-.0009479	.0052917
Interestspread	.0530122	.083172	0.64	0.524	-.1100018	.2160263
_cons	.0080752	.0031063	2.60	0.009	.001987	.0141635

```

Instruments for differenced equation
GMM-type: L(2/.)CPI
Standard: D.mc1 D.Interestspread
Instruments for level equation
GMM-type: LD.CPI
Standard: _cons

```

Figure 4 – NKPC model specifications estimated by GMM for Price inflation and output gap

Looking at **Figure 4**, $\beta = 0.673$ and 0.675 without and capital cost captured, respectively, representing the discount factor of the model. $\lambda = 0.00197$ and 0.00217 , showing weak effect that the output gap put on price inflation. With associated p-values > 0.05 (p-value = 0.205 and 0.172), it was concluded that the output gap, as a proxy of real marginal cost, had statistical insignificant effect on price inflation at 95% confidence levels.

Moving to **Figure 5**, the discount factor $\beta = 0.6508$ and 0.6511 when mc_2 was used. This discount rate is smaller than the one used for the output gap; regardless of the employed proxy of real marginal cost, the discount factor β did not change much when interest spread was included in the model. A clear, remarkable difference caused by the change of proxy is the found effect of mc_2 on CPI: With associated p-value < 0.05 (p-value = 0 with and without interest spread consideration), the coefficients of 0.059 and 0.067 were statistically significant at 95% level of confidence. It is therefore concluded that real marginal cost, proxied by unit labour cost, can influence price inflation positively, and the influence is slightly stronger when capital cost is captured (via interest spread).

Finally, when mc_3 was used, the results are shown in **Figure 6**. $\beta = 0.6505$ and 0.6499 , which are quite close to the discount factor values when mc_2 was used. Associated p-values of λ were always < 0.05 (p-values = 0), so λ was statistically significant at 95% confidence level, with or without inclusion of the interest spread. $\lambda = 0.0646$ and 0.0797 , respectively. It can be concluded that real marginal cost, when proxied by the labour income share, had a positive impact on inflation, and the impact is slightly stronger when capital cost is considered.

To summarise, the traditional NKPC was identified in Vietnam, when inflation was measured as price inflation (percentage change in CPI), and real marginal cost was represented by the unit labour cost or the labour income share. The findings support the idea that elements of the labour market, being proxies of marginal cost, performed better in NKPC than the output gap. The first and second research objectives were achieved. Additionally, the slope of the curve was slightly steeper when labour income share was used, although the difference was quite minor. Positive, statistically significant values of the discount factors showed a positive relationship between lagged CPI and current one, implying that inflation is persistent, and inflation of the past period strongly affected inflation of the current period. Such a persistence is a typical feature in inflation dynamics, confirming the relevance of inflation expectations and the role of past inflation in predicting future inflation.

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3
 Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 306
 Wald chi2(2) = 384.56
 Prob > chi2 = 0.0000

One-step results

CPI	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
CPI						
L1.	.6508321	.0352597	18.46	0.000	.5817245	.7199398
mc2	.0590546	.0136719	4.32	0.000	.0322581	.085851
_cons	.0105962	.0015533	6.82	0.000	.0075518	.0136407

Instruments for differenced equation

GMM-type: L(2/.)CPI
 Standard: D.mc2

Instruments for level equation

GMM-type: LD.CPI
 Standard: _cons

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3
 Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 306
 Wald chi2(3) = 387.59
 Prob > chi2 = 0.0000

One-step results

CPI	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
CPI						
L1.	.6511127	.035279	18.46	0.000	.5819671	.7202582
mc2	.0675432	.0144236	4.68	0.000	.0392735	.0958129
Interestspread	.1538317	.0828807	1.86	0.063	-.0086115	.316275
_cons	.0058247	.0030041	1.94	0.053	-.0000632	.0117125

Instruments for differenced equation

GMM-type: L(2/.)CPI
 Standard: D.mc2 D.Interestspread

Instruments for level equation

GMM-type: LD.CPI
 Standard: cons

Figure 5 - NKPC model specifications estimated by GMM for Price inflation and the unit labour cost

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3

Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 306
 Wald chi2(2) = 391.06
 Prob > chi2 = 0.0000

One-step results

CPI	Coefficient	Std. err.	z	P> z	[95% conf. interval]
CPI					
L1.	.6505256	.0349865	18.59	0.000	.5819533 .7190979
mc3	.0646445	.014692	4.40	0.000	.0358486 .0934403
_cons	.0105966	.001541	6.88	0.000	.0075763 .0136169

Instruments for differenced equation

GMM-type: L(2/.)CPI

Standard: D.mc3

Instruments for level equation

GMM-type: LD.CPI

Standard: _cons

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3

Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 306
 Wald chi2(3) = 398.45
 Prob > chi2 = 0.0000

One-step results

CPI	Coefficient	Std. err.	z	P> z	[95% conf. interval]
CPI					
L1.	.6499444	.0349067	18.62	0.000	.5815285 .7183604
mc3	.0797989	.0160007	4.99	0.000	.0484381 .1111597
Interestspread	.2005169	.0848891	2.36	0.018	.0341372 .3668965
_cons	.0044086	.0030375	1.45	0.147	-.0015449 .010362

Instruments for differenced equation

GMM-type: L(2/.)CPI

Standard: D.mc3 D.Interestspread

Instruments for level equation

GMM-type: LD.CPI

Standard: _cons

Figure 6 - NKPC model specifications estimated by GMM for Price inflation and the labour income share

4.1.2. Short-run dynamics of wage inflation

Now, the same estimation procedure was repeated where the dependent variable was Wage inflation. Estimates are presented in **Figures 7, 8 and 9**.

Unlike the case when Price inflation was used (**Figure 4**), the positive and statistically significant relationship between marginal cost proxy (mc_t) and wage inflation (see **Figure 7**) suggests that increases in marginal costs lead to higher wage inflation. $\lambda = 0.0032$ and 0.0035 , with associated p-values = 0.003 and $0.001 < 0.05$. This finding is consistent with economic theories where higher production costs often result in higher wages to maintain workers' purchasing power or reduce labour shortages. The model appears to be robust, as indicated by the high significance levels of the coefficients and the Wald test. This supports the notion that inflationary dynamics in wages are driven by a combination of historical inflation patterns, current marginal costs, and labour market factors. The discount factor $\beta = 0.765$ and 0.767 with and without interest spread.

The overall statistical significance of the model is confirmed by the Wald chi-squared test result of 779.59 , with a p-value of 0.0000 . This indicates that the variables included in the model do indeed explain a significant portion of the variation in wage inflation. The p-values for the other coefficients further confirm the robustness of the model, with most variables being highly significant, except for the constant term.

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3
 Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 301
 Wald chi2(2) = 779.59
 Prob > chi2 = 0.0000

One-step results

Wageinflation	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
Wageinflation						
L1.	.7654834	.0274488	27.89	0.000	.7116847	.8192821
mc1	.0032091	.001083	2.96	0.003	.0010865	.0053316
_cons	.0066554	.0011708	5.68	0.000	.0043607	.00895

Instruments for differenced equation
 GMM-type: L(2/.)Wageinflation
 Standard: D.mc1

Instruments for level equation
 GMM-type: LD.Wageinflation
 Standard: _cons

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3
 Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 301
 Wald chi2(3) = 781.09
 Prob > chi2 = 0.0000

One-step results

Wageinflation	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
Wageinflation						
L1.	.7676078	.0274985	27.91	0.000	.7137116	.8215039
mc1	.0035263	.0011053	3.19	0.001	.00136	.0056927
Interestspread	.0831947	.0574482	1.45	0.148	-.0294017	.195791
_cons	.0040044	.0021732	1.84	0.065	-.000255	.0082638

Instruments for differenced equation
 GMM-type: L(2/.)Wageinflation
 Standard: D.mc1 D.Interestspread

Instruments for level equation
 GMM-type: LD.Wageinflation
 Standard: _cons

Figure 7 - NKPC model specifications estimated by GMM for Wage inflation and the output gap

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3

Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 301
 Wald chi2(2) = 869.37
 Prob > chi2 = 0.0000

One-step results

Wageinflation	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
Wageinflation						
L1.	.7332957	.0262328	27.95	0.000	.6818803	.784711
mc2	.0515204	.0094065	5.48	0.000	.033084	.0699569
_cons	.0077923	.0011203	6.96	0.000	.0055965	.009988

Instruments for differenced equation
 GMM-type: L(2/.)Wageinflation
 Standard: D.mc2

Instruments for level equation
 GMM-type: LD.Wageinflation
 Standard: _cons

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3

Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 301
 Wald chi2(3) = 886.17
 Prob > chi2 = 0.0000

One-step results

Wageinflation	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
Wageinflation						
L1.	.7316616	.0261022	28.03	0.000	.6805023	.7828209
mc2	.0601607	.0098664	6.10	0.000	.040823	.0794985
Interestspread	.1562556	.0565762	2.76	0.006	.0453683	.2671428
_cons	.0030117	.0020587	1.46	0.143	-.0010232	.0070466

Instruments for differenced equation
 GMM-type: L(2/.)Wageinflation
 Standard: D.mc2 D.Interestspread

Instruments for level equation
 GMM-type: LD.Wageinflation
 Standard: _cons

Figure 8 - NKPC model specifications estimated by GMM for Wage inflation and the unit labour cost

Moving to **Figure 8**, mc_1 was replaced by mc_2 whose coefficients (λ) were 0.0515 and 0.0601 with and without consideration of the interest spread. With associated p-values < 0.05 (p-values = 0), such positive effects of the unit labour cost on wage inflation were statistically significant at 95% level of confidence. The significance of this relationship underscores the importance of cost pressures in shaping wage dynamics. $\beta = 0.733$ and 0.731 . Although the output gap and unit labour cost both were found to influence positively wage inflation, the strength difference was clear: a change in marginal cost caused by changes in unit labour cost will drive up inflation much more than changes in the output gap.

Finally, the use of mc_3 produced results in **Figure 9**. The discount factor $\beta = 0.731$ and 0.728 . With associated p-values again < 0.05 (p-values = 0), λ – the coefficients of mc_3 or the slope of the NKPC – were statistically significant at 95% confidence level, even when the capital cost was captured (via interest spread). $\lambda = 0.0544$ and 0.0691 , showing that when the capital cost was considered, the effect of marginal cost proxied by labour income share became slightly stronger.

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3

Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 301
 Wald chi2(2) = 883.25
 Prob > chi2 = 0.0000

One-step results

Wageinflation	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
Wageinflation						
L1.	.7319613	.0260513	28.10	0.000	.6809017	.7830209
mc3	.0544957	.0101403	5.37	0.000	.0346211	.0743703
_cons	.0078289	.0011117	7.04	0.000	.00565	.0100077

Instruments for differenced equation
 GMM-type: L(2/.)Wageinflation
 Standard: D.mc3

Instruments for level equation
 GMM-type: LD.Wageinflation
 Standard: _cons

System dynamic panel-data estimation
 Group variable: Firmid
 Time variable: quarters

Number of obs = 156
 Number of groups = 3

Obs per group:
 min = 52
 avg = 52
 max = 52

Number of instruments = 301
 Wald chi2(3) = 913.55
 Prob > chi2 = 0.0000

One-step results

Wageinflation	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
Wageinflation						
L1.	.7283587	.0257966	28.23	0.000	.6777983	.7789191
mc3	.0691926	.010952	6.32	0.000	.0477272	.0906581
Interestspread	.1931928	.0577428	3.35	0.001	.0800189	.3063667
_cons	.0019717	.0020674	0.95	0.340	-.0020804	.0060238

Instruments for differenced equation
 GMM-type: L(2/.)Wageinflation
 Standard: D.mc3 D.Interestspread

Instruments for level equation
 GMM-type: LD.Wageinflation
 Standard: _cons

Figure 9 - NKPC model specifications estimated by GMM for Wage inflation and the labour income share

Table 3 summarised GMM-estimated specifications for the NKPC model when inflation had two measures, marginal cost had three proxies, with and without inclusion of the interest spread. Based on the estimated β and λ , the measure of price rigidity θ was calculated based on the formula: $\lambda = (1-\theta)(1-\beta\theta)/\theta$

Table 3 – A summary of estimated specifications for the traditional NKPC model in Vietnam

	λ	λ^*	β	β^*	θ	θ^*
Price inflation						
<i>mc₁</i>	Statistically insignificant					
<i>mc₂</i>	0.059 (0.00)	0.067 (0.00)	0.6508 (0.00)	0.6511 (0.00)	0.87	0.86
<i>mc₃</i>	0.0646 (0.00)	0.0797 (0.00)	0.6505 (0.00)	0.6499 (0.00)	0.87	0.85
Wage inflation						
<i>mc₁</i>	0.0032 (0.003)	0.0035 (0.001)	0.765 (0.00)	0.767 (0.00)	0.99	0.99
<i>mc₂</i>	0.0515 (0.00)	0.0601 (0.00)	0.733 (0.00)	0.731 (0.00)	0.87	0.86
<i>mc₃</i>	0.0544 (0.00)	0.0691 (0.00)	0.731 (0.00)	0.728 (0.00)	0.87	0.85

(* values are values when the interest spread was included in the model; associated p-values are in brackets)

From **Table 3**, it was seen that the price rigidity measure did not change much when interest spread was included in the model, at the average of 0.86 (except for the case of *mc₁* in wage inflation). According to the Calvo's pricing rule, this means that there was a fixed probability $(1-\theta) = 0.14$ (14%) that a firm will adjust price in a certain period – as quarterly data was used in this research, it is implied that to match the pricing rule assumption of the NKPC model, there is a fixed possibility that 14% of firm will adjust price in a quarter, while averagely 86% keep their prices fixed.

In summary, when inflation was measured by wage inflation rather than price inflation, a remarkable difference was noticed: The output gap also had a positive, significant impact on

wage inflation (while it did not on price inflation). However, the impact on wage inflation was much smaller than those caused by other proxies of marginal costs associated with the labour market (unit labour cost and labour income share). Whether the output gap was influential to inflation or not, strength of the impact by the output gap was always smaller than the impacts by two other proxies.

Regardless of the selected inflation indicator (wage inflation or price inflation), the NKPC curve was always validated in Vietnam. Marginal cost did affect inflation positively, when the cost was proxied by unit labour cost or labour income share. An increase in the output gap only led to a higher wage inflation (but not price inflation).

The fact that the discount factor β was always positive and had quite similar values regardless of the employed proxy for marginal cost implied that inflation was persistent and current inflation was strongly related to past one. This relationship was stronger when wage inflation was used, compared to price inflation (as β of the former was in the 0.72-0.76 range and the latter 0.65-0.67 range).

As the measure of price rigidity was identified to be averagely 0.86 (without considerable change when the interest spread was considered), it was concluded that in the examined time period (quarter), 86% of the firms in Vietnam keep their prices fixed and 14% of them had the power to adjust prices.

Finally, interest spread was found to have statistically significant effects on Price inflation when labour income share was used (coefficient = 0.2, p-value = 0.018), on Wage inflation when unit labour cost was used (coefficient = 0.15, p-value = 0.006), and when labour income share was used (coefficient = 0.19, p-value = 0.001) (see **Figures 6, 8 and 9**). This finding was good for further discussion (section below).

4.2. Discussion

4.2.1. Existence of a traditional NKPC in Vietnam and some cautious notes for application

Traditional NKPC identified

The traditional NKPC was identified in this research, showing that firms' real marginal costs and expected future inflation can influence positively the current inflation. The validity of the curve in Vietnam contributes to the literature another recent, empirical example beside the ones

by Kurozumi and Oishi (2022) (in Japan and the US), Gabrielvan (2019) (in Sweden, Canada and New Zealand), and Vasilev (2015) (in Hungary).

As the discount factor β is positive, it is argued that firms in Vietnam find future profits more important than the current one. It also pointed out that future inflation is positively correlated to the current inflation, showing the forward-looking behaviour in price-setting of the firms. β values in the $[0;1]$ range implied that inflation persists in Vietnam, either being stable over the years or on the upwards direction in the examined period (2012-2025). Compared to the picture of inflation rate evolution in Vietnam provided in the Literature Review (section 2.4.2), this implication is acceptable: 2004-2013 was a period of high inflation rates in Vietnam with first the grand influx of foreign investment, high spending of state-owned companies, and later the consequences of the Global Financial Crisis (Nguyen, Phan and Tran, 2022). However, inflation has been relatively stable since 2013 to be under 4.5% annually. Many geopolitical and economic factors detailed in this section led to the forecast of increasing inflation in Vietnam in the coming years (IMF, 2024; Tung Linh, 2025).

With the measure of price rigidity θ closer to 1 (being 0.85-0.87 for most cases, and exceptionally 0.99 for mc_1 and wage inflation), price adjustment in Vietnam is less frequent or more limited, so firms focus more future marginal cost (when they can reset the prices) than the current marginal cost (Mihalache and Bodislav, 2019). On average, 14% of the firms had the power to adjust their prices in a period while 86% keep their prices fixed in the NKPC model estimated for Vietnam.

Application of the NKPC model with caution in Vietnam

Issues with the NKPC's estimated specifications raised by Vasilev (2015), Mavroeidis et al (2014) and Belinga and Doukali (2019) are recognised in this research: the upwards bias (towards 1) of the price rigidity θ and the downward bias (closer to 0) of the curve slope/coefficients λ of marginal cost. Such issues may be caused by (1) the multiple assumptions of the NKPC model, especially the constant increase of price over mc , (2) the shortage of a J-test of over-identification restrictions (Chao et al, 2014) for the existence of many moments and heteroscedasticity, in order to check whether the model is correctly specified (Szafranek, 2017) – this is a limitation of this research, (3) measurement error occurred in the making of proxies for the actually unobservable marginal cost and/or (4) the weakening λ due to inflation more resistant to changes in the labour market, in the context of globalisation and technological advances (Ratner and Sim, 2022; Ahn and Lee, 2023) (more details below).

The flexibility of firms in adjusting prices might be more restricted in Vietnam than in more market-driven economies. Vietnam's market is still heavily shaped by state-owned enterprises (SOEs), which often have pricing power that is less sensitive to market forces than private firms. SOEs, despite being privatized in part, still often rely on government interventions and regulations that may distort market price-setting mechanisms (Tuyet and Ninh, 2023). For example, SOEs in key sectors like energy and transportation are heavily influenced by government-set prices, which limits their ability to pass on marginal cost increases to consumers. This could explain why some of the proxies for marginal costs, particularly unit labour cost, are not as robust in predicting inflation (European Investment Bank, 2024). Meanwhile, private sector firms, especially those in competitive industries like electronics manufacturing, are more responsive to changes in economic conditions and are more likely to adjust prices based on future expectations of inflation. As a result, the model's emphasis on forward-looking firms must be considered with caution in the Vietnamese context, as SOEs may display a more backward-looking or less flexible approach to pricing.

When the Vietnam market is opener, which is happening in the coming years as the government reduces incentives, letting energy and food price become more market-based (Tung Linh, 2025), the application of the NKPC is still complicated by the fact that world market shocks to domestic food and energy are more amplified in small, open economies (where energy and food spending account for a large part of the household's consumption basket) than big, developed ones (Volha and Jan, 2024).

Differences in estimates for the NKPC between the two dependent variables – wage inflation and price inflation are clear. Price inflation was affected by only mc_2 and mc_3 while wage inflation was affected by also mc_1 (beside mc_2 and mc_3). One cause of the dissimilarity between wage inflation and actual inflation is the economic reform process of Vietnam. A fundamental element of the reforms in Vietnam has been the de-centralisation of planning and a liberalisation of markets including the labour and capital markets. These reforms facilitated the shift away from mainly state-owned corporations (Vo, 2023) (SOEs) towards a more variant economy with a growing number of people under the banner of privately owned enterprises and also increased foreign direct investment (FDI) activity. This also resulted in increased competitiveness in various industries, which made businesses more efficient and embrace new technologies in order to stay afloat. Since productivity gains are one of the main factors through which economic growth can be decoupled with wage inflation, the fact that Vietnam has registered productivity gains as a result of the implemented reforms has further helped cap

wage inflation. In a conventional environment, wage increment creates pressure on prices as companies transfer a portion of advancements in the cost of labour to the consumers. However, when workers become more productive, firms can afford to pay higher wages without proportionally increasing unit labour costs, thereby limiting the cost pressures on prices. This dynamic is particularly evident in sectors that benefit most from technological progress and scale economies. Firms may be mitigating labour cost increases through efficiency gains, technological substitution, or absorbing costs to remain competitive, all of which weaken the direct inflationary impact of wage growth.

4.2.2. The role of marginal cost proxies in Vietnam

The issue of the interconnection between inflation and the marginal costs is central in the NKPC. The results of the testing model provide that the output gap (*mc1*) has a positive power in predicting the wage inflation, which is within the expectation of the structural NKPC and shows that the output gap may not (yet) be an outdated indicator. Within the context of Vietnamese firms, such finding would coincide with larger macroeconomic development, wherein inflationary pressures tend to be directly statistically correlated with economic overheating or a tight labour market. There are some cautionary notes though: The ability of the output gap to drive inflation was only realised for wage inflation (but not price inflation), at a much weaker intensity compared to other labour-market related proxies, and with an extreme assumption of the Calvo's pricing rule: $\theta = 0.99$ implied that in a certain period, 99% of firms keep their prices fixed and only 1% have the power to adjust their prices (forward-looking behaviour). Such an assumption seems quite unfeasible in the real world, and combined with weak influence power of the output gap, it is safer to not depend on output gap to tackle inflation.

A spotlight of this research was the consideration of two more proxies - unit labour cost (*mc2*) and labour income share (*mc3*) for marginal costs in Vietnam. Positive relationships were found between these two and inflation, regardless of the inflation measures (wage or price inflation). The strength range is 0.051-0.064 (λ value range), with labour income share having a stronger impact than unit labour cost on inflation. In the Vietnamese setting, an increase in wages in industrial sectors, particularly the export-driven ones such as electronics and textiles may cause the firms to experience higher marginal costs, which will force an increase in prices (Francois et al, 2023).

Although unit labour cost and labour income share had positive effects on inflation, the impact strengths were relatively small and there are possible explanations for that; it is even forecast that the impact may continue to move towards 0 in the future. Such productivity improvements driven by Artificial Intelligence (AI) and automation technologies can offset rising wages, reducing unit labour costs and limiting firms' incentives to raise prices. Essentially, the increased efficiency allows firms to absorb wage hikes without passing them on to consumers. The invention of new technology encourages capital replacements of labour particularly in routine or manual jobs. This replacement has the ability to limit wage gains through lowering labour bargaining power and having a general damping effect on labour costs (Nghiem and Narayan, 2022). The reduced pressures on labour costs can then transfer over to a reduced directed pass-through effect of wage increase to inflation or even a lowering of inflation.

Economic reforms introduced more flexible labour practices and diversified labour market arrangements. The growth in contract labour, outsourcing, and informal employment reduced rigidities in wage-setting compared to the prior centralized system (Nguyen et al., 2021). Increased labour market flexibility dampened wage inflation dynamics by allowing firms to adjust employment and compensation in line with efficiency goals rather than fixed wage schedules. Moreover, the reform process has augmented the importance of human capital and skills development. Investment in education and training aligned labour supply with the evolving requirements of higher productivity sectors. This improved matching reduces structural mismatches and excessive wage demands in particular segments, helping moderate aggregate wage growth even as the overall economy expands. On the institutional side, labour regulations have gradually evolved but still reflect a careful balancing act between workers' protection and market flexibility. This complex environment sometimes slows wage adjustments or leads to wage stagnation despite economic growth, further weakening a straightforward wage-inflation pass-through.

4.2.3. Comparison of the NKPC slope in Vietnam with the ones in other economies

The traditional NKPC in Vietnam has a slope (λ) of 0.059 - 0.064 (for price inflation) and 0.051 - 0.054 (for wage inflation). When the output gap was used to represent marginal cost, the slope is flatter ($\lambda = 0.0032$). Compared to findings by previous researchers in other economies, the Phillips curve in Vietnam during 2012-2025 was much flatter: $\lambda = 0.12$ in Morocco (Belinga and Doukali, 2012), $\lambda = 0.37$ to 0.58 in Poland (depending on the GMM version used)

(Szafranek, 2017). It was steeper, though, than the slope found by Vasilev (2015) in Hungary: $\lambda = 0.0002$ (traditional NKPC) and 0.0023 (hybrid NKPC). An open, small economy may have a flatter curve due to under-use of labour and/or indirect effects of the world market on domestic inflation (via imported food and energy) (Szafranek, 2017). A flatter Phillips curve in Vietnam implies that it is more costly for the SVB to stabilise inflation in Vietnam (than what it costs the central banks in Morocco or Poland). The third research objective about the slope of the curve in Vietnam was achieved.

4.2.4. Significant effect of the long-short interest rate spread on inflation

In this research, interest spread was found to have statistically significant, positive effects on Price inflation when labour income share was used, and on Wage inflation when marginal cost was proxied by either unit labour cost, or labour income share (at 95% confidence level). Such a finding that interest rate is an important determinant of inflation in Vietnam was previously seen in Nguyen, Phan and Tran (2022)'s inflation research for the 1997-2000 period. Interest rate was the second strongest factor (after the government spending) with positive effect on price inflation.

Interest rates in Vietnam, influenced by both domestic monetary policy and international financial conditions, provide businesses with signals about future inflationary trends (Nghiem and Narayan, 2022). In this respect, the results showed that higher interest rate spreads are linked to higher inflation, a finding that corroborates the forward-looking pricing behaviour described in the NKPC. Vietnamese firms, especially those in manufacturing and exports, adjust their prices in anticipation of future monetary policy shifts, which directly affect their costs of financing and their pricing strategies (Ly, 2022).

The Vietnamese economy remains relatively monetary-policy dependent with frequent adjustments to interest rates and credit policies to combat inflation. While the interest rate spread may indeed be a leading indicator of inflation expectations, its predictive power might be less reliable in the context of the Vietnamese economy, where price controls, government subsidies, and other fiscal tools continue to play a substantial role in determining inflationary outcomes (IMF, 2024).

4.2.5. Final thoughts – a hybrid NKPC in Vietnam and Money supply as an inflation measure

The hybrid NKPC model

A potential explanation for the existence of backward-looking behaviour in Vietnamese firms is that many businesses operate within traditional industrial sectors, such as textiles, agriculture, and construction, where past inflation rates and historical cost structures often serve as a more reliable guide for price-setting (Nguyen, Masaru and Bui, 2025). Microenterprises, especially in rural areas, often have limited access to sophisticated forecasting tools and global market insights, and as such, their pricing behaviour is more reactive to changes in input costs and wages rather than anticipatory of future inflationary trends.

Moreover, the non-tradable sector in Vietnam, which includes many services, is more insulated from global economic conditions and thus tends to be more backward-looking (Lim, Xu and Binh, 2025). The service sector, including education, healthcare, and retail, often reflects price rigidity and inertia as firms adapt to long-standing business models rather than adjusting rapidly to changes in inflation expectations or economic shifts. This further complicates the full application of the forward-looking assumption in the traditional NKPC model, and suggests the examination of a hybrid NKPC one in Vietnam.

Changes in money supply (M1) as possible inflation measure

Theoretically, this variable is expected to have a positive relationship with inflation, as an increase in money supply typically leads to higher inflation. In the case of Vietnam, this relationship is even clearer (Nguyen, Hoang and Le, 2022). As a rapidly developing emerging market economy, Vietnam is particularly sensitive to changes in its monetary policy, as its financial system is still evolving. An increase in money supply in such an economy, especially when it outpaces economic growth, tends to lead to demand-pull inflation, where too much money in the system bids up prices.

5. CONCLUSIONS AND IMPLICATIONS

This final section is divided into three sub-sections: (5.1) concludes about the completion of the research objectives, summarising key findings of this research; (5.2) presents some implications taken from the findings, which helped achieved the fourth (and last) research objective. Section (5.3) highlights some areas for future research based on the limitations of this research.

5.1. Conclusions

This grand project was wrapped up successfully when all four research objectives were achieved and the research questions answered. The first objective was achieved when a traditional NKPC was identified in Vietnam for the period of 2012Q2-2025Q2, using quarterly macroeconomic data. The model is valid as firms' marginal cost and expected future inflation had positive impacts on inflation, regardless of the employed measure of inflation. Briefly speaking, price inflation (measured by change in CPI) was positively affected by the marginal cost via two proxies Unit labour cost, and Labour income share, at the impact intensity of (0.059; 0.797) with and without the inclusion of the long-short interest rate spread (to capture capital costs). The output gap, as a proxy for marginal cost, had statistically insignificant power to price inflation. Meanwhile, wage inflation could be driven by all three proxies of marginal cost, including output gap. The sign of impact was again positive, with the output gap having the weakest influential power (impact intensity of 0.0032-0.0035), outweighed by the two other labour-market related indicators whose impact strength was in the (0.051; 0.691) range. The inclusion of the interest spread resulted in higher estimates of the curve slope/ the coefficients of the marginal cost proxies.

Additionally, positive values of the discount factor in the (0;1) range also implied a positive correlation between current and future inflations, matching the forward-looking price-setting behaviour in the traditional NKPC model. It also pointed out persistence of inflation (in stable state or upwards trend) in Vietnam, which is confirmed by the inflation patterns of Vietnam provided by earlier researchers.

The model estimation also allowed this research to figure out the price rigidity for the NKPC assumptions: In any examined period (any quarter during 2012-2025), about 86% of firms in

the Vietnam market kept their prices fixed, while only 14% had the power to pre-set/ adjust prices according to their marginal costs and expected future inflation.

The second research objective was achieved: it is confirmed that Unit labour cost and Labour income share performed better as proxies of marginal cost for the NKPC model. They could positively influence both price inflation and wage inflation. In contrast, the conventional output gap showed no statistically significant effect on price inflation, and a significant but quite weak impact (closer to 0) on wage inflation. For real marginal cost to affect considerably inflation, the two proxies associated to the labour market are clearly preferred. For both types of inflation examined, Labour income share always had a strong effect than Unit labour cost on inflation. When the interest rate spread was considered in the model, impacts of the proxies of marginal costs increased.

The third research objective was achieved by comparing the slope of the Phillips curve in Vietnam with those in other small, open economies. The curve in Vietnam is steeper than in Hungary, but much flatter than the ones in Morocco and Poland. Such a flattening of the curve in Vietnam implies it will be more costly or difficult for the SVB to reach inflation target based on the NKPC model. Other reasons may explain the flattening of the curve in this small, open economy such as measurement error caused by the selected proxies (for marginal costs and/or inflation), by the selected estimation method (due to remaining drawbacks of the GMM method and the choice to use single, one-step GMM rather than the combination of more GMM versions), the multiple assumptions of the NKPC model, and/or the fact that inflation in such an economy is greatly affected by the world market (particularly food and energy prices).

5.2. Implications

This section helps to achieve the fourth research objective. Firstly, as the traditional NKPC was validated for price inflation and wage inflation in Vietnam, Unit labour cost and Labour income share (proxies of marginal cost), and expected future inflation were confirmed to be positive determinant of the inflation. To drive up or down the short-run inflation, the SVB can make monetary decisions which tackle changes in the Unit labour cost and/or the Labour income share. Although the output gap was found to be influential to wage inflation, its much weaker impact compared to the two other proxies prevents it from being a factor of focus for the SVB.

Secondly, although the forward-looking NKPC model was valid in Vietnam, the application of this model by academic researchers and the SVB in its monetary policy can be tricky or more complicated than in theory. Vietnam is an open, developing economy with its distinct political and economic attributes that can potentially weaken effects of the marginal cost and expected future inflation on current inflation; in other words, they can weaken the effectiveness of the traditional NKPC as a model of short-run inflation dynamics, make the curve flatter, and/or make the hybrid NKPC a fitter model when backward-looking behaviour is stronger than forward-looking one. These attributes are: Restricted flexibility for firms to adjust prices in an economy frequently intervened by the government and the central bank/SVB, and heavily shaped by state-owned enterprises; different ability or habit to adjust prices in different economic industries; the government's plan to make energy, education and medical services more market-based, making Vietnam more influenced by price shocks in these services in the world market; technological advance including AI making the transition from the labour market to inflation weaker.

Thirdly, findings from this research confirmed the issue of weak parameter identification associated with the lack of consensus on the optimal estimation method and measure/proxy to use (for inflation and marginal cost). The SVB should apply a “thick-modelling” approach by employing multiple measures and estimation methods when testing the NKPC model.

5.3. Areas for future research

This research is not free from limitations, which can be potential areas for future research. The research objectives can be expanded to identify the evolution of the Phillips curve over time, by comparing the curves in two different time periods, for example. Similarly, the examined time period can be extended from 14 years in this research to 25 or 35 years like some previous researchers did. More data may improve robustness of the estimated model specifications. The issue of weak parameter identification can be improved by using more inflation measures (for example, inflation calculated from changes in M1 aggregate), or more versions of GMM (Iterative GMM, two-step GMM, continuous updating GMM/ GMM CUE, and/or two-stage least square GMM/ GMM TSLS). The use of the J-statistic test of over-identification restrictions is also necessary; undone in this research, it can help to assess whether the built NKPC model is correctly specified. An additional identification of the hybrid NKPC model is also highly recommended.

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