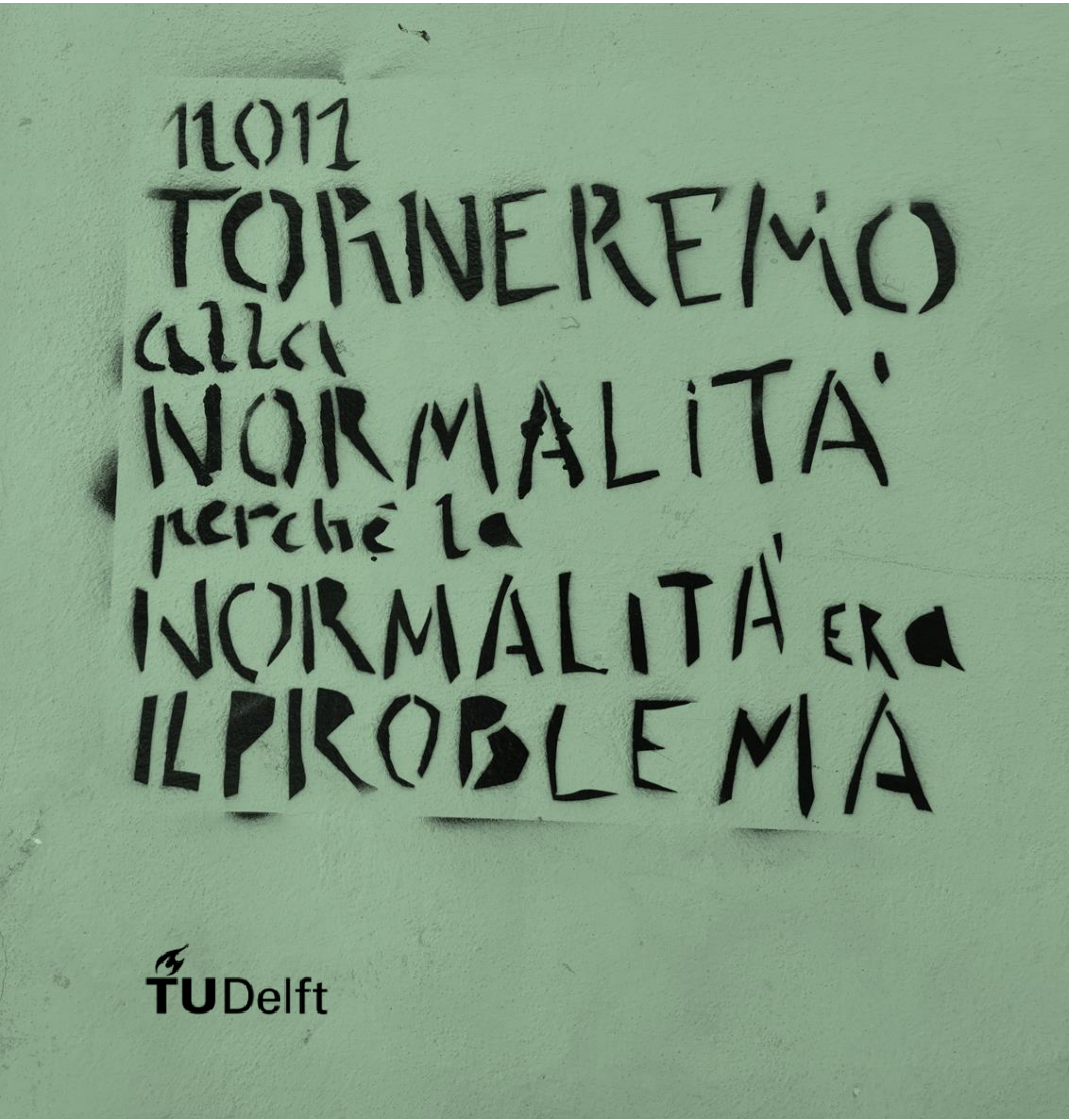
Nicolò Canal

Beyond conventional growth

Analysing economic growth through the lens of hysteresis



TU Delft

Beyond conventional growth

Analysing economic growth in a demand-led framework

By

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Executive summary

The search for the key drivers of economic growth in capitalist economies has been a focal point of economic analysis since the days of classical economists like Adam Smith, David Ricardo, and Karl Marx. To better understand growth and the forces enabling capitalist economies to expand their production of goods and services, economists often categorise economic factors into two independent groups.

On one hand, there are demand-side factors such as consumer spending and investment, which primarily drive economic fluctuations. On the other hand, there are supply-side factors like technological innovation and labour force growth, which set the potential output path of an economy. This potential output represents the maximum production level an economy can achieve without causing inflation, acting as a centre of gravity for actual economic dynamics.

Potential output is particularly crucial for Eurozone countries due to its significant role in fiscal regulations and monetary policy. Fiscal rules, such as those governing structural budget balance, require countries to align their budgets with potential output to ensure sustainable public finances. The European Central Bank (ECB) monitors the output gap—the difference between actual and potential output—to assess whether economies are approaching inflationary limits. Both fiscal and monetary policies thus rely heavily on the concept of potential output, highlighting its importance in maintaining economic stability and growth.

This research aims to enhance the understanding of economic growth through a simple demand-led model that incorporates hysteresis—the lasting effects of demand-side dynamics on potential output. Despite increasing recognition of hysteresis, few studies have developed straightforward dynamic models integrating these mechanisms. Notable exceptions include the work of Fazzari, Ferri, and Variato (2020), who examined hysteresis effects on US economic growth using a simple demand-led model. This study extends their framework, using Italy's economy from 1979 to 2018 as a case study, and introduces key conceptual and methodological changes to improve model accuracy and uncertainty analysis.

Italy's economic context, marked by low and stagnant GDP and labour productivity growth, high unemployment, and widespread involuntary part-time employment, provides a unique setting for this investigation. The Fazzari, Ferri, and Variato (2020) model is demand-led, with potential output as the upper boundary for economic dynamics. Demand-side factors, especially autonomous components like government spending and exports, shape the system's evolution. Hysteresis mechanisms link potential output to changes in unemployment rates and capital stock accumulation, challenging traditional views that separate supply-side and demand-side dynamics.

Dynamic simulations of the model across various scenarios yield critical insights. Accurate simulations require specific values for key parameters, such as the propensity to save and the long-run target capital-output ratio. The model reveals a trade-off between accurately describing demand-side and supply-side dynamics, particularly regarding labour productivity evolution post-1990s and general labour supply trends over the study period.

The empirical simulations show that the stability of steady-state solutions depends mainly on certain demand-side parameters. The adjustment speed for expected growth (α)—indicating how many years of past yearly growth are used by households to form future growth expectations (with higher α implying a longer memory)—and the adjustment speed for the capital-output ratio (λ)—showing how quickly the actual capital-output ratio converges to its long-run value set by firms—are critical.

Accurate scenarios for the Italian economy fall outside the unstable range, ensuring stable economic dynamics. However, the value of α suggests caution due to the implied long memories of past growth in forming future expectations.

Our research introduces unique conceptual and methodological tools that enhance the analysis of economic growth. The use of Causal Loop Diagrams (CLDs) visually represents feedback loops and interdependencies within the model, making complex relationships easier to understand and communicate. Additionally, our empirical analysis employs the All-Factors-At-a-Time (AAT) method, which allows for simultaneous variation of all model parameters across their feasible ranges. This approach offers a more comprehensive and realistic examination of non-linear systems compared to traditional methods.

For policymakers, recognising hysteresis and integrating these advanced tools into economic models can lead to more informed and effective decision-making. By considering the long-term impacts of demand-side policies on potential output, and using visual and comprehensive analytical methods, policymakers can better navigate the complexities of economic growth and stability. This research advocates for a more integrated and nuanced approach to economic policy, fostering broader dialogue and enhancing our collective understanding of growth dynamics.

While this research provides valuable insights, it acknowledges several limitations. Methodologically, the study relied on assumptions about the initial capital-output ratio and growth rates due to a lack of initial data, potentially impacting model accuracy. The empirical approach, while intuitive, may lack the mathematical rigour needed for robust results, and more advanced econometric techniques could enhance parameter estimates. Conceptually, the model struggled to capture supply-side dynamics, particularly labour productivity stagnation and labour supply evolution. The reliance on exogenous inputs for autonomous demand components limits the model's ability to fully replicate real-world demand-side dynamics.

Future research should build on this work by expanding the current model to better capture case-specific information, particularly recognising the impact of austerity measures on Italy's economy. Revising the hysteresis mechanisms is crucial to accurately reflect the dynamics of supply-side variables, incorporating factors such as labour protection legislation and financialisation proxies. Additionally, addressing inequality and ecological constraints within the model could provide a more comprehensive understanding of sustainable economic growth. These aspects are critical for enhancing the model's applicability and relevance in public and policy debates.

Moreover, comparative analysis using different models, such as the Solow-Swan model, could offer unique perspectives on economic growth theories and their assumptions. Exploring the connection between economic modelling and policymaking, particularly how diverse economic theories are integrated into policymaking, presents another promising avenue. This could involve interviews with experts to understand how models are employed in major policymaking institutions and how a plurality of economic theories can be effectively communicated to the public. By addressing these areas, future research can enhance the robustness and applicability of economic growth models.

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I. Introduction

At the heart of the economic analysis of capitalist economies lies a fundamental quest to identify the drivers of economic growth. Since the foundational work of classical economists like Adam Smith, David Ricardo, and Karl Marx, there has been a continuous effort to understand whether the growth trajectories of different countries can be linked to specific factors. Over time, various hypotheses and conceptualisations have emerged, offering diverse insights into the dynamics of capitalist growth.

A key observation, now well-established in economic theory, is the notion of business cycles. This concept describes how economies and societies experience periods of expansion and recession due to the complex interplay of various forces and the inherent instability of capitalist processes such as production, accumulation, and distribution. Despite extensive research, significant debate among economists persists regarding the drivers of these fluctuations, methods for their prediction and management, and whether economies fluctuate around a long-run equilibrium path. My work primarily originates from this last question: is there an equilibrium around which real output fluctuates?

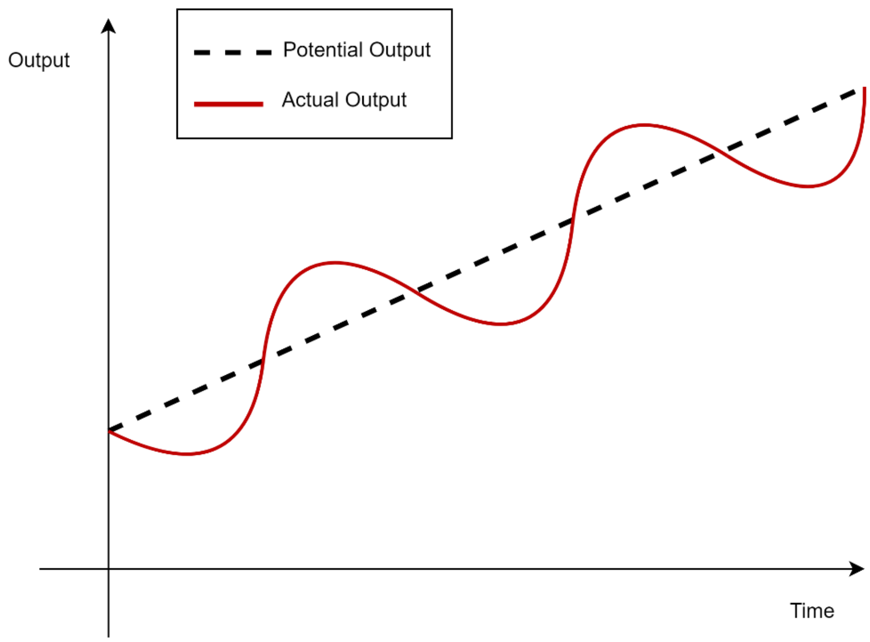

Figure 1*: Stylised representation of potential and actual output dynamics. The reader should not consider potential output simply as the trend of actual output. Rather, at least following its most common interpretation, it is best understood as a gravitational centre, around which the dynamics of actual output evolve over long periods of time.*

The common answer is affirmative. This unobservable equilibrium path, often referred to as potential output, suggests an underlying order behind the apparent chaos of capitalist growth dynamics. Potential output is commonly defined as the maximum level of economic output that can be achieved without causing inflation (Figure 1). Despite being an abstract concept, potential output plays a critical role in EU fiscal policy. The European Commission relies on potential output estimates to determine the structural budget balance, a key parameter for setting spending and consolidation guidelines for national governments across the EU. Moreover, potential output and the associated concept of the output gap (the difference between actual and potential output) are essential for central banks when formulating monetary policy (Fatás 2019; Heimberger, Huber, and Kapeller 2020).

In practical terms, when actual output exceeds potential output, it signals the need for austerity measures. Governments are expected to cut expenditure and raise taxes, while central banks may increase interest rates to prevent the economy from overheating. Conversely, when actual output falls below potential output, expansionary policies may be implemented to stimulate growth. This dynamic ensures that fiscal and monetary policies are aligned with the overall economic stability and growth objectives of the EU.

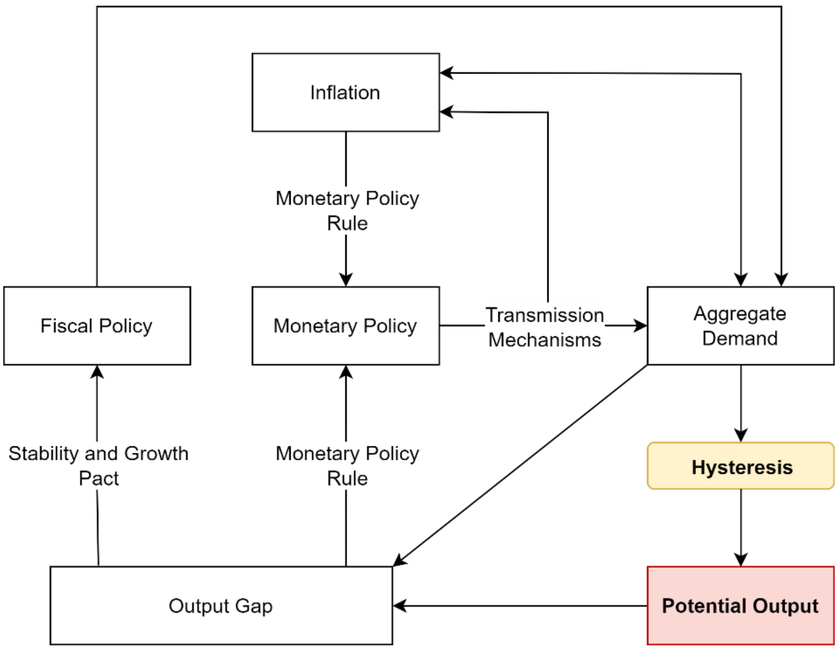

Figure 2: *Conceptual diagram capturing the relevance of potential output, and the output gap, for guiding fiscal and monetary policymaking. This diagram was specifically designed for the case of E(M)U countries since it includes the Stability and Growth Pact (SGP) agreement. Nonetheless, this conceptual framework could be easily extended to other countries by excluding the SGP and appropriately substituting it with different legislative or institutional frameworks which use the output gap as a key criterion for guiding fiscal policies.*

Figure 2 illustrates the intricate interplay between potential output and policy decisions, both fiscal and monetary, which will be explored in detail in the subsequent chapters of this thesis. However, the discourse on potential output is neither uniform nor settled. There is no consensus on its empirical estimation and theoretical definition across different economic schools (Fontanari, Palumbo, and Salvatori 2020). The foundational neoclassical school, rooted in marginalist thought, asserts that the long-run trajectory of potential output is predominantly governed by supply-side factors. In contrast, heterodox economists, including post-Keynesians, neo-Kaleckians, and neo-Kaldorians, argue that demand-side forces play a critical role in shaping long-run potential output (Blecker and Setterfield 2019; Palumbo 2015; Carnazza et al. 2023).

To explain these terms simply, demand-side factors refer to aspects that influence the overall demand for goods and services in the economy, such as consumer spending, government expenditures, and investment. On the other hand, supply-side factors relate to the production capacity of the economy, including technological innovation, availability of skilled labour, and capital stock.

These debates highlight a core disagreement about the driving factors of economic dynamics—demand-side versus supply-side. Despite these fundamental disagreements, non-economists might be surprised to learn that the economics discipline has largely centred around the supply-side paradigm. Most economists studying economic growth focus primarily on supply-side factors, believing that while demand-side forces only affect temporary fluctuations, robust long-term growth (i.e., rising potential output) relies on supply-side elements such as technological innovation and a high-quality workforce (Blecker and Setterfield 2019; Rochon and Rossi 2016).

Despite critiques over the past few decades, mainstream economic theories continue to underpin the work of key international research organisations and policymakers, including the IMF, World Bank, European Central Bank, and European Commission. However, the long-lasting scars induced by the Great Financial Crisis on the evolution of OECD countries' potential output (see Figure 3) have compelled economists, irrespective of their school of thought, to acknowledge the enduring effects of negative demand-side shocks on potential output. This phenomenon, which stems naturally from the demand-side understanding proposed by heterodox economists, has been named, trying to draw similarities with natural sciences phenomena, hysteresis, and has received considerable attention in the past fifteen years.

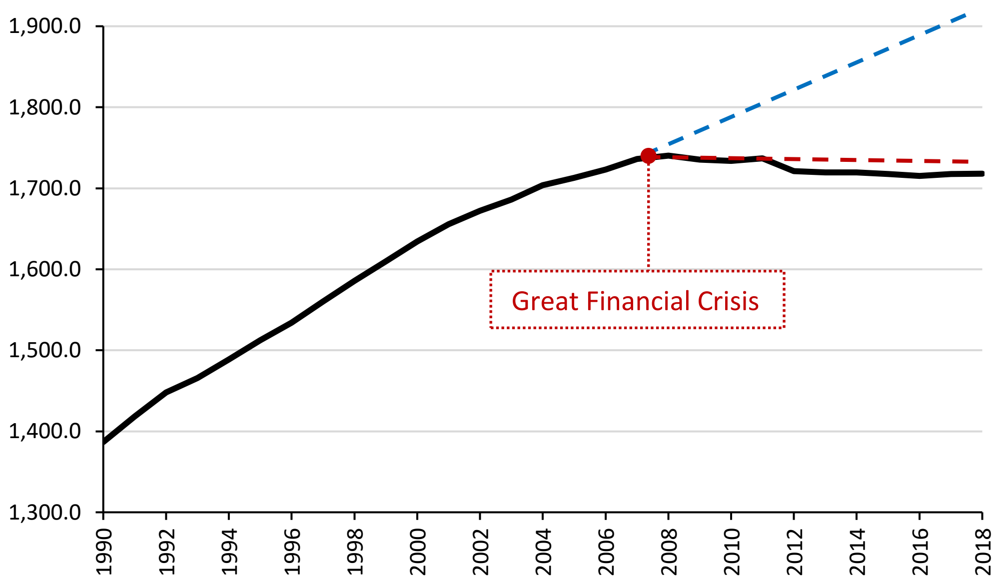

Figure 3: *Potential GDP at constant prices of the Italian economy. The blue dashed line outlines the approximate pre-recession trajectory of potential GDP, while the red dashed line represents the post-recession trend. The disparity between these lines underscores the hysteresis impact of the 2008 Great Financial Crisis on potential output. (Data source: AMECO Database)*

Despite recognising the influence of demand-side forces on (long-run) potential output, strong disagreements remain around the mechanisms responsible for hysteresis. More importantly, the vast majority of macroeconomic models used by influential institutions (e.g., European Commission) still do not explicitly investigate or capture the possibility for demand-side expansionary policies to positively influence future potential output without resulting in inflationary pressures. This conceptual understanding, which is essentially a intellectual heritage of orthodox theories of growth, gives rise to the so-called asymmetric formulation of hysteresis.

In light of these limitations, and following the failure of standard models to predict the buildup of the 2007-2009 financial crisis (Fischer et al. 2017), a growing demand for heterodox perspectives has characterised not only the academic environment but also the public and policymaking environments. However, even though there has been significant advancement in complex heterodox macroeconomic models, such as stock-flow consistent models (Nikiforos and Zezza 2017), the empirical investigation of simpler dynamic macroeconomic models has been somewhat overlooked.

The importance of analysing reality through the lens of simple models should not be overlooked. In fact, this thesis starts from the understanding that while large models can provide comprehensive and detailed descriptions of economic developments, their effectiveness in guiding real-world policies does not stem from their complexity. Instead, it is the presence of a fundamental "backbone conceptual model" that policymakers can easily understand, aligning with their value judgments about the reality they want to shape with their actions.

Therefore, if our goal is to promote a new or alternative understanding of economic growth, accounting for the role played by hysteresis and the importance of not relegating demand-side dynamics to just short-run developments, relying on overly complex models may actually diminish our chances of success.

Against this backdrop, the empirical research undertaken by Fazzari and González (2023) stands out. Their work, which extends the demand-led model developed by Fazzari, Ferri, and Variato (2020), is significant for several reasons. Firstly, its structural simplicity, incorporating fewer than ten equations covering both demand and supply elements, allows for clear interpretation and facilitates the critical evaluation of diverse economic scenarios. This simplicity is instrumental in enabling a deeper understanding of the model's mechanics and implications.

Furthermore, the model's incorporation of Harrod’s instability principle effectively captures the nuances of business cycle dynamics alongside the evolution of potential output growth (Fazzari et al., 2013). This aspect of the model enriches the dynamic understanding of macroeconomic factors, extending the analysis beyond traditional equilibrium considerations.

Lastly, the model adopts a comprehensive approach to both demand and supply dynamics. While placing significant emphasis on the role of demand in shaping macroeconomic trends, it also recognises the dynamic constraints and influences of supply-side factors. This approach allows for a more realistic and holistic portrayal of economic processes, acknowledging that supply constraints are not static but evolve in response to demand shifts.

Research questions

Given all these considerations, and based on the model formulation given by Fazzari, Ferri, and Variato (2020), central to this thesis is the following research question:

How can a simple demand-led model, incorporating the concept of hysteresis, enhance our understanding of economic growth?

Italy will be chosen as the case study for this research. Choosing Italy as the focal point for this study is far from a restrictive move; it represents a strategic decision to apply the Fazzari, Ferri, and Variato (2020) model within a markedly different economic landscape than that of the United States. This deliberate contrast offers a unique opportunity to explore the model's robustness and adaptability to varying economic contexts.

Building on the main research question, the study delves into several key sub-research questions, each designed to dissect and understand the intricate facets of economic growth, policy, and modelling:

1. How have (potential) economic growth and hysteresis been conceptualised in macroeconomic literature?
2. What are the key stylised facts to consider when studying the Italian economy?
3. What are the key features of the Fazzari, Ferri, and Variato (2020) growth model?
4. How do changes in the model's input factors across their feasible empirical ranges affect model accuracy and dynamic stability?
5. What are the potential policy implications of this research?
6. What are the key limitations of the proposed analysis, and how should future studies be developed?

Thesis structure

The primary aim of this thesis is to answer the research questions outlined above. Accordingly, the thesis is structured to follow a coherent narrative, as schematically illustrated in *Figure 4*, which provides a research flow diagram that supports the overall storyline.

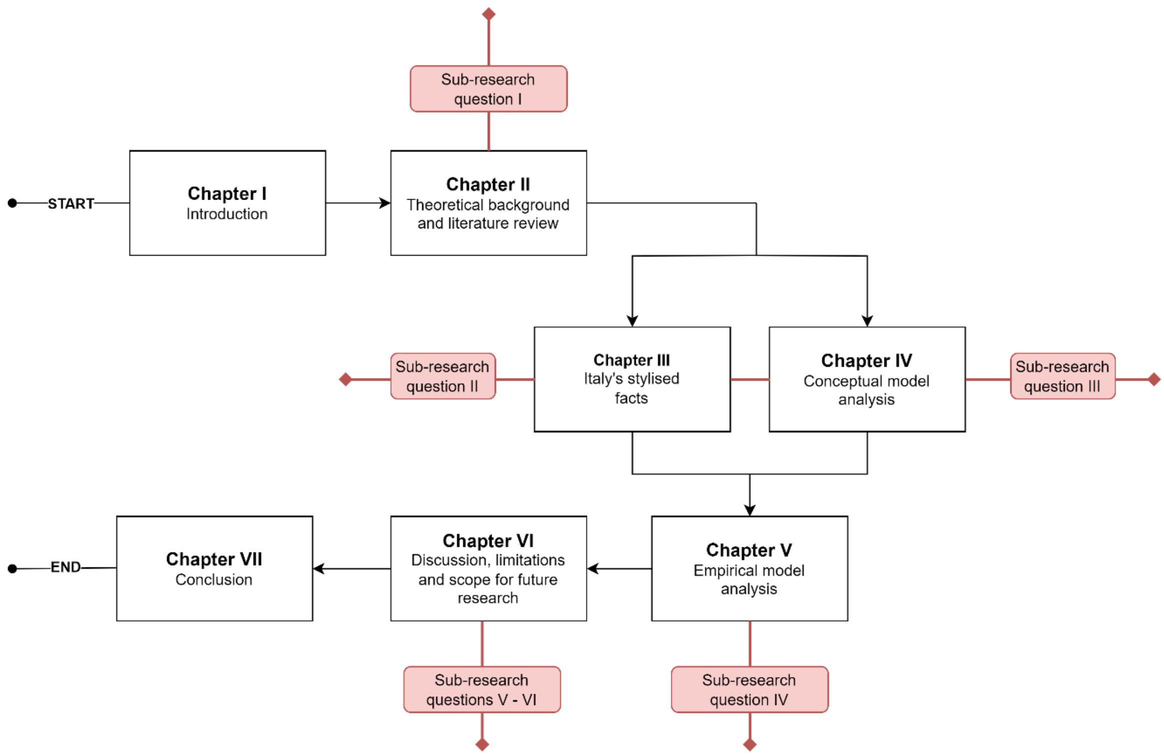

Figure 4: *Research flow diagram.*

II. Theoretical background and literature review

When macroeconomists assess the overall health of the economy, they generally do this by comparing the level of real GDP (a measure of the actual output of the economy) to potential output, or the level of output that the economy could feasibly produce without fuelling excessive inflation. If the economy is running "hot", actual output will be close (or even higher than) potential output, and when the economy is in a recession, actual output will be below potential. Potential output, as should be clear, is not a directly observable variable – and this raises difficult issues concerning its conceptualisation and measurement.

The concept of potential output emerges from the diverse and complex economic theories that attempt to describe the unpredictable evolution of capitalist economies. In this research, I will sidestep an in-depth theoretical debate for practical reasons: my expertise does not extend to years-long investigations needed to link theory with practice, and I presume the reader prefers a direct approach over theoretical intricacies. Thus, I will offer a stylised representation of different approaches to conceptualising and measuring potential output, which should suffice to understand the core differences among economic schools and what these imply for the conduct of real-world policymaking.

Potential Output: Traditional Approach

Defined as the highest economic output achievable without fuelling inflation, potential output is a non-observable concept inferred from measurable variables like unemployment, inflation, and actual output (Proietti et al. 2020). Despite its elusive nature and the complexities of its calculation, it remains a pivotal economic indicator, epitomising the optimal level of economic activity around which real-world dynamics oscillate, as illustrated in *Figure 1*.

Unlike actual output, the dynamics of which are inherently unpredictable given the vast number of forces at play, mainstream economists have long argued that potential output is determined by some structural (i.e., slow-moving) factors influencing economic activity (Rochon and Rossi 2016, Ch. 10). Among these factors, which typically originate from the supply side[1] of economic activity, a few have always played a key role. Demographic forces shape the size and composition of the labour force. Technological innovations lay the foundation for the organization and efficiency of production. Institutional arrangements, such as labour protection legislations, which presumably create frictions and limit the optimal operations of market activities, also contribute to determining potential output.

A key characteristic of all these structural (supply-side) factors is that they are usually considered exogenous with respect to economic activity. In other words, the actual realizations of economic activity (or real GDP), considered to be driven by (short-run) demand-side forces, only result in fluctuations around the (long-run) potential path (Solow 1997).

To support this argument with a practical formulation, and to understand the link between potential output and inflation, let us begin by characterising the evolution of actual output using the following identity:

$$y = \frac{y}{L}\frac{L}{N}\,N$$

In this identity, y represents real GDP, or real output; L denotes the hours of labor input; N captures the potential labour input from the entire labour force. To add further clarity, consider the definitions of labour productivity and the employment rate:

Labour productivity $\lambda = \frac{y}{L}$

Employment rate $E = \frac{L}{N}$

Using these definitions, we can reformulate the first identity as:

$$y = \frac{y}{L}\frac{L}{N}\,N = \lambda\, E\, N$$

[1] In this thesis, I will often refer to the differences between supply and demand side factors. Furthermore, I will introduce the notions of aggregate and effective demand, and differentiate between short-term and long-term dynamics. It is understandable that these concepts may seem somewhat abstract and unclear. To address this, a straightforward explanation of these ideas is provided in Appendix A. For additional insights, readers are encouraged to consult Jespersen (2016) and Lavoie (2022, Chapters 1–5).

This equation can also be expressed in terms of the unemployment rate (u), given that $E = 1 - u$. Thus, it becomes:

$$y = \lambda\,(1 - u)\,N$$

In exploring potential output's fundamental characteristics, we frame it as the (long-run) equilibrium path around which actual output fluctuates. Therefore, potential output y_p is identified as:

$$y_p = \lambda_p\big(1 - u_p\big)\,N_p$$

Here, λ_p and N_p represent the potential long-run equilibrium values of labour productivity and the labour force, respectively. The focus then shifts to u_p, initially understood as the potential rate of unemployment. This variable is not just a long-run attractor for the actual employment rate; it is also considered to be the sole rate of unemployment compatible with stable inflation. This unique property has led to the potential level of unemployment being referred to as the Non-Accelerating Rate of Unemployment (NAIRU) (Storm and Naastepad 2012).

In the following section, we will delve deeper into the concept of NAIRU, exploring its theoretical roots and its pivotal role in the relationship between unemployment and inflation, as conceptualized in mainstream economic theory.

Exploring the NAIRU

In exploring the concept of the Non-Accelerating Rate of Unemployment (NAIRU), Storm and Naastepad (2012, chap. 1) discuss its traditional formulation, which emerges from a wage bargaining process. This process is described by two linear equations representing the growth of nominal wage claims of workers and the price-setting behaviour of firms:

Wage setting (WS) curve $\quad \widehat{W} = \alpha_0 - \alpha_1 u + \alpha_2 \hat{\lambda} + \alpha_3 z + \hat{p}_e \qquad \alpha_j > 0 \quad j = [0,3]$

Price setting (PS) curve $\quad \widehat{w} = \hat{\lambda}$

In these equations, $\widehat{W}$ is nominal wages growth, u is the actual unemployment rate, $\hat{\lambda}$ represents (labour) productivity growth, z captures different institutional and legislative factors that strengthen workers' bargaining power (e.g., employment protection legislation), $\hat{p}_e$ is the expected inflation rate, and $\widehat{w} = \widehat{W} - \hat{p} =$ Nominal wage growth $-$ Inflation rate $=$ Real wage growth.

From this simplified wage bargaining model, we can derive the unique (long-run) equilibrium unemployment rate that ensures constant inflation by assuming that (in the long run) inflation has to be constant. This is possible only if $\hat{p} = \hat{p}_e = \hat{p}_T$, or when actual and expected inflation are the same and equal to the inflation target set by the central bank ($\hat{p}_T = 2\%$ in the case of the ECB). Imposing this assumption, we obtain:

$$u_p = NAIRU = \frac{\alpha_0 - (1 - \alpha_2)\,\hat{\lambda} + \alpha_3 z}{\alpha_1}$$

This model and the resulting NAIRU are based on several critical assumptions about workers' and firms' behaviour, as detailed by (Storm and Naastepad 2012). Notably, this formulation assumes that demand-side factors have no long-term influence and treats labour productivity as exogenous to the economy's performance. Moreover, within this framework, policies aimed at exceeding potential employment or output levels would be counterproductive, leading to inflationary pressures.

This model, along with the resulting NAIRU, hinges on multiple critical assumptions, thoroughly described by Storm and Naastepad (2012), concerning the behaviour of workers and firms, but also the underlying factors capable of supporting sustainable (i.e. non-inflationary) growth in the long-run.

Above all, this formulation of the NAIRU—and thus potential output—assumes a complete absence of long-run influences from demand-side factors, and more particularly, it considers labour productivity as exogenous to the economy's performance.

This last claim is visually supported by the causal loop diagram in *Figure 5*.

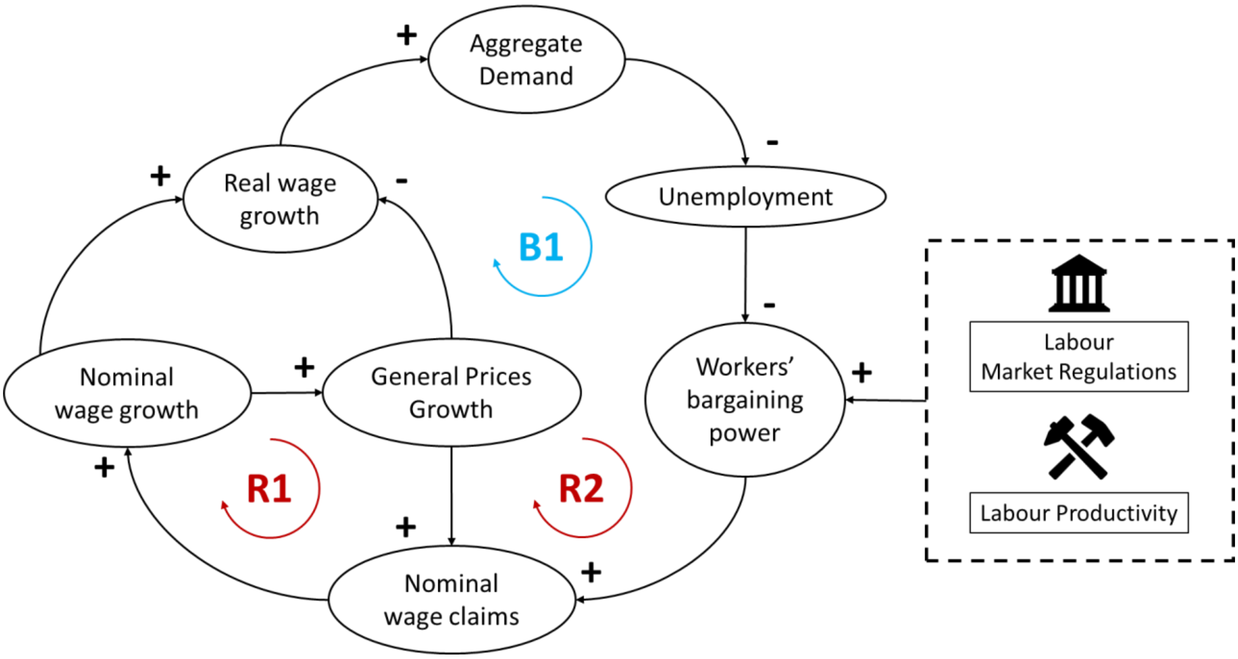

Figure 5: *Causal Loop Diagram (CLD) representing the implications of demand-side forces within the traditional NAIRU framework. Each arrow indicates a causal relationship between two factors, with the sign (+/-) showing the type of relationship: positive for variables moving in the same direction, negative for variables moving in opposite directions. Feedback loops are identified by circular arrows: reinforcing loops (R) amplify effects and can lead to cycles of growth or decline, while balancing loops (B) counteract changes to maintain stability in the system. Source: Author's illustration.*

In this Causal Loop Diagram (CLD), a positive shock to aggregate demand initiates a sequence of reactions captured by reinforcing loops R1 and R2 and balancing loop B1. Specifically, R1 illustrates the wage-price spiral, a process where increased demand results in lower unemployment and, therefore, higher nominal wages and subsequently higher prices, further propelling wage demands. Concurrently, R2 could depict a typical Keynesian multiplier effect where a boost in demand sequentially increases economic output and employment.

However, the presence of balancing loop B1 indicates the system's inherent capacity for self-regulation. Over time, this loop acts to mitigate the shock's effects, realigning unemployment with the NAIRU as the economy adjusts through various stabilizing factors, such as moderated nominal wage demands and price adjustments that negate the initial demand shock, ultimately restoring macroeconomic equilibrium.

A more complex CLD would include the strategic interventions of monetary policymakers (central bankers), who, upon noticing escalating inflation, would introduce contractionary measures (i.e., higher interest rates) to curb the (inflationary) excess demand, serving as a crucial external loop that ensures long-term price stability and adherence to the NAIRU.

The previously described formulation of the NAIRU, and its direct link with inflation, is also concisely articulated by the expectations-augmented New Keynesian Phillips curve (Storm 2023, p.43):

$$\hat{p}_t = \kappa \left(y_t - y_t^p\right) + \mu_t + \beta\, \hat{p}_e = \kappa\, \tilde{y}_t + \mu_t + \beta\, \hat{p}_e \qquad \kappa > 0 \text{ and } 0 < \beta < 1$$

Here, $\tilde{y}_t$ represents the output gap (or the difference between actual and potential output), and μ_t is a random disturbance capturing cost shocks. This equation, a cornerstone of mainstream macroeconomic models, essentially correlates positive (or negative) output gaps with inflationary (or deflationary) pressures and underscores the significance of workers' inflation expectations in price dynamics.

While this equation does not explicitly mention the NAIRU, the analytical connection between this variable and potential output allows us to easily translate the unemployment gap (i.e. the difference between actual unemployment and the NAIRU) into the output gap.

Policy relevance: why should we care?

Insofar as potential output and the NAIRU (or the natural rate of unemployment) are primarily of interest to economics scholars, it might not seem worthwhile to research the implications of their inclusion in macroeconomic models. However, as already mentioned in the introduction (see Figure X), these unobservable theoretical factors have profound implications for real-world monetary and fiscal policymaking.

The implications for the conduct of monetary policy can be understood by combining the insights drawn from the expectations-augmented New Keynesian Phillips curve, introduced earlier, with the so-called Taylor rule (Taylor and Williams 2010):

$$i_t = r^* + \hat{p}_t + 0.5\ (\hat{p}_t - \hat{p}^*) + 0.5\ (y_t - y_t^p)$$

where r^* denotes the equilibrium real interest rate, and $\hat{p}^*$ is the desired long-run, or "target," inflation rate set by central banks.

According to this formulation, central banks should cautiously monitor the output gap as well as the difference between the current inflation rate and its target value, since movements in the former, or equivalently in the unemployment gap, will result in inflationary pressures.

Moreover, adhering to automatic policy rules like the Taylor rule may, according to some mainstream scholars (e.g., Clarida, Gali, and Gertler 1999), not only ensures robust price stability but also enhances the reputation of independent central banks and anchors the long-term inflation expectations of firms and households to the central banks' desired target.

However, it is crucial to recognise a nuanced reality that monetary policymakers frequently emphasise: the limitations of automatic monetary policy rules are most apparent during periods of economic instability. As Storm (2023) describes, in times where clear and effective guidance is most critical, the rigidity of these rules fails to address the complexities of economic dynamics.

Yet, current macroeconomic models and frameworks that are central to informing the policy decisions of central banks often reflect the influence of simple rules such as the Taylor rule. This suggests that the role of potential output in monetary policy is more of a guiding factor than a direct driver, as it shapes policymakers' theoretical understanding of the relationship between the output gap and inflation. This conceptual role is significant, even if rules like the Taylor rule, which may incorporate potential output in their formulations, are not rigidly applied within the operational frameworks of central banks.

When it comes to fiscal policies in EU countries, the significance of potential output is well-established and has been formally integrated into key fiscal monitoring practices and regulations (Heimberger and Kapeller 2017). Since the 2005 amendment of the Stability and Growth Pact (SGP), which comprises a set of rules designed to ensure fiscal discipline among member states, potential output has played an increasingly prominent role (see *Figure 6*). Specifically, this reform led the European Commission (EC) to adopt structural budget balances—budgets adjusted for potential output—as the primary measure of discretionary fiscal policy within the European Union.

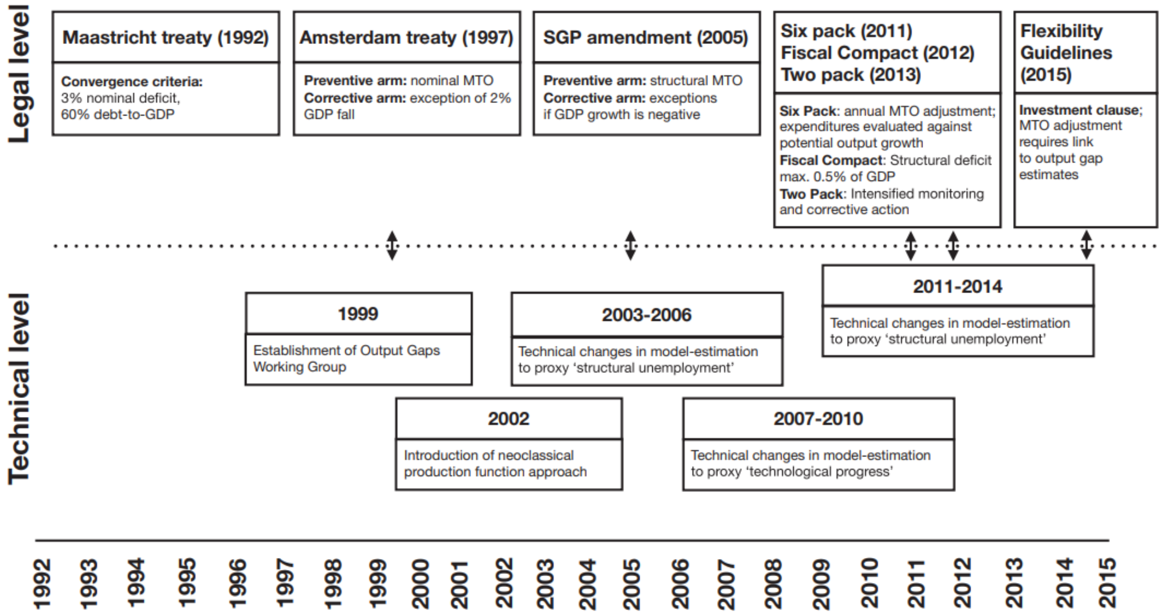

***Figure 6**: Development of EU fiscal regulation frameworks. Source: Heimberger et al. (2020, p. 9)*

The 'six-pack' regulations of 2011 and the Fiscal Compact treaty of 2012 have further entrenched this methodology, requiring member states to target a structural budget balance as a medium-term objective and imposing sanctions for non-compliance. The institutionalisation of structural balance within the EU's fiscal framework, which member states have also agreed to incorporate into their national legal systems, implies that fluctuations in structural deficit levels directly impact the urgency for member states to undertake fiscal consolidation (Palumbo 2015; Heimberger, Huber, and Kapeller 2020).

Empirical approaches to potential output: a brief note

Given the key importance of potential output—and the output gap—in supporting and potentially guiding real-world monetary and fiscal policymaking, the reader should now understand the importance of empirically estimating this unobservable variable within reasonable margins of accuracy.

According to Palumbo (2015), the plethora of economic studies aiming to estimate potential output can be categorized into two broad groups: statistical and economic theory-based.

In a nutshell, the first group attempts to estimate potential output using statistical filtering techniques (e.g., the Hodrick-Prescott filter) on time-series data of actual output without relying explicitly on theoretical economic constructs (Bassanetti, Caivano, and Locarno 2013)

On the flip side, economic theory-based methods presuppose specific economic relationships—such as the Phillips curve, the Cobb-Douglas production function, and Okun's law—to connect the unobservable variable (potential output or output gap) with observable variables, whether on a quarterly (like the unemployment rate and inflation rate) or an annual basis (such as actual output). This group also includes studies that integrate potential output estimates into larger economic models, predominantly New Keynesian DSGE (Dynamic Stochastic General Equilibrium) models (Vetlov et al. 2011; Burlon and D'Imperio 2020).

Despite the clear methodological differences, many leading monetary and fiscal institutions adopt a hybrid approach, combining elements from both statistical and theoretical traditions. A case in point is the Commonly Agreed Methodology (CAM) employed by the European Commission, which uses a classic Cobb-Douglas production function to estimate potential output:

$$Y_p = TFP_p \; L_p^{\alpha} \, K^{1-\alpha}$$

In this equation, Y_p denotes potential output; TFP_p and L_p represent the structural components of total factor productivity and labour supply, respectively; and α is the output elasticity of labour. This production function serves as a theoretical backbone to the CAM model (Havik et al. 2014).

To complement this, the CAM model applies sophisticated statistical filters to detrend the actual values of labour supply and TFP, determined as the residual from the regression of actual output on actual inputs—a process that embodies the statistical aspect of the approach (Palumbo 2015).

This blend of economic theory, as seen in the Cobb-Douglas production function, and statistical methods makes the CAM model a clear example of a hybrid approach for empirically estimating potential output.

Nonetheless, these methods are not without their critics (e.g. Fioramanti and Waldmann, 2017; Fontanari, Palumbo, and Salvatori 2020). From an empirical standpoint, Proietti et al. (2020) highlight how the selection of initial conditions and variances for stochastic processes in econometric models can yield vastly differing estimates of potential output. Furthermore, the reliability of parameter estimates derived from time-series econometric methods is heavily contingent upon the quality of the underlying data, which is susceptible to the uncertainties of ex-post revisions to official statistics and macroeconomic forecasts.

The presence of these inescapable uncertainties is evident in the varying output gap estimates contained in different vintages of data, as shown in *Figure 7*.

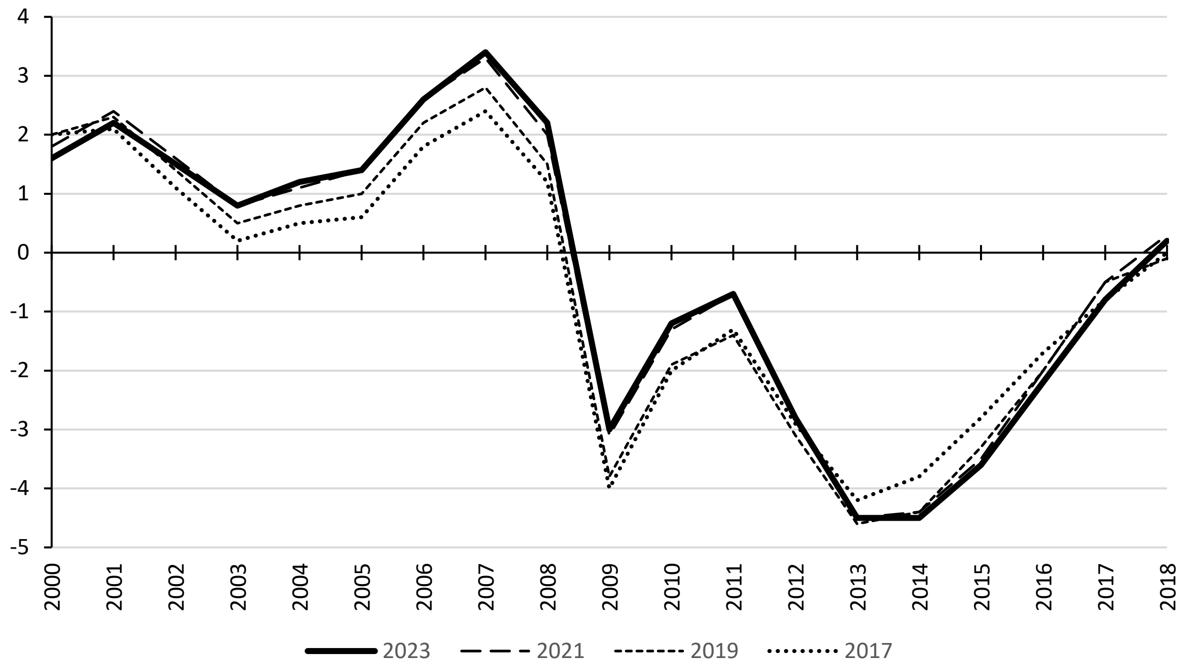

***Figure 7**: Evolution of output gap estimates (2000-2018) according to the Commonly Agreed Methodology (CAM) utilised by the European Commission. This graph illustrates the inherent variability in these estimates, which are subject to the technical configurations of statistical filters and the empirical calibration process. The figure clearly demonstrates that ex-post revisions and technical adjustments have significant impacts not only on future projections of the output gap but also on historical data, emphasising the retrospective effect of methodological changes. Source: AMECO database.*

A moving target: introducing hysteresis in economic policy

In considering the theoretical framework we previously introduced, it might appear that, despite some complications stemming from empirical methods, potential output serves as an ideal target for guiding economic policies. However, this seeming simplicity conceals a fundamental hypothesis about economic growth, which we have already outlined: namely, that demand-side forces primarily drive short-term fluctuations around a supply-determined potential path.

At this juncture, a critical question arises: what if the dichotomy between demand-side fluctuations and the supply-side potential path is not as clear-cut as theorised? Or, to put it differently, what if the growth path and economic cycles are, in fact, interdependent?

To explore the ramifications of this complex question, let us envisage a hypothetical scenario involving a group of policymakers, endowed with both monetary and fiscal instruments (such as a central bank and a national government). Their dual objectives are to stabilize prices around a pre-set target and to enhance the economy's long-term growth. Assuming we have perfect foresight – the ability to on average accurately predict the business cycle's trajectory over the coming quarters or years (see *Figure 8*) – our recommendations, based on traditional economic theory, would initially seem straightforward.

For instance, in response to an anticipated positive output gap associated with inflationary pressures, the logical step would be to curb aggregate demand and employment through restrictive monetary policies (e.g., raising interest rates) and fiscal interventions (such as reducing public investment). Once these measures have tempered fluctuations around the long-term potential path, the focus would shift towards bolstering potential growth, perhaps by supporting research and development investments or by reducing wage rigidities through unemployment benefit restrictions and limiting labour union bargaining power, as depicted in *Figure 8*.

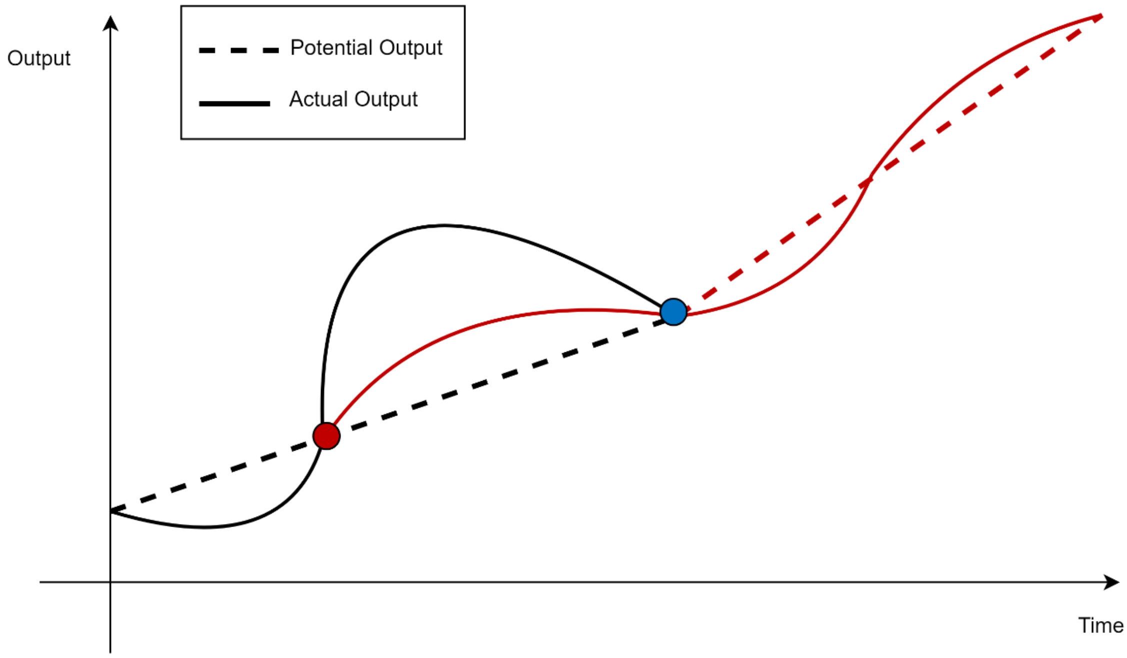

Figure 8*: Hypothetical evolution of actual and potential output according to mainstream theory. This graphical representation juxtaposes potential output, indicated by a dashed line, against actual output, denoted by a solid line. The red and blue dots symbolise the strategic opportunities, or "policy windows", available to policymakers for the application of fiscal and monetary measures. The solid and dashed red lines capture the effects of the implemented set of policies, as described in the body text of this subchapter, on actual and potential output according to their mainstream formulation. Source: Author's illustration.*

However, the scenario alters dramatically if we consider that demand-side factors might influence the potential path – a concept known as hysteresis. This term, which will be central to this entire research, has sparked profound debates among economists over the past nearly 50 years. While initially dismissed or only marginally acknowledged by mainstream thinkers, especially following the unemployment trends in Europe during the 1970s (for instance, in the context of endogenous growth theory), the concept of hysteresis gained undeniable prominence after the 2007-2008 financial crisis (Cerra, Fatás, and Saxena 2023).

Considering hysteresis, our previous policy suggestions encounter a dilemma. The once-optimal approach of implementing restrictive monetary and fiscal measures now appears as a double-edged sword. While these interventions might mitigate positive (demand-driven) fluctuations, they could concurrently hinder the evolution of the potential path (*Figure 9*). Therefore, this revelation starkly contrasts with the objective of fostering the long-run productive capacity of an economy.

Despite hysteresis's intriguing implications on potential output, one might question its real-world relevance. Decades of research provide strong empirical evidence (refer to *Table 1* for a few key studies) and theoretical support that GDP fluctuations have persistent effects. In essence, cyclical growth movements do not just follow a trend; they influence the trend (Cerra, Fatás, and Saxena 2023).

As we transition into a more detailed exploration of hysteresis in the subsequent subchapter, it is essential for the reader to bear in mind the significant policymaking implications of this concept that we have just begun to unravel. Grasping the nuances of hysteresis is not merely an academic exercise; it fundamentally challenges the bedrock of traditional economic thinking and demands a thorough reconsideration of policy strategies, given its extensive influence on the paths economies take.

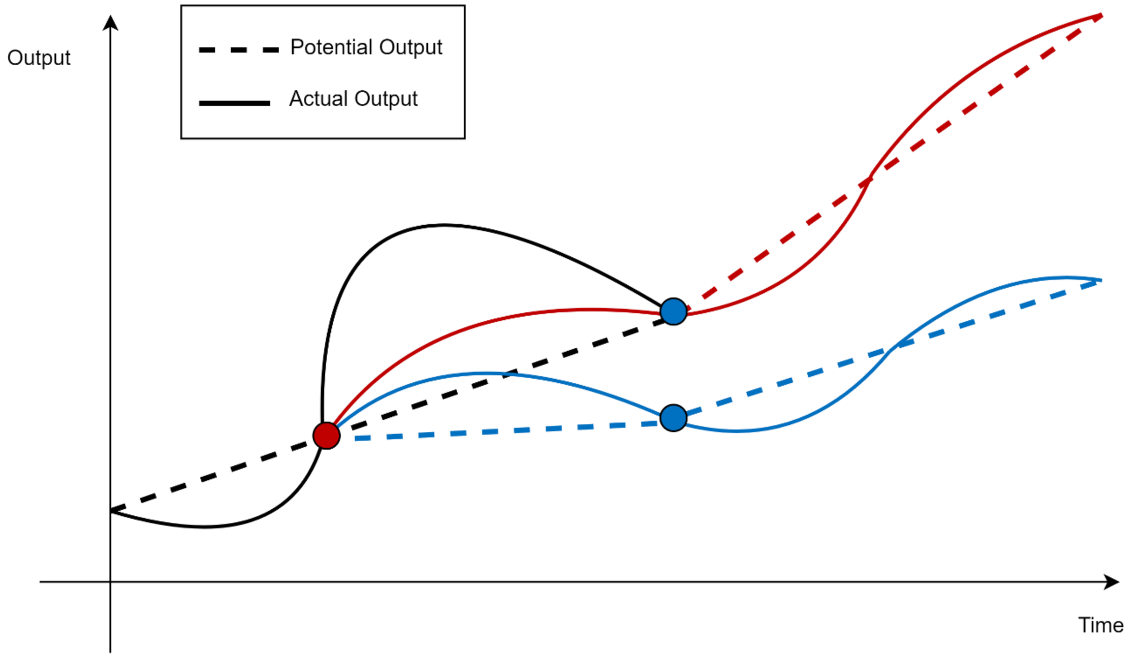

Figure 9: *Hysteresis and potential output. The figure illustrates the evolution of actual and potential output, depicted by solid and dashed blue lines respectively, under the influence of hysteresis within macroeconomic dynamics. Source: Author's illustration*

Reference	Findings
Blanchard & Summers, (1986)	Temporary increases in unemployment could lead to very persistent increases in the NAIRU (Non-Accelerating Inflation Rate of Unemployment).
Ball (2014)	Analysis of 23 countries revealed that post-GFC output deficits have correspondingly diminished the estimates of potential output on a nearly one-to-one basis.
Cerra and Saxena (2017)	Robust evidence on the permanent impact of all shocks on the levels of GDP for 192 countries.
Blanchard et al. (2015)	Demand shock-induced recessions are equally likely to result in a long-lasting deviation from the pre-recession output trend, indicative of hysteresis effects.

Girardi et al. (2020)	Findings point to the possibility that proactive demand expansion can have sustained, positive outcomes on output, thereby providing a counter-narrative to the traditionally negative association of hysteresis with economic downturns.

Table 1: *Empirical Evidence for Hysteresis Effects. This table summarises key empirical studies that substantiate the presence of hysteresis in macroeconomic processes. A significant portion of these works are reviewed in the comprehensive analysis by Cerra, Fatás, and Saxena (2023). Additionally, Girardi, Paternesi Meloni, and Stirati (2020) represents a notable example of (heterodox) research on the positive long-run effects of proactive demand expansion policies.*

Unravelling the complexities of hysteresis mechanisms

The exploration of hysteresis, as outlined in the preceding subchapter, may have left the reader with lingering questions and curiosities. To address these, it becomes imperative to delve deeper into the mechanisms of hysteresis as recognised in economic literature. The reader may find it intriguing that the formulation of hysteresis and its underpinning mechanisms continue to fuel robust discussions among economists, a sentiment echoed in the recent work of Cerra, Fatás, and Saxena (2023).

Notwithstanding this ongoing debate, two principal pathways have crystallised over the past two decades, delineating labour market and goods market mechanisms. A succinct array of theoretical categories for these mechanisms is detailed in *Table 2*.

Stockhammer and Jump (2022, sec. 2.3) provide an extensive summary of these mechanisms, supported by empirical evidence. Yet, it may be beneficial to also present a brief overview of two predominant hysteresis mechanisms.

The first is the 'de-skilling mechanism,' which suggests that prolonged unemployment may lead to the erosion of professional skills and a growing disconnection from the workforce, especially when unemployment benefits are ample. On top of this, individuals who are unemployed for an extended period become less effective in suppressing wages and inflation, thereby potentially increasing the NAIRU and diminishing the potential output of the economy. This last statement raises an intriguing question: why are long-term unemployed individuals less effective in curbing inflation?

Labour market mechanisms		**Goods market mechanisms**	
Insider-Outsider	Unions, representing the employed 'insiders', negotiate for wages and conditions that inadvertently make hiring costlier, prolonging unemployment for 'outsiders' and contributing to wage inflexibility.	***Capital accumulation***	Recession-induced investment declines affect demand and employment, with capital stock influencing the equilibrium rate of unemployment and the bargaining power in the labour market.

De-skilling / Duration mechanisms	Prolonged unemployment leads to skill loss, reducing employability and wage pressure, with unemployment benefits duration further influencing this dynamic.	***Factor productivity growth***	Investment in research and development typically decreases during recessions, leading to a drop in productivity growth, which impacts potential output.
Conventional wage norms	Workers' perceived fairness in wages influences their productivity, with norms changing in response to market conditions, thus affecting the equilibrium rate of unemployment and wage growth.	***Deflationary monetary policy***	Aggressive deflationary policies during recessions can lead to higher unemployment, with the duration and severity of disinflation correlating with an increase in the NAIRU.

Table 2: *Summary of hysteresis mechanisms as described by Stockhammer and Jump (2022).*

This concept gains clarity when considering a modified version of the causal loop diagram seen in *Figure 5*. Here, the connection between unemployment levels and workers' bargaining strength is not solely influenced by the overall unemployment rate but also by the make-up of the unemployed population, comprising both short-term and long-term unemployed. This nuanced distinction holds significant theoretical importance. According to this framework, long-term unemployed workers effectively withdraw from wage bargaining processes. This withdrawal manifests as an artificially lowered unemployment level, essentially equivalent to the short-term unemployment rate. Consequently, this artificial reduction in unemployment levels strengthens the bargaining power of workers, potentially triggering a reinforcing wage-spiral loop (R1).

The ramifications of this mechanism are nuanced but critical. Firstly, it underscores the necessity to monitor the changing composition of unemployment over time. A constant overall unemployment rate may mask significant shifts in the balance between short-term and long-term unemployment, which is pivotal in maintaining workers' bargaining power and ensuring price stability. Secondly, it highlights the importance for policymakers to be cautious in incentivising prolonged unemployment, such as through generous unemployment benefits.

In evaluating this hysteresis mechanism, two key insights emerge. Initially, one must acknowledge that labour market mechanisms, often supported by mainstream economists (e.g., Blanchard 2018), have garnered very limited empirical support, as indicated by Girardi, Paternesi Meloni, and Stirati (2020). This empirical shortcoming partly arises from the reliance on unobservable variables or abstract constructs, such as the power wielded by labour unions. These intricacies make the integration of labour market hysteresis mechanisms into macroeconomic models for policy support a precarious endeavour. Moreover, these mechanisms often convey a predominantly negative view of (organised) labour. For instance, the simplified description of the de-skilling mechanism implies that once workers transition from short-term to long-term unemployment, they are no longer deemed relevant in the wage negotiation processes between employed workers and firms. This perception predominantly focuses on the short-term unemployed, propelling wage demands to levels that might deter the re-employment of the supposedly less skilled, long-term unemployed.

This Hobbesian view of labour markets calls for profound reflection, not only on its empirical validity but also concerning the underlying philosophical and sociological assumptions about the behaviours of workers and firms.

Additionally, this portrayal often overlooks the constructive contributions of workers to organisational efficiency in production and the intrinsic value of work beyond economic compensation. A more positive perspective, prevalent in industrial relations literature, is eloquently captured by Storm and Naastepad (2012, p. 88), who posit that "if all other things are equal, productivity is higher in enterprises that feature relatively more substantive worker involvement in production, participation in decision-making, and profit-sharing."

In contrast, goods market mechanisms, particularly those focusing on capital stock accumulation, have become a point of convergence for mainstream and heterodox economists, as noted by Girardi, Paternesi Meloni, and Stirati (2020). These mechanisms emphasise the critical role of investment in fixed capital on capital accumulation and technological progress. Incorporating Nicholas Kaldor's notion of embodied technological change, new investments in fixed assets, such as advanced production robots, lead to enhanced productive efficiency (Kaldor 1957). This improvement is a result of the incorporation of the latest and most efficient technologies in newer capital vintages, thus making investment dynamics crucial to understanding the evolution of an economy's productive potential.

Hysteresis: further dilemmas

The discourse on hysteresis, as we have briefly explored in the preceding sections, rests on two fundamental yet subtle assumptions. These become particularly salient when one examines *Figure 9.* The first assumption posits that hysteresis mechanisms are triggered almost instantaneously following the adoption of new policy measures. The second suggests that hysteresis exclusively influences the growth trajectory of potential output.

While these suppositions have been instrumental as conceptual tools, their simplicity masks the intricate reality of hysteresis. Therefore, a deeper and more nuanced exploration is necessary, especially in the context of its ramifications on fiscal and monetary policies. This involves reconsidering these foundational assumptions.

The exploration of hysteresis' “response time” is intriguing. We can envisage varying degrees of immediacy in hysteresis responses by modelling potential output using diverse moving averages of real GDP. By doing this, the duration of the moving average period inversely correlates with the trend series' sensitivity to changes in real GDP. This approach, albeit somewhat elementary, transitions the focus from precise, econometric methods to a broader, intuitive grasp of hysteresis.

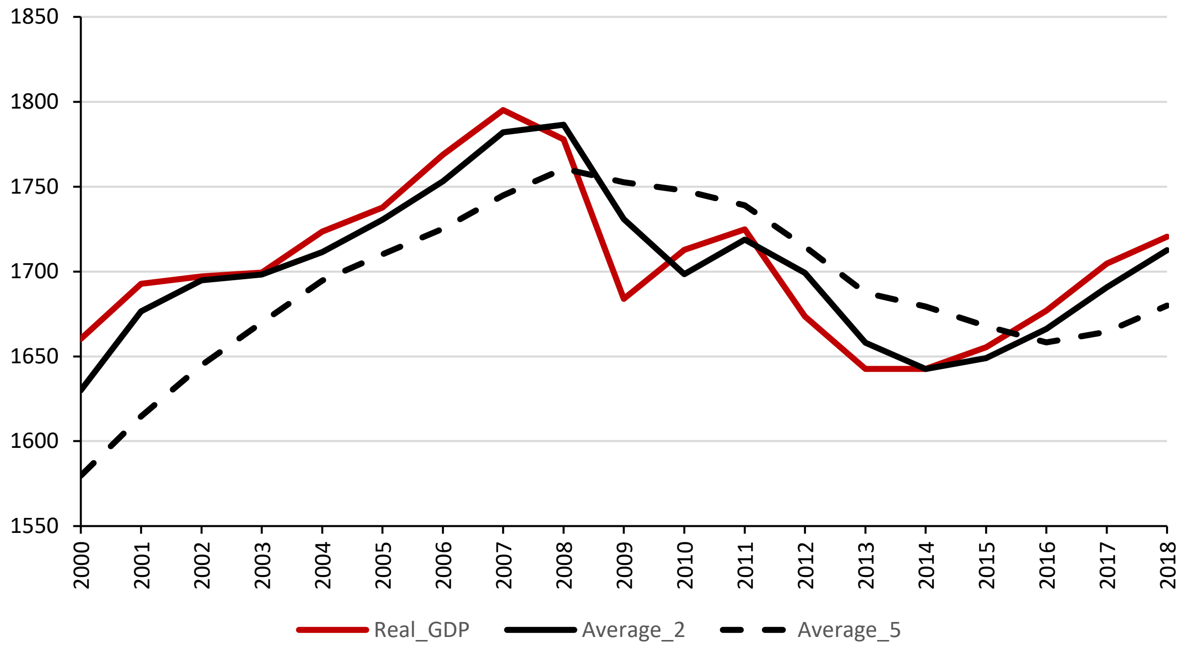

Figure 10: *Evolution of Italian real GDP (i.e. real output) and moving averages between 2000 and 2018. The moving averages are computed using the formula:* $(\sum_{i=0}^{N-1} y_{t-i})/N$ *where* N *is the span in years for the moving average;* y_t *stands for real GDP at time* t*. The illustration clearly shows that longer-span moving averages, such as Average_5, display reduced sensitivity to temporal fluctuations compared to shorter spans like Average_2, highlighting the smoothing effect of the moving average duration. Source: AMECO database, authors' calculations.*

The outcomes of this conceptual experiment are illustrated in *Figure 10* and *Figure 11*. These results provide insights into the velocity of hysteresis mechanisms, particularly during the critical period encompassing the 2007-2009 financial crisis and the subsequent Eurozone crisis (2009-2014). The crises, along with the macroeconomic policies enacted, had severe repercussions on the Italian economy, notably a GDP in 2018 that lagged significantly behind its pre-crisis levels.

Significantly, these crises did not stem from issues on the supply side. Instead, they were sparked by the downfall of the overinflated and unregulated US shadow banking system (Storm, 2018). Additionally, unsustainable financial flows between European countries, facilitated by the integration of European finance, played a major role (Storm and Naastepad, 2016). This is a crucial aspect to understand, as it highlights the enduring, and possibly irreversible, effects that demand shocks can have on potential output due to hysteresis.

When examining the influence of negative demand shocks on potential output, distinct patterns emerge depending on the speed of the hysteresis mechanisms. "Slow hysteresis" mechanisms, represented by a five-year moving average, show a lagged impact on potential output post-financial crisis, with potential output consistently outperforming real GDP from 2008 to 2016. In contrast, "fast hysteresis" mechanisms, indicated by a two-year moving average, demonstrate a closer coevolution of potential and real output, negating significant and persistent output gaps post-shock (refer to *Figure 10*). This observation is substantiated by comparing the amplitude of output gap fluctuations under different hysteresis speeds (variables Gap_2 and Gap_5 in *Figure 11.)*

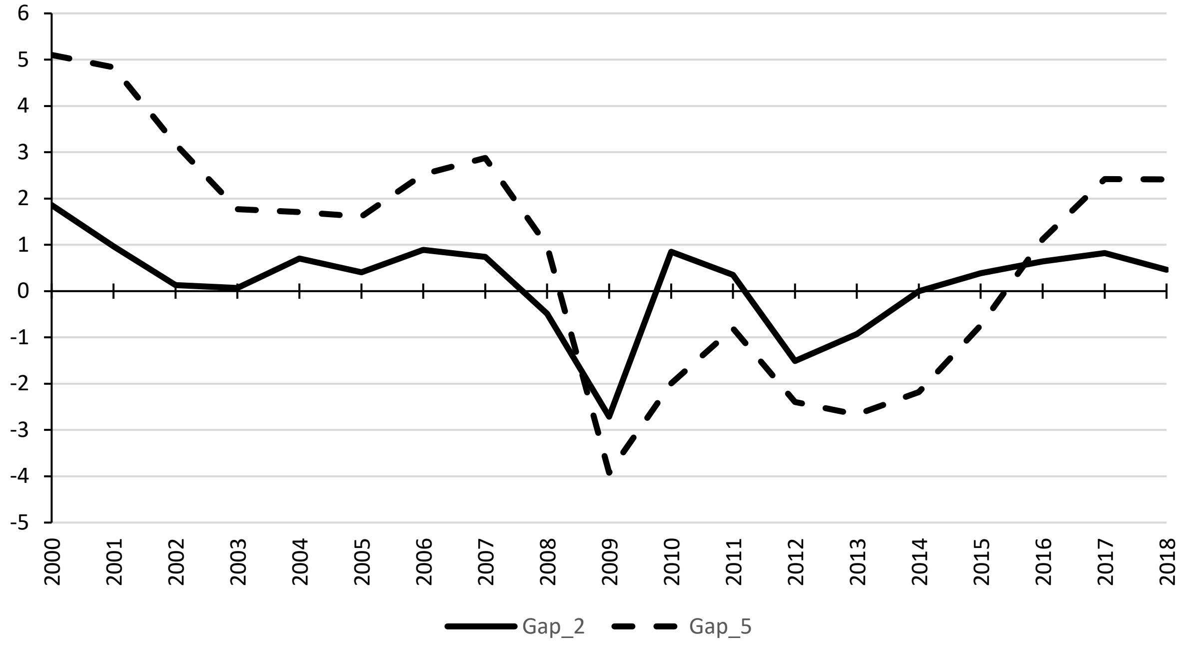

***Figure 11**: Gap between actual GDP and its moving average, as a percentage of moving average. This modified output gap is computed with the formula: $Gap_N = (y_t - \overline{y_t})/\overline{y_t}$ where y_t and $\overline{y_t}$ represent, respectively, real GDP at time t and its N-year moving average. Source: AMECO database, author's calculations.*

The implications of these findings are far-reaching for policy design. In scenarios where potential output estimations are highly sensitive to real output variations, as seen with "fast hysteresis" mechanisms, the utility of the output gap as a metric for policy decisions is considerably limited. This necessitates a revaluation of fiscal and monetary policy strategies under varying hysteresis conditions.

Moving beyond the "response time" analysis, we next address the second foundational assumption: that hysteresis impacts only the growth rate of potential output. Contrary to this simplification, hysteresis, as delineated by Lavoie (2018), can produce two interrelated effects: hysteresis and super-hysteresis (illustrated in *Figure 12*). Understanding the distinction between these effects is crucial: hysteresis, impacting the level of potential output, implies the economy's growth capacity remains unaffected post-shock. In contrast, super-hysteresis, affecting the growth rate of potential output, suggests that shocks alter the economy's ability to accumulate productive resources and sustain growth.

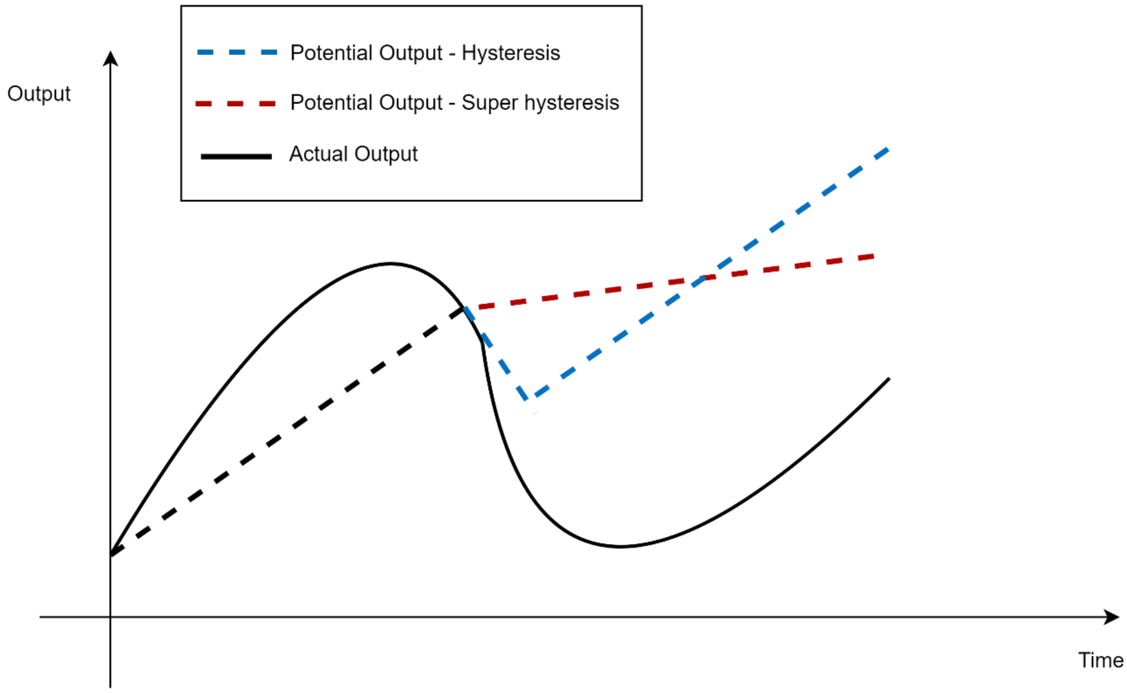

Figure 12: *Simple and super hysteresis at play. Source: Lavoie (2018, figs 2–3)*

It is essential to recognise that the concept of simple hysteresis is rooted in mainstream economic theory, which posits an exogenously determined growth rate of potential output, independent of real output dynamics. This allows for the acknowledgment that potential output levels can be permanently influenced by real output movements while still adhering to the notion of an inherent, exogenous potential output growth rate.

However, considering the hysteresis mechanisms discussed earlier, there is no basis to categorically exclude the possibility of real output dynamics having a lasting impact on potential output growth. Empirical evidence following the 2007-2009 financial crisis supports this (see *Figure 3*). Some economists may attribute the decline in potential output growth to structural factors such as stagnating labour productivity due to low levels of R&D investment and progressive economic tertiarization (Deleidi, Paternesi Meloni, and Stirati 2020) as evidenced in *Figure 13*. Yet, a broader interpretation might suggest that the long-term decline in real output growth of the Italian economy may be the driving force behind the slowdown in potential output growth.

This leads to the 'chicken-and-egg' debate: which precedes, potential output or real output? But, unlike the traditional paradox, in this context, it is more straightforward to identify the primary cause, given that potential output is a theoretical construct based on actual output. Thus, despite theoretical debates over which variable leads economic growth, it is empirically untenable to claim that potential output is an independent determinant with intrinsic properties akin to gravitational centres in natural sciences.

As a final dilemma in the hysteresis literature, it is crucial to highlight the predominantly asymmetric formulation of hysteresis. This perspective suggests that, while economic downturns exert lasting detrimental effects on an economy's potential output, the converse – that surges in demand enhance the level or growth rate of potential output – is not widely accepted (Paternesi Meloni, Romaniello, and Stirati 2022). Such an asymmetric interpretation, which has always been challenged by heterodox economists starting from the early work of Okun (1973), holds profound implications for policymakers, particularly when considering hypothetical scenarios that mirror real-world economic dynamics.

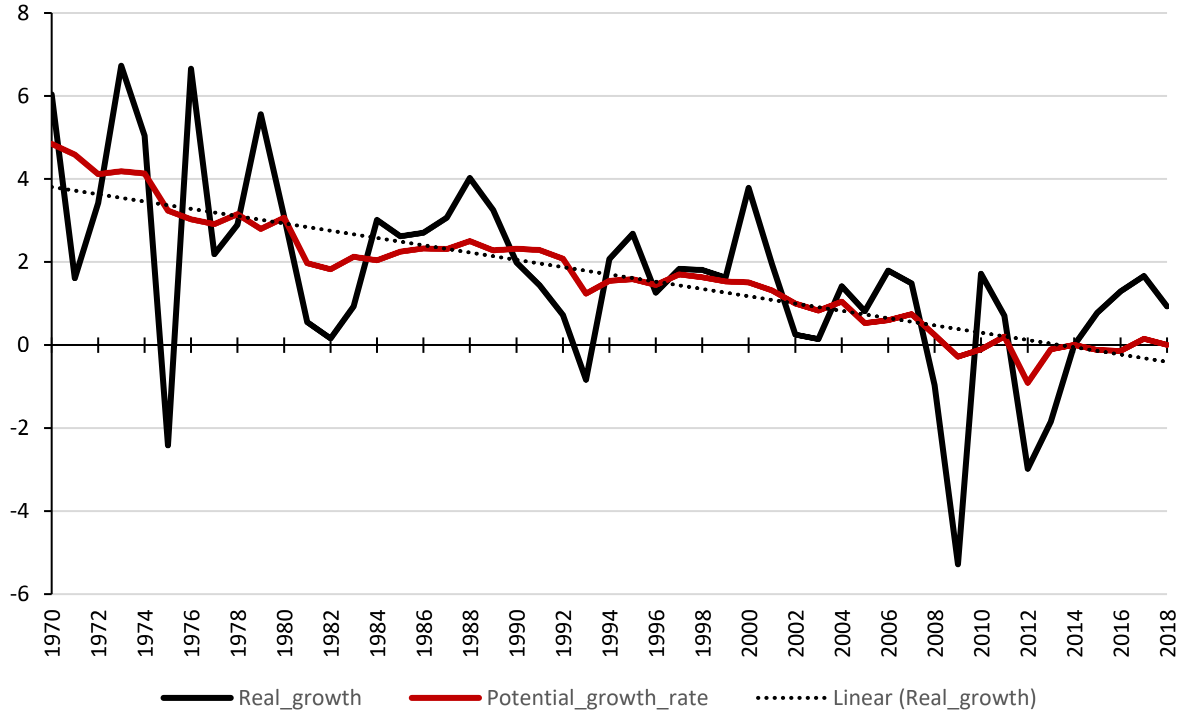

Figure 13: *Evolution of Italian real and potential GDP's annual growth rates from 1970 to 2018. Both growth rates are obtained from this general formula:* $g_t = (y_t - y_{t-1})/y_{t-1}$. *The linear trend of the real growth rate reveals a significant long-term decline in the Italian economy's growth capacity. Furthermore, the downtrend in potential output growth suggests a diminishing ability of the economy to expand without triggering inflationary pressures. Source: AMECO database, author's calculations.*

For instance, consider, after an adverse output shock, the emergence of a situation characterised by a combination of simple hysteresis and super-hysteresis; that is, a scenario marked by both a diminished level and a decelerated growth rate of potential output (see *Figure 14*). In response to such a predicament, fiscal and monetary policymakers promptly intervene, aiming to mitigate further detrimental impacts on potential output and to alleviate the negative oscillations of the economic cycle, thereby averting deflationary spirals. Specifically, after a thorough evaluation of the crisis's magnitude and its enduring characteristics, they embark on implementing demand-stimulating strategies including augmenting government expenditure and reducing interest rates.

Nevertheless, as these measures effectively navigate the economy away from recession and incrementally narrow the negative output gap, policymakers are confronted with the necessity to reassess their subsequent initiatives. Indeed, should they subscribe to the asymmetric interpretation of hysteresis, they would be inherently cautious of any strategy that might propel real output beyond its sustainable threshold, known as potential output. Consequently, once the actual output approximates or reaches its potential, there is a need for policymakers to desist from further demand stimulation and instead transition towards more conservative strategies focused on maintaining price stability.

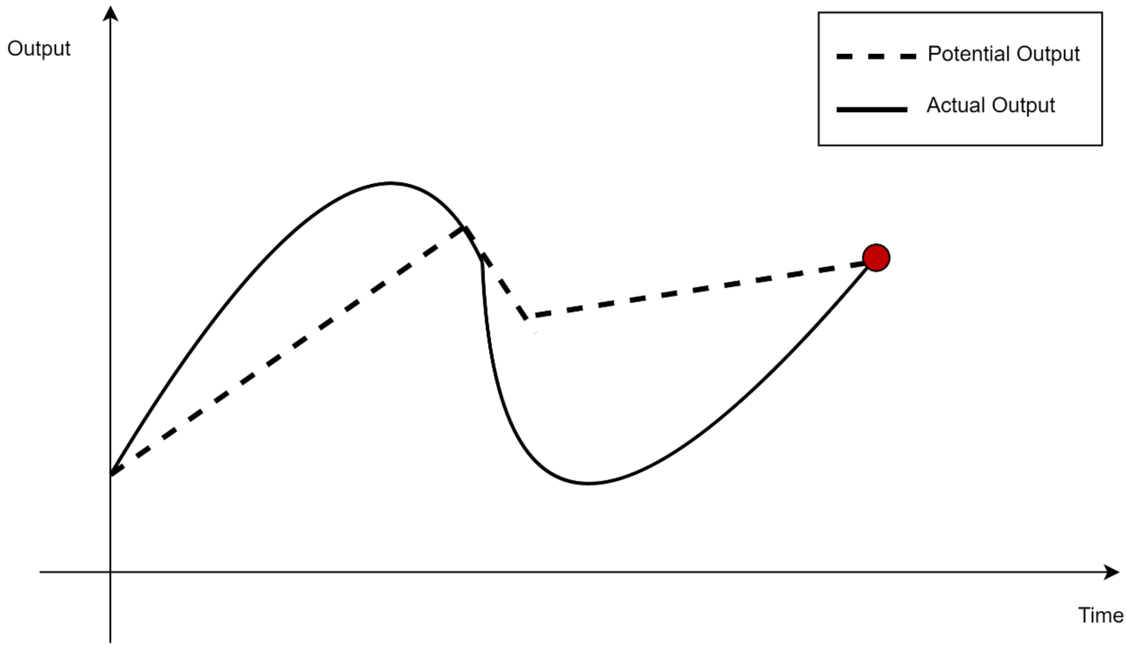

Figure 14: *Output dynamics with simple and super hysteresis effects. This diagram conceptualises the hypothetical path of economic output under the influence of both simple and super hysteresis. The red dot marks the critical juncture where the output gap closes, purportedly prompting policymakers to re-evaluate their strategic approach. Source: Author's illustration.*

Conversely, should they subscribe to a symmetric perspective of hysteresis, they might advocate for sustaining a "high-pressure economy," perpetually targeting full employment as a means to exert a beneficial influence on the evolution of potential output. In this view, stimulating demand is not merely about short-term economic revival but is seen as a catalyst for fostering the development of novel and more sophisticated production methodologies, laying the groundwork for enhanced potential growth.

Despite initially garnering substantial endorsement among mainstream economists, the concept of asymmetric hysteresis has faced considerable scrutiny and debate over recent decades, attracting critical perspectives from both heterodox and mainstream scholars alike (Girardi, Paternesi Meloni, and Stirati 2020; Yellen, 2016; Ball 2014). This ongoing debate about the asymmetric nature of hysteresis signifies a watershed moment in the realm of economic theory. It underscores the need for a fundamental reassessment of entrenched beliefs, particularly regarding the formulation and execution of economic policy. This debate serves as a reminder of the continuous necessity for adaptable and pluralist approaches in economic policymaking, considering the intricate and often unpredictable interactions between demand, potential output, and inflation.

As we reflect upon all the different ideas introduced so far, we find ourselves at a critical point. In our analysis, we have operated under the premise of a definitive linkage between potential output—or more precisely, the output gap—and price dynamics, envisaging a straightforward transition from economic fluctuations to inflationary or deflationary trends. However, the real-world embodiment of this linkage is significantly more complex and nuanced than theoretical models might imply. This complexity, along with various other critical considerations, points us towards exploring an alternative conceptualisation of potential output.

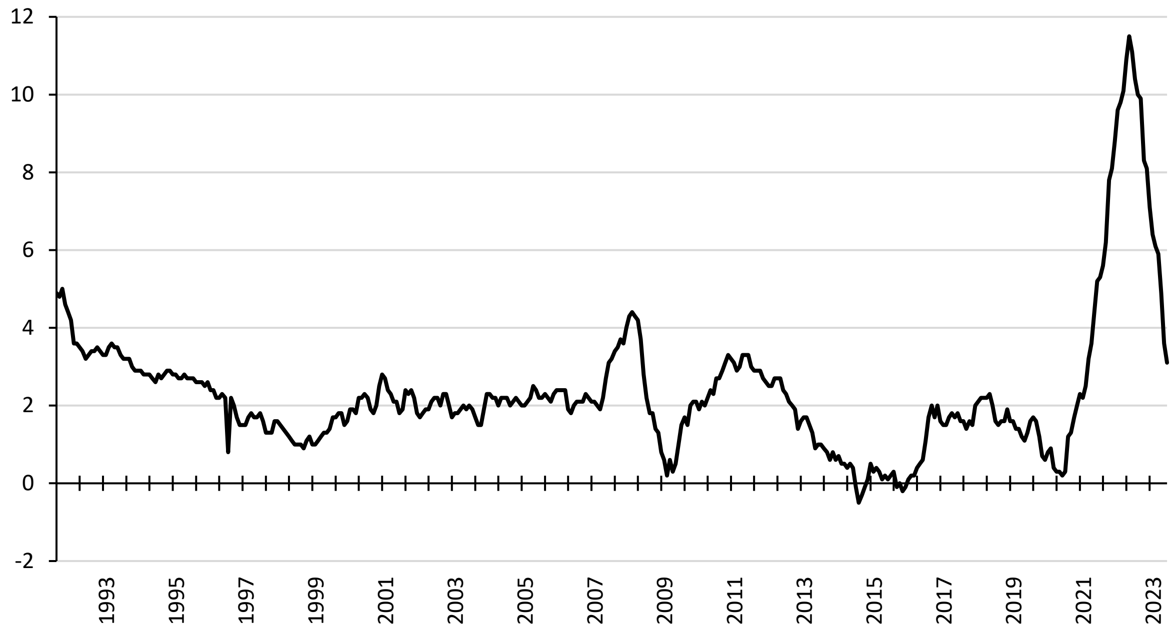

Figure 15: *Monthly Inflation Rate Trends in EU Countries (January 1992 - November 2023). This chart traces the monthly inflation rates across European Union member states over a span of more than three decades, utilising the Harmonised Index of Consumer Prices (HICP). The HICP provides a consistent basis for comparing price movements and inflationary trends across the varied economic landscapes of the Eurozone and EU nations (see HICP - Information on data). Source: Eurostat*

Potential output: is an alternative needed?

The past three decades, barring the turbulent period of the 2007-2009 financial crisis, have seen a notable stability in prices (see *Figure 15*), reducing inflation to a less pressing issue for many European macroeconomists. In particular, post the establishment of the Eurozone in 1992, the emphasis predominantly shifted towards minimising government intervention in market mechanisms, advocating for stringent austerity to manage public debt, particularly in Southern Europe, and enhancing the export competitiveness of Eurozone nations. Amidst these discussions, inflation, somewhat unexpectedly, returned to the forefront, spurred by the delayed consequences of the Covid-19 pandemic and the Russian invasion of Ukraine, leading to an unparalleled inflationary surge across the Eurozone (see *Figure 16*).

This unexpected inflationary spike raises a crucial question: Why did such significant geopolitical events not raise alarms among economists about the potential for building inflationary pressures? Further, should not the evolution of the output gap have served as a precursor to these developments? Theoretically, as we explored in previous subchapters, a rise in real output levels above those of potential output should signal impending inflationary pressures. This notion aligns with the expectations-augmented New Keynesian Phillips curve – introduced on page 16– which posits that, barring random cost shocks, inflation can primarily be attributed to a positive output gap or escalating inflation expectations.

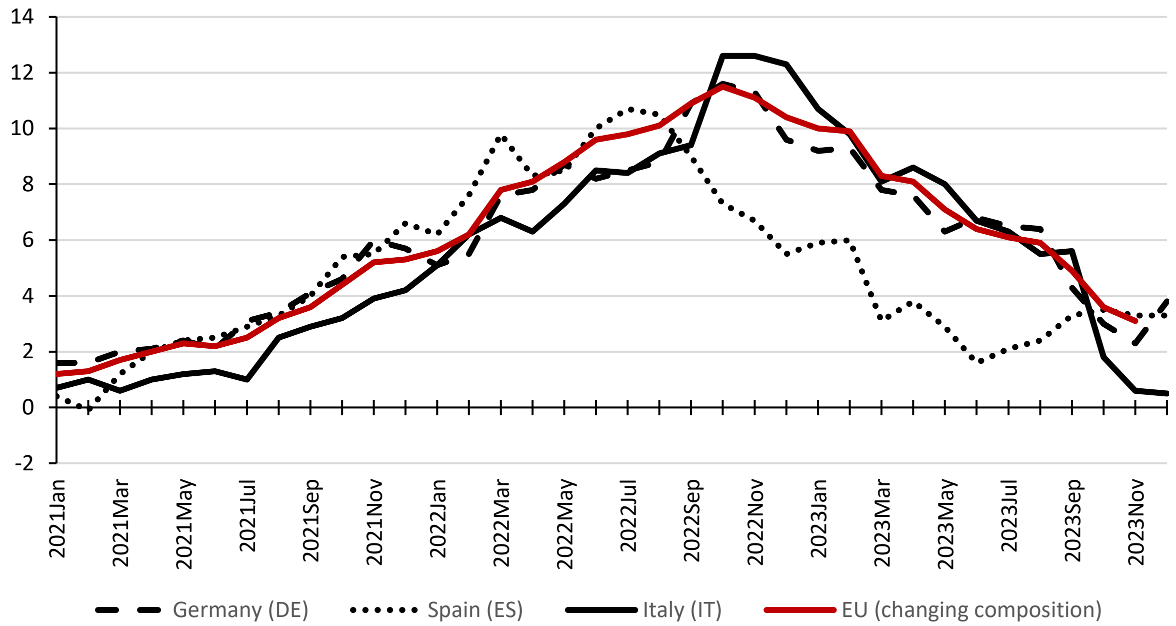

Figure 16: *Comparative inflationary dynamics among EU countries (January 2021 - December 2023). This graph presents the monthly inflation rates of EU member states, highlighting the varied economic responses to shared macroeconomic shocks, including the COVID-19 pandemic and the Russian invasion of Ukraine. Notably, while Italy and Germany exhibit parallel inflationary trends, Spain displays a distinctly divergent pattern. These variations can be attributed to the unique ways price dynamics manifest across different national economies and their respective macroeconomic policies, all within the context of the singular monetary policy framework enforced by the European Central Bank. Source: Eurostat.*

Yet, as Storm (2023) observes in the context of the U.S. economy – a perspective applicable across the Atlantic – both inflation expectations and the output gap have fallen short of their roles as reliable indicators for impending inflation. This observation has been corroborated by influential figures in monetary policy, such as Tarullo (2017). Moreover, ECB President Lagarde, in recent speeches, echoed these sentiments, highlighting the challenges in forecasting inflationary trends (Lagarde 2023b; 2023a). Setting aside the complexities of inflation expectations for the sake of brevity, it is imperative to understand why the output gap has not effectively served as a tool in mitigating rising inflation.

Our previous discussion revealed that the concept of potential output, barring structural demographic influences like labour force size, is intrinsically linked to the natural rate of unemployment or the NAIRU. This cornerstone theory posits that inflationary tendencies emerge when actual output exceeds potential output, or when unemployment falls below the NAIRU. Essentially, this view attributes inflation to wage demands by workers outpacing what firms can sustainably offer, equal to growth in labour productivity, leading to price increases as these higher wage costs permeate through to intermediate and final goods and services.

From this view, with inflation fears rooted in labour market trends, it is expected that the reaction to the recent inflation rise was cautioning against the counterproductive situation arising if inflation expectations detach from central banks' targets, or if a too-tight labour market empowers workers to demand unsustainable wages (Lane 2022; Lagarde 2023b). What might bemuse those less versed in economic debates is the swift shift in stance by some leading economists once inflation showed signs of receding – a development predicted by several heterodox economists (e.g. Weber and Wasner 2023). These economists either revised their views (see *Box 1*) or retroactively adjusted their models to align with new empirical data, a practice Storm (2023) wryly terms "the art of paradigm maintenance." This persistence in adhering to a flawed model indicates a pressing need to explore alternative conceptions of potential output outside mainstream economics.

07/07/2022	***14/12/2023***
""We need five years of unemployment above 5 percent to contain inflation—in other words, we need two years of 7.5 percent unemployment or five years of 6 percent unemployment or one year of 10 percent unemployment," Summers said during a speech at the London School of Economics." (Weissmann 2022)	"First of all, one should always have been aware that a substantial part of the increase in inflation was transitory. So no one should have thought that most of the route from 7 per cent to 2 per cent needed to be achieved in ways that were correlated with increases in unemployment." (Armstrong 2023)

Box 1: *Reflections on anti-inflationary policy: the perspective of Larry Summers. These excerpts exemplify the phenomenon of "ex-post policy revisionism" where prominent economists fundamentally contradict their previous policy interpretations in light of new developments, such as the swift decrease in inflationary pressures beginning in early 2023. Larry Summers, a key voice in economic discourse, is notable for his past role as Director of the White House National Economic Council during the Obama Administration and his current position on the board of directors at OpenAI (Murgia, Hodgson, and Hammond 2023).*

In seeking different perspectives, the modern classical (or classical-Keynesian) approach, as outlined by authors like Palumbo (2015) and Trezzini and Palumbo (2016), offers a stark contrast. This approach diverges from mainstream economics in two fundamental ways. First, unlike the mainstream view of potential output as a structural equilibrium path for actual output, modern classical theory, drawing from the original ideas of Okun and Keynes, sees potential output as an upper limit to production in an economy typically characterised by less-than-full employment (Carnazza et al. 2023, p.513). Second, building on the theoretical work of Italian economists Piero Sraffa and Pierangelo Garegnani, it eschews a deterministic link between prices and quantities. This theory contends that the relationship between output and prices is not governed by a universal law but is shaped by the historical and institutional context of each economy (Palumbo 2015)

This reimagined concept of potential output has inspired various empirical studies. A notable example is Fontanari, Palumbo, and Salvatori (2020)'s development of a new empirical method for estimating the output gap, updating Okun's law. This method was applied by Carnazza et al. (2023) to demonstrate that using the Updated Okun Method (UOM) instead of the conventional CAM model for the Italian economy revealed significantly larger output gaps, suggesting a greater scope for expansionary fiscal policies. Other studies have delved into the dynamics of potential output and the natural rate of unemployment within demand-led growth models, although, as Fazzari and Gonzalez (2023) note, much of this heterodox research remains either theoretical (Bassi and Lang 2016; Nishi and Stockhammer 2020a; 2020b) or focused on static analyses (Storm and Naastepad 2012).

Given these distinct characteristics of the modern classical formulation of potential output, one might question its utility. It appears to lack the mainstream version's attributes – serving as a benchmark for actual output and signalling inflationary trends – which have traditionally supported policymakers in managing macroeconomic policies. However, it is precisely this mainstream conceptualisation of potential output, with its inherent socio-political biases, that necessitates a revaluation. Mainstream economics gradually moved away from the Keynesian advocacy of active government intervention for full employment, instead favouring a narrative where organised labour and government actions are seen as impediments to societal welfare, achievable through minimal intervention in the profit-maximising behaviours of firms and utility-maximising actions of individuals.

The enduring support for the concept of potential output in mainstream economics, paradoxically, reinforces the need for central bank intervention for price stability – ostensibly at odds with a laissez-faire ideology. However, upon closer inspection, this contradiction resolves into a coherent framework where central banks, envisioned as independent entities with an impartial understanding of economic realities, are tasked with preventing pro-cyclical government policies and aligning labour negotiations with set inflation targets.

In light of this interpretation and considering the empirical shortcomings of the mainstream potential output concept in aiding policy decisions, exploring alternative frameworks becomes not just an empirical imperative but a crucial step towards fostering a narrative that recognises the positive roles of workers and governments in achieving more equitable and sustainable economic outcomes.

III. Italy’s stylised facts

In the wake of the 2007-2008 financial crisis and the ensuing Eurozone crisis, the academic and journalistic landscape has been rife with narratives casting Southern European countries, notably Italy, as the laggards of the European Union, supposedly hindering the economic achievements of their Northern counterparts. This prevalent discourse often attributes Italy's economic woes to a myriad of internal factors: a rigid labour market, inadequate investment in innovation and technology, and a public administration and legal system plagued by inefficiency and corruption. This perspective has gained traction not only internationally but also among many Italian intellectuals, further entrenching the view of Italy as the primary culprit for its own economic decline.

Nevertheless, as highlighted by a wealth of critical literature on this topic, including the works of Storm (2019), Tridico (2015), Halevi (2019a; 2019b), and Cesaratto and Zezza (2018), such interpretations barely scratch the surface of a much more complex and nuanced reality. These conventional views often represent overly simplistic approximations, or even outright misunderstandings, of the intricate issues at play. Understanding the decline of Italy's economy demands a deeper exploration beyond these surface-level explanations.

The significance of this analysis extends beyond the realm of academic discourse. For Italians, the consequences of prolonged economic stagnation have been acutely felt, both directly and indirectly. Italy's political landscape, marked by the rise of successive populist governments – with Giorgia Meloni’s (far-right) government being the most recent example – reflects a broader crisis in European solidarity and integration. This situation, as Costantini (2018) argues, acts as a mirror, reflecting the fractures within the European Union's framework of cooperation and mutual support among its member states.

Italy's situation, however, differs markedly from that of other EU countries like Greece, which have also been subjected to stringent austerity measures and subsequently left to grapple with the fallout of such policies (Varoufakis, 2017). In fact, Italy's case demands attention for a fundamental reason: as (Storm 2019, p.196) aptly puts it, "Italy is too big to fail." As noted by Guarascio, Heimberger, and Zezza (2023), Italy is not only the third-largest economy in Europe, trailing only behind Germany and France, but its extensive international connections in the realms of goods, services, and finance make it a pivotal player in shaping the future of Europe's economic landscape.

Therefore, this chapter aims not only to provide an academic exploration of key stylized facts regarding the Italian economy over the course of four decades (1978-2018) in the context of Fazzari, Ferri, and Variato (2020)’s model, but also to offer a broader understanding of the factors that, while not directly included in the model, are crucial to consider when analysing its behaviour and outcomes.

The structure of the chapter is as follows. First, key macroeconomic factors, as those included in Fazzari, Ferri, and Variato (2020)’s model, and their evolution from 1978 to 2018 will be examined. Second, it is crucial to emphasise that the study of macroeconomics should not exclude the examination of the historical context within which it occurs. As such, a detailed "four-streams" chronology of significant political and economic events relevant to both Italy and the global stage will be presented. This will be followed by an analysis of the underlying drivers of these economic dynamics, based on critical academic studies. Finally, the chapter will propose policy solutions that, according to heterodox economists, could potentially reverse Italy’s trajectory of decline. These policy recommendations are not only significant for Italy but also hold implications for the broader European Union, especially in the context of addressing systemic economic disparities and fostering a more cohesive and democratic union. By integrating these insights with the empirical calibration of Fazzari, Ferri, and Variato (2020)'s model (*Chapter V*), this chapter seeks to contribute to a nuanced understanding of Italy's economic predicament and its wider implications for the EU.

Output

An examination of the trajectory of Italy's real GDP and real GDP per capita offers an initial, albeit somewhat simplified, insight into the nation's growth over the past four decades. This trend becomes particularly insightful when we compare Italy's economic performance with that of its closest economic counterparts, France and Germany, as illustrated in *Figure 17*.

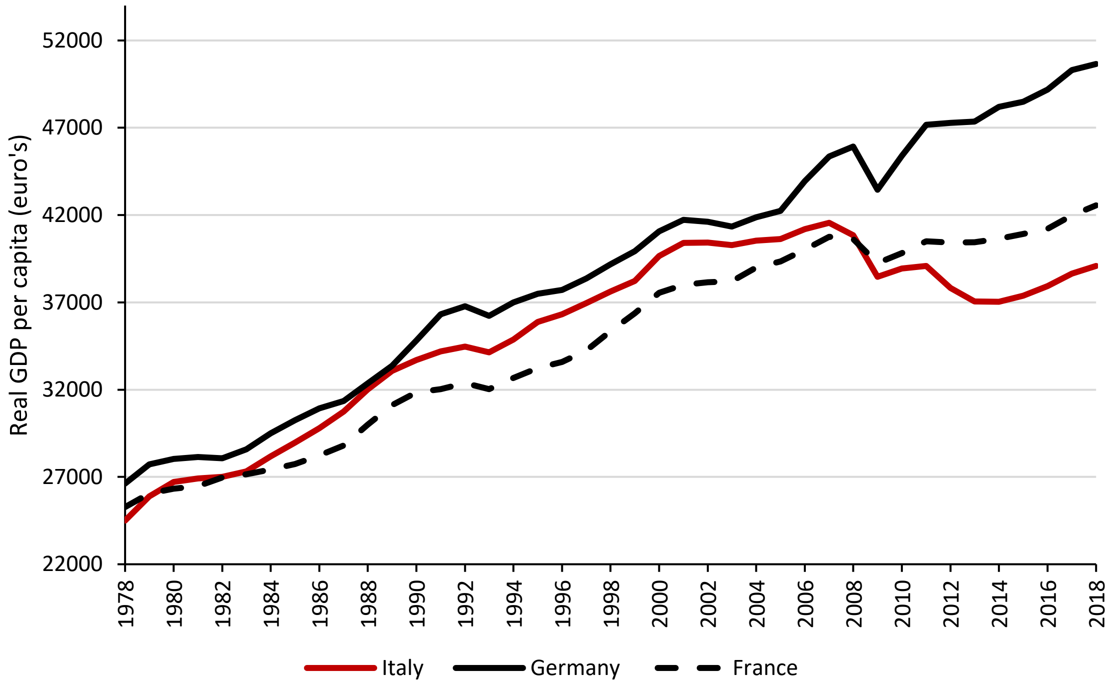

Figure 17*: Real GDP per capita for Italy, Germany, and France. Values in thousands constant (2010) USD, expressed in PPP. Source: Long Term Productivity Database*

From the evolution of this indicator, we can broadly delineate three distinct phases. The first phase, covering the years from 1978 to 2000-2001, saw the Italian economy successfully keeping pace with the escalating economic prosperity witnessed in both France and Germany. However, the following phase, from 2000-2001 through to 2008, was marked by a period of almost complete stagnation in Italy's real GDP per capita. It is during this stage that we begin to observe a noticeable, though still relatively mild, divergence in the economic paths taken by Italy, Germany, and France.

The most striking divergence emerged in the decade from 2009 to 2018. Particularly noteworthy is Italy's economic standing in 2018, which remained below the levels attained in 2007-2008, starkly illustrating the absence of robust, self-sustaining growth mechanisms capable of reversing Italy's entrenched position of stagnation (as seen in Figures 18 and 19).

While exploring real GDP per capita provides a basis for comparative study, examining the specific trends in Italy's real GDP growth allows us to uncover further insights. Employing a similar decomposition method to Storm's (2019, Table 3) allows us to extend our analysis beyond simple growth figures, offering a detailed look at how different components of GDP, such as private and public consumption, have changed over time. The data presented in *Table 3* illustrate the trends of interest across four decades.

	1979-1988	1989-1998	1999-2008	2009-2018
Private consumption	1.8	1.1	0.6	-0.1
Public consumption	0.6	0.1	0.3	-0.1
Gross capital formation	0.4	0.2	0.4	-0.4
Net exports	-0.5	0.2	-0.1	0.2
Real GDP growth	2.6	1.6	1.2	-0.3

Table 3*: Average growth rates of GDP components in the Italian economy from 1979 to 2018. Growth rates for each component are averaged over 10-year periods. Source: AMECO Database; own calculations.*

From this table, two significant observations emerge.
First, the trend in real GDP growth highlights a consistent decline in Italy's economic performance over forty years. This decline, which has its roots in the early 1970s, will be explored in more detail later in this thesis. Interestingly, when combining Italy's declining GDP growth with growth patterns from Germany and France, as shown in *Figure 18*, we can intuitively picture a common trend of decreasing growth among these euro area countries, especially before the divergence that arose after the financial crisis. However, the detailed discussion to follow will show that Italy's economic downturn is particularly worrisome since it has deeply hampered numerous factors deemed critical for sustained economic growth.

Second, examining the average changes in GDP components over time reveals that Italy's downturn is not only due to reduced domestic demand—which includes private and public consumption, and gross capital formation—but also because of weak performance in net exports. The challenge for Italy's growth model to transition from relying on domestic demand to enhancing net exports has been a significant topic of discussion, especially after the Eurozone sovereign debt crisis. This will be examined further in subsequent sections.

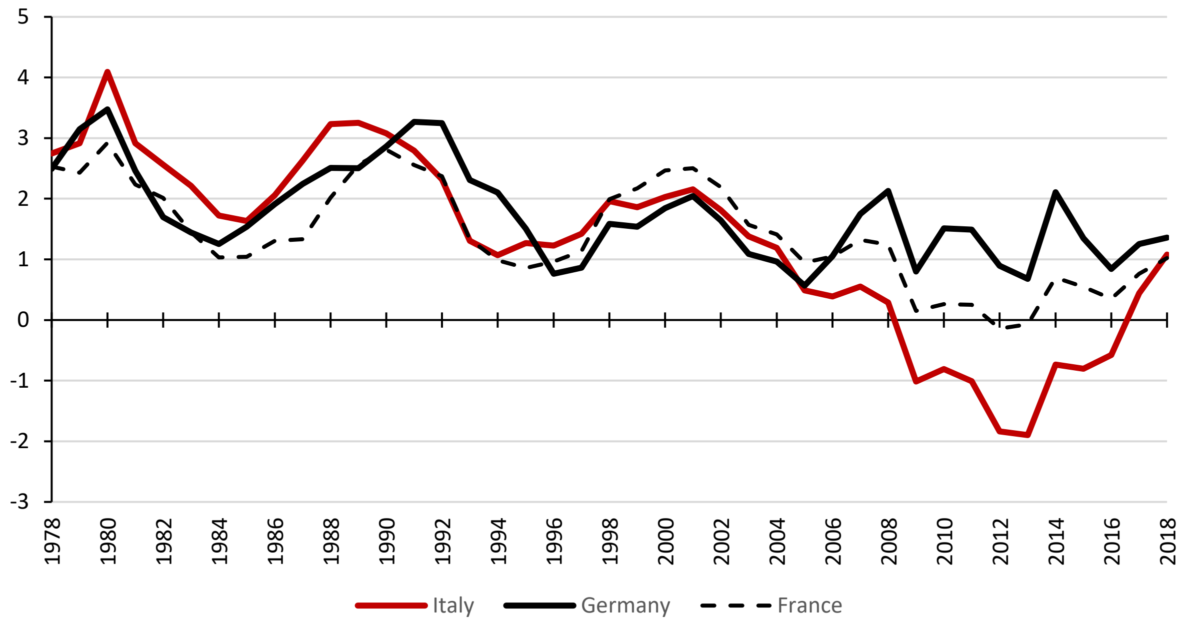

Figure 18*: 5-years moving average real GDP per capita growth rates of Italy, Germany, and France. Source: Long Term Productivity Database; own calculations.*

It is imperative to re-emphasise that Italy's unfavourable economic dynamics have had repercussions beyond mere short-term factors. This was initially highlighted in *Figure 3*, where we pointed out that Italy's decline has detrimentally impacted its long-term economic potential, as gauged by potential output (i.e., potential GDP). Furthermore, the scars left by the financial crisis of 2007-2008 and the subsequent Eurozone crisis, though common to many leading economies, did not impact Italy, Germany, and France uniformly. Germany and France, for example, maintained modest annual growth rates in potential output – averaging 1.26% and 0.92%, respectively, for the period 2009-2018. In stark contrast, Italy experienced an outright stagnation in its potential GDP, with an average growth of -0.09% during the same period (see Figure 19).

While it is true, as extensively discussed in Chapter II, that caution must be exercised when analysing theoretical and unobservable variables such as potential output, this does not detract from the pertinence of questioning whether Italy’s recent economic decline, unlike other European nations, has exacerbated certain structural limitations. These limitations potentially reinforce hidden, adverse feedback loops, thereby perpetuating a cycle of economic stagnation or even progressive decline in Italy’s economic landscape.

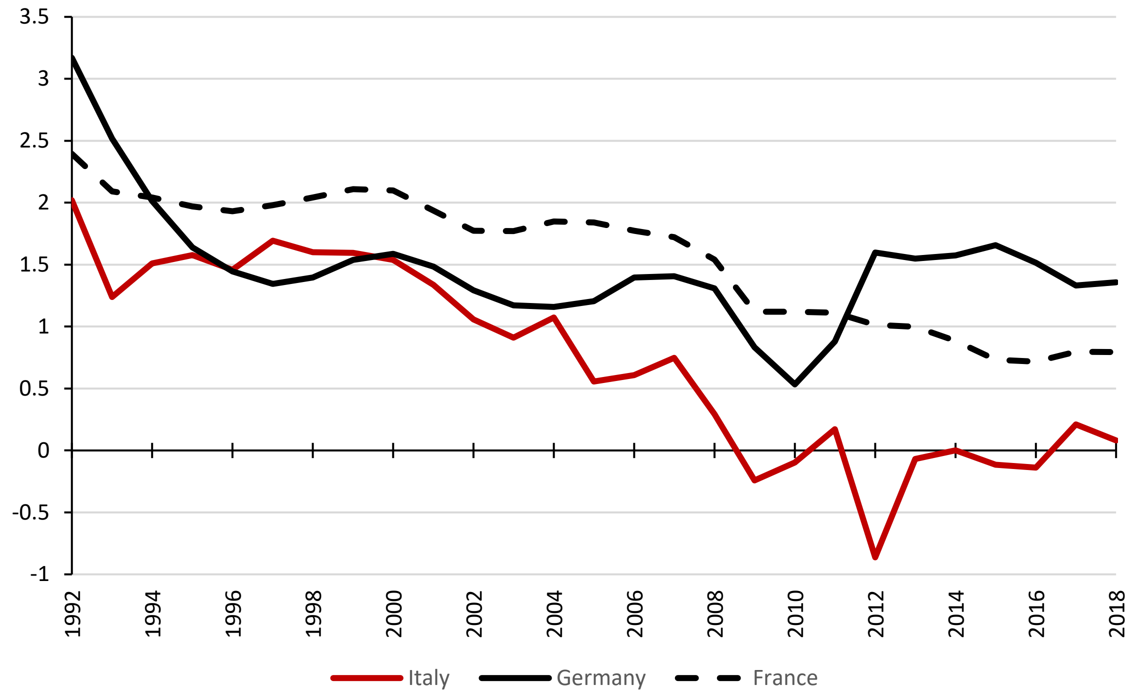

Figure 19: *Potential output growth rates for Italy, Germany, and France. Expressed in percentage terms. Source: AMECO Database; own calculations.*

Labour productivity growth

Considering the disappointing trajectory of (potential) output, especially over the last decade, it becomes necessary to scrutinise specific structural elements that are theoretically thought to foster more vigorous and resilient economic growth. As discussed in Chapter II one such factor is labour productivity (growth). This is viewed not just as an indicator of productive efficiency, but also as a crucial determinant of the pace at which real wages can increase while maintaining price stability.

Most importantly, this factor is deemed crucial for many reasons, such as affecting export growth and maintaining the sustainability of welfare systems, including public health and pension schemes, especially in advanced economies grappling with an increasingly ageing population (Deleidi, Paternesi Meloni, and Stirati 2020). Therefore, to have a broader understanding of the Italian economic evolution in the last four decades, analysing labour productivity (growth) is essential.

	1979-1988	1989-1998	1999-2008	2009-2018
Italy	2.72	1.63	0.83	-0.41
Germany	1.98	1.95	1.61	1.02
France	1.73	1.66	1.41	0.48

Table 4: *Average labour productivity growth in the Italian economy from 1979 to 2018. Growth rates are averaged over 10-year periods. Source: Long Term Productivity Database; own calculations.*

Upon examination of *Table 4*, it is evident that over the period of interest, the Italian economy, along with that of its closest economic partners, has experienced a consistent downturn in labour productivity growth rates. However, in contrast to Germany and France, which have managed to maintain a modicum of growth in productivity, Italy has suffered a markedly sharper decline. Additionally, the productivity trajectory of Italy during the focus period reveals a significant stagnation, especially in the years leading up to the adoption of the Euro in place of the Italian Lira (1999-2002) and following the financial crisis (2007-2009).

Labour market dynamics

Anticipating our analysis of Fazzari, Ferri, and Variato (2020)'s model that will be presented in the next chapter, it is crucial to know that, according to this model, potential output growth, as determined by supply factors, is a function of the combined growth in labour productivity and labour supply. Moreover, these supply-side variables are significantly shaped by the dynamics on the demand side, particularly through changes in the unemployment rate.

This highlights the crucial importance of labour market dynamics in comprehending Italy's macroeconomic development. However, to truly capture the evolution of the Italian labour market, it is essential to look beyond traditional metrics like employment and unemployment rates. As Antenucci, Di Bucchianico, and Salvati (2023) point out, a broader perspective is necessary, particularly considering the issue of underemployment, which conventional indicators might miss. Underemployment occurs when workers are employed below their full capacity, either working fewer hours than they desire or in roles that do not fully utilise their skills, experience, or education. This form of hidden unemployment not only results in economic inefficiency but also diminishes job satisfaction, exacerbates social inequality, and potentially impacts overall well-being and social cohesion.

With this broader perspective in mind, our examination of Italy's labour market will nevertheless begin by analysing the unemployment rate, also in relation to its evolution in the German and French contexts.

The unemployment rate is arguably the most recognised indicator of the labour market and frequently features in discussions among the public. However, it is essential to define this metric precisely to understand why it does not fully capture the extent of labour underutilisation. According to the latest standards set by the International Conference of Labour Statisticians (ICLS), the unemployment rate is calculated as:

$$u = \frac{U}{U + E} = \frac{U}{N}$$

Here, U represents the number of unemployed people; E denotes the employed population; and the sum of U and E equals the total labour force (N).

To grasp how the unemployment rate is computed, it is crucial to examine the definitions of employment and unemployment as outlined by authoritative sources like the Italian National Institute of Statistics (ISTAT).

For instance, **unemployed individuals** are defined as individuals (aged 15 to 74) who are not currently working but have: actively searched for work in the four weeks leading up to the reference week and are ready to start working (or begin self-employment) within the next two weeks; or secured employment that will start within three months from the reference week and would be prepared to start sooner if possible.

Conversely, those considered **employed** are individuals (aged 15 to 74) who, during the reference week, worked at least one hour for compensation or profit, including unpaid family workers. This category also includes people temporarily absent from work for reasons such as holidays, sickness, compulsory maternity/paternity leave, or employer-financed training.

With these specific definitions in mind, it becomes clear why these metrics alone cannot provide a comprehensive view of labour market dynamics. Indeed, as detailed by the International Labour Organization (ILO), to achieve a more complete picture of labour underutilisation, it is essential to complement traditional unemployment rates by examining additional indicators capturing, for instance, the incidence of involuntary part-time employment.

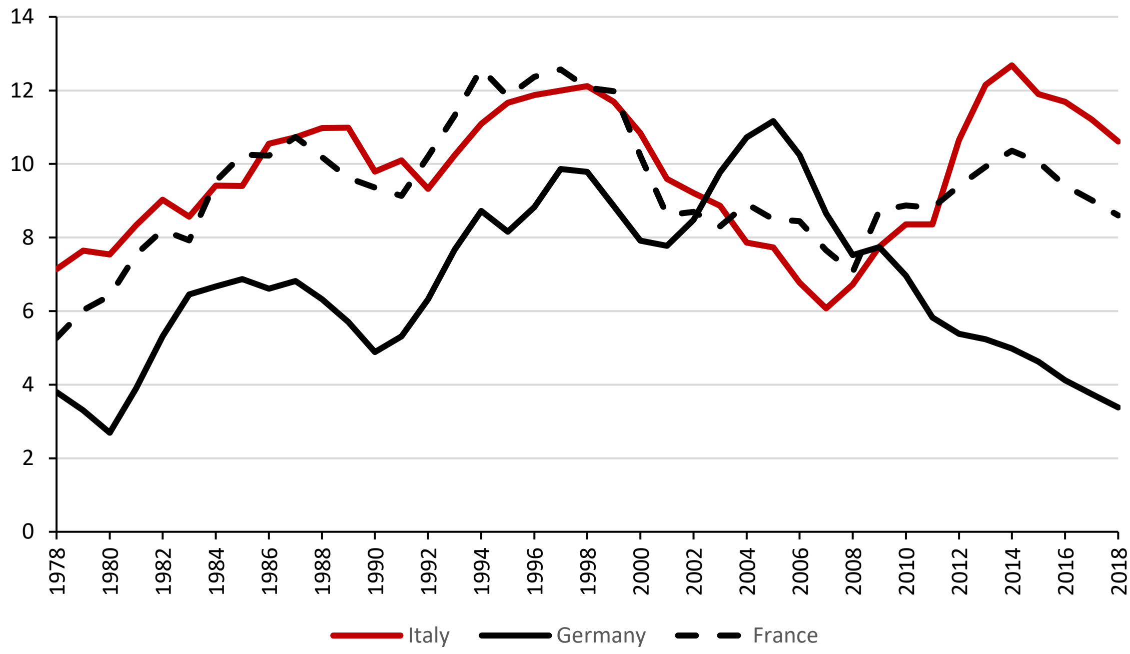

Figure 20: *Unemployment rates for Italy, Germany, and France between 1979 and 2018. Expressed in percentage terms. Source: Macrohistory Database.*

Examining *Figure 20* reveals that the unemployment rate trends mirror the three phases identified in our real GDP per capita analysis. From 1978 to 2000, a period of increasing unemployment was observed in all three countries, with Italy and France's rates ascending from 7.6% and 5.3% to hover around 12% by the late 1990s. Concurrently, Germany's unemployment figures grew from a modest 3.8% to nearly double at around 7.8%. The turn of the millennium marked a period of improvement until 2008, with Italy and France's rates dipping to between 6% and 7%. Germany, despite some fluctuations, managed to maintain a steady rate in the run-up to the financial crisis. Post-2009, the scenario shifted: Italy and France's rates escalated, settling at 10.6% and 8.6%, respectively, by 2018. Contrastingly, Germany's unemployment rate demonstrated a significant decline, culminating in the lowest figures seen in nearly 40 years.

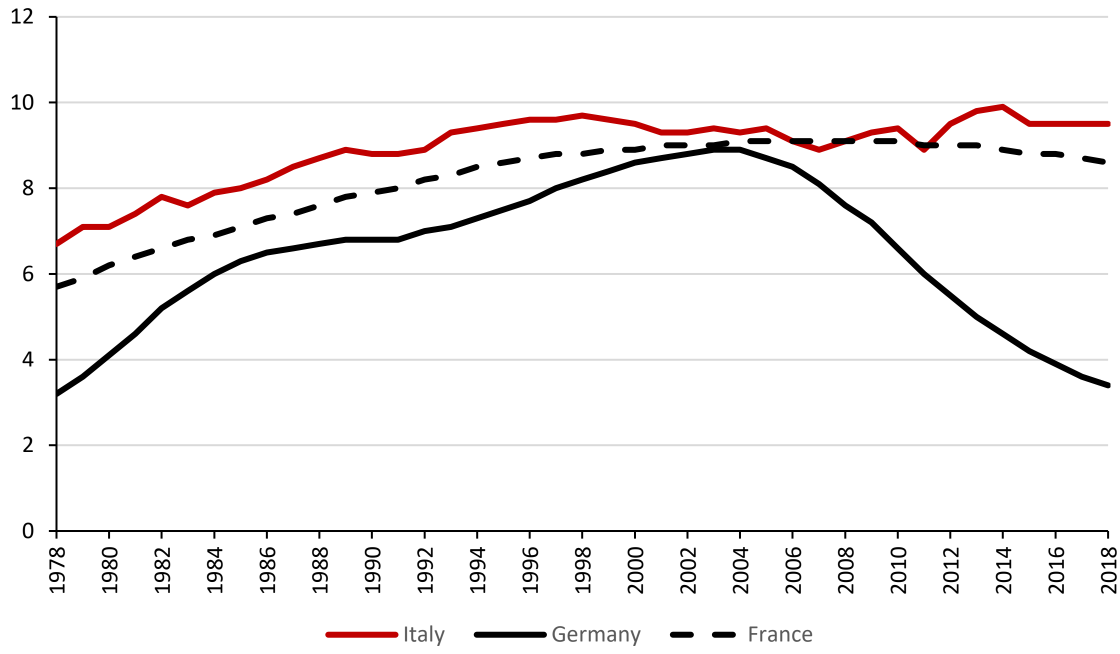

Figure 21: *Evolution of the Non-Accelerating Wage Rate of Unemployment (NAWRU) for Italy, Germany, and France between 1979 and 2018. Expressed in percentage terms. Source: AMECO Database.*

In line with our examination of GDP growth, we delve into the possibility that recent shifts indicate entrenched, structural changes in unemployment. This inquiry is visualised in *Figure 21* through the trajectory of the Non-Accelerating Wage Rate of Unemployment (NAWRU). Setting aside the critiques of NAWRU outlined in Chapter II and interpreting its intended meaning, we discern significant patterns. Specifically, over the past forty years, Italy and France appear to have diminished structural capacity to integrate additional workers without triggering inflation (reflected in a rising NAWRU), with their structural unemployment rates rising from 6.7% and 5.7% to 9.5% and 8.7%, respectively. Conversely, Germany experienced a substantial increase in structural unemployment—from 3.2% in 1978 to 8.9% in 2004—yet remarkably reverted to a NAWRU of 3.4%, nearly mirroring its initial state within a span of just over a decade.

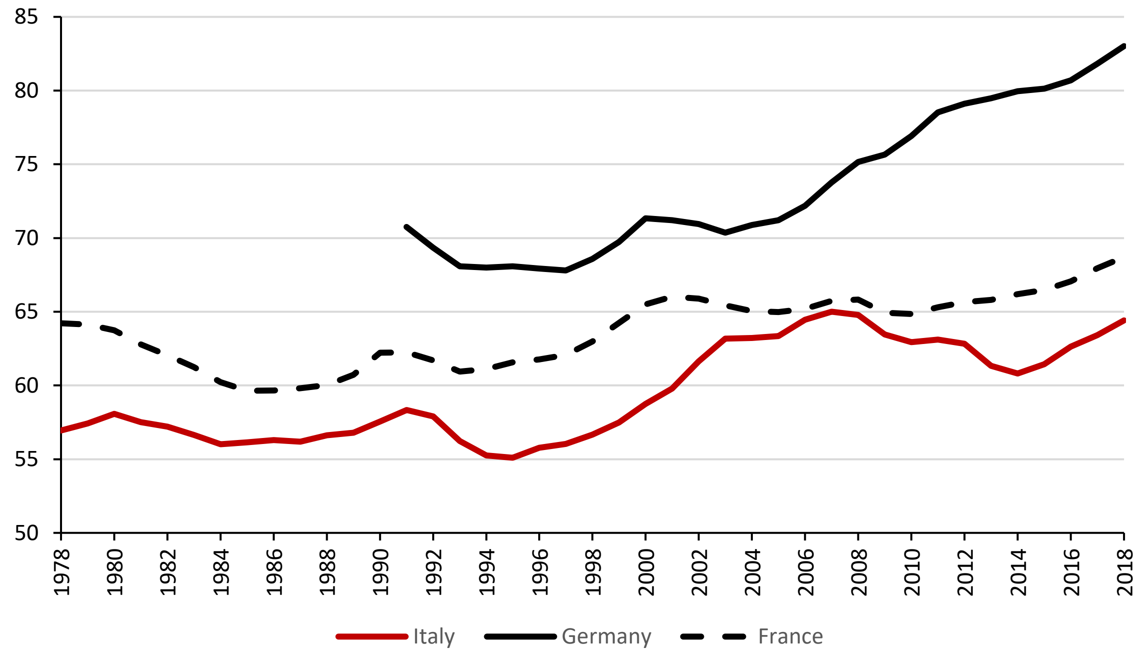

Figure 22: *Employment rate in Italy, Germany, France between 1979 and 2018. Expressed as a percentage of total population aged 15-64. Source: AMECO Database.*

Turning our focus away from unemployment, *Figure 22* examines the progression of the employment rate. Data constraints prevent the analysis of Germany's employment rate before 1991, but the graph still reveals two interesting observations. Initially, in the mid-1990s to mid-2000s, Italy appeared to be aligning with France's employment rate. However, Italy's trajectory dipped, ultimately falling behind France by a five-percentage-point margin by the end of the analysed timeframe. Secondly, this analysis diverges from that of unemployment rates as it demonstrates a consistent hierarchy within the trio over the period concerned, with Germany consistently outperforming, followed by France, and Italy trailing. Notably, the gap between these nations has notably expanded since the early 2000s.

As a third aspect in our analysis, we turn to complement our earlier discussions on employment and unemployment (rates) by examining the evolution of another vital labour market indicator: the labour force participation rate (LFPR). This indicator reflects the portion of the working-age population (those aged between 15 and 64) that is engaged in the labour market, either through employment or active job search:

$$LFPR = \frac{E + U}{POP_{act}} = \frac{N}{POP_{act}}$$

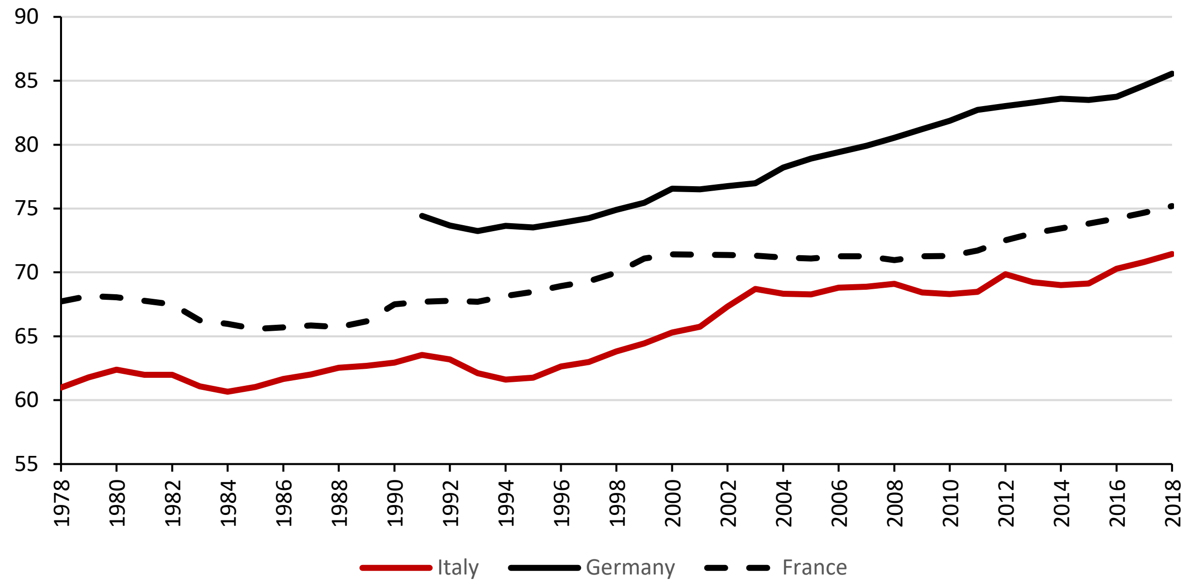

Figure 23: *Labour force participation rate in Italy, Germany, and France between 1979 and 2018. Expressed as a percentage of total population aged between 15 and 64. Source: AMECO Database; own calculations.*

Analysing the evolution of the (labour force) participation rate of Italy, Germany and France as displayed in *Figure 23*, three major stylised facts emerge. First, a general upward trend is noted across all three nations, indicative of a labour force growth outpacing that of the working-age population. This is inferred from the growth rate of the participation rate, approximately calculated as:

$$\widehat{LFPR} \cong \hat{N} - \widehat{POP}_{act}$$

Second, focusing on the Italian economy, the evolution of its participation rate can be clustered into three distinct phases. From 1978 to the mid-1990s, the rate was relatively static, hovering below 64%. A period of substantial growth followed, with the rate climbing nearly 7 percentage points from 61% to 68% up to around 2003. Then, from 2004 to 2018, the participation rate in Italy saw only a modest increase, settling around 70%, largely influenced by its (positive) dynamics in the aftermath of the Eurozone crisis.

Third, while Italy has experienced some growth in labour force participation, it continues to trail behind its major Eurozone counterparts. When compared to France, Italy exhibits a participation shortfall of about 4%, and the divide with Germany is around 15 percentage points. This disparity underscores Italy's relative lag in integrating its working-age population into the labour market.

Beyond evaluating the number of individuals actively participating in the labour force, either as employed or unemployed workers, it is essential to assess how income distribution mechanisms have impacted workers' compensation during the period of interest. *Figure 24* gives indication of average real wage growth per employee for Italy, France and Germany.

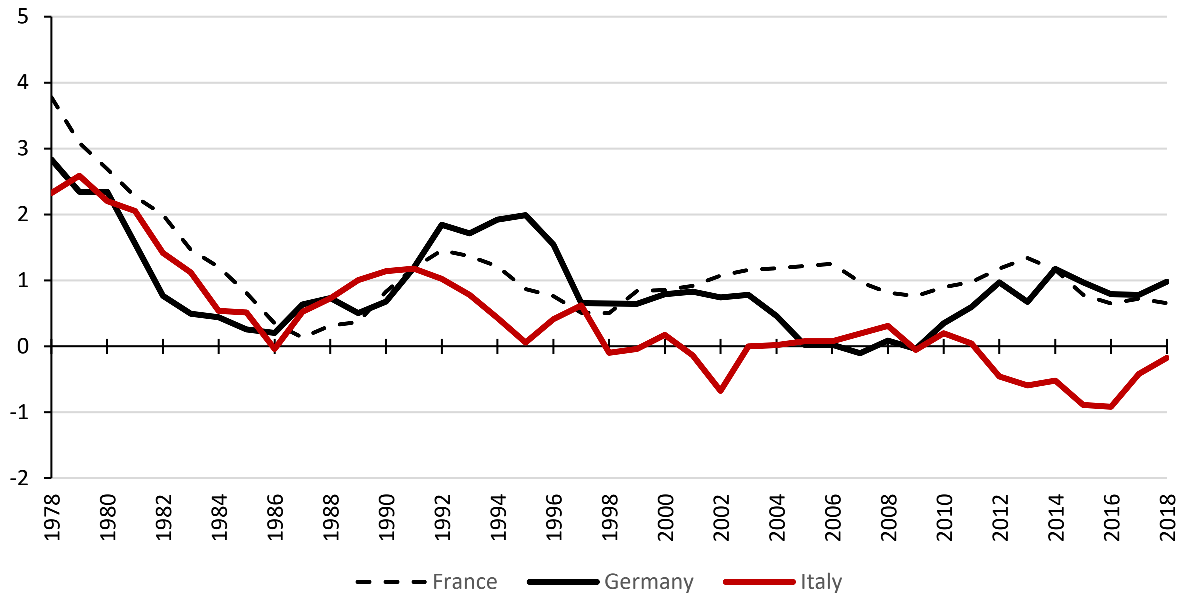

Figure 24*: 5-years moving average real wage growth per employee in Italy, Germany and France. Source: Macrohistory database; own calculations.*

This graph reveals two key observations. First, a significant moderation in wage growth is evident across all three euro area countries, with an especially sharp downturn in the first decade under review. Second, focusing on Italy, despite a slight and short-lived uptick in real wage growth around the late 1980s, real wages have largely remained stagnant. This observation is backed by data on real compensation per employee, presented as a normalised index (where 100 represents the level in 2015) in *Table 5*. This highlights another layer of disparity between Italy and its closest counterparts. While workers in France and Germany have also faced considerable wage moderation over the past forty years, the reduction in their earnings is less severe compared to the situation of Italian workers.

	1979-1988	1989-1998	1999-2008	2009-2018
Italy	96.0	102.8	103.1	101.1
Germany	78.7	87.3	93.8	98.7
France	75.2	81.8	90.0	99.2

Table 5: *Average normalised real compensation per employee in Italy, Germany, and France from 1979 to 2018. The real compensation per employee is represented as a normalised index with 2015 as the base year (2015=100). Averages are computed over ten-year intervals. Source: Eurostat; own calculations.*

To conclude this comparative analysis of the Italian labour market, it would be valuable to consider a more encompassing measure of unemployment that incorporates the aspect of underemployment, following the approach of Antenucci, Di Bucchianico, and Salvati (2023, sec. 2.2.4). This measure, often termed u_6 in economic studies, is formulated as:

$$u_6 = \frac{U + E_{ipt} + E_{pot}}{N + E_{pot}}$$

Here, U captures the traditionally defined unemployed; E_{ipt} denotes the involuntary part-timer workers, who are those working fewer hours than desired and are ready to work more; and E_{pot} includes those seeking work but not immediately available, along with "discouraged workers" who are those ready to work but not actively seeking employment.

The key benefit of this metric is its ability to better reflect the actual scale of labour underutilization, going beyond traditional unemployment measures. A significantly higher u_6 rate compared to the standard unemployment rate suggests an untapped workforce potential that could be mobilised with stronger economic growth and the removal of barriers faced by workers. This phenomenon is of considerable interest beyond economics because, as evidenced by recent studies, pervasive underemployment impacts not just the economy, but also has profound negative consequences on individuals, including reduced social standing, life satisfaction, and overall physical and mental wellbeing (Gedikli et al. 2023).

However, this thesis does not calculate u_6 due to significant data limitations, both in the data points' range (limited to 2008-2018) and due to breaks in the time series from changes in methodology. Nevertheless, we still address the notion of underemployment by examining the trends of involuntary part-time work in Italy, Germany, and France, as a proxy for the broader phenomenon of underemployment.

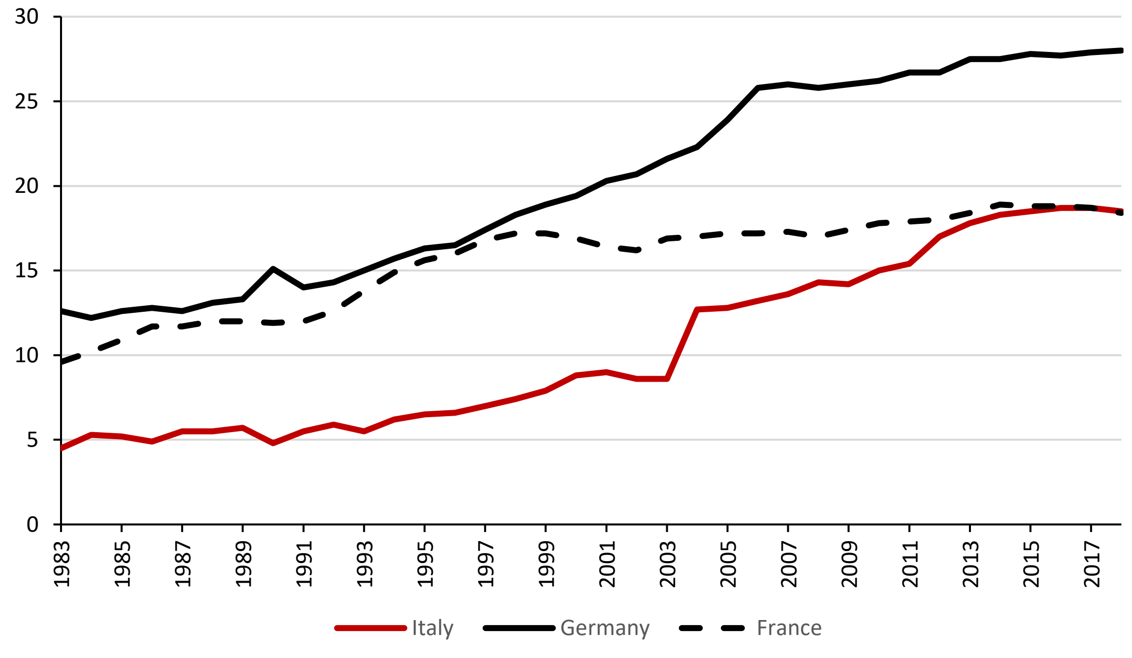

Figure 25: *Part-time employment as a share of total employment in Italy, Germany, and France between 1979 and 2018. Source: Eurostat; own calculations.*

Figure 25 showcases that part-time employment as a share of total employment has steadily increased over the past three decades across all three nations, albeit at varying rates. Italy has seen a significant climb (from about 5% in 1983 to just over 18% in 2018), with Germany not far behind (rising from around 12% in 1983 to 28% in 2018), and France also growing (from roughly 10% in 1983 to just above 18% in 2018). This growth in part-time employment is not inherently problematic; many workers may opt for part-time roles to accommodate education, family responsibilities, or other personal choices. To discern whether part-time work is a matter of choice, we can examine the prevalence of involuntary part-time employment relative to total part-time work.

As depicted in *Figure 26*, the picture that emerges is certainly more nuanced. While the German market seems to suggest a preference for part-time work, the situations in France and Italy are starkly different. In France, a substantial fraction of part-time workers (around 40% in 2018) would prefer to work more if possible. Italy presents an even more striking scenario, where the majority of part-time employment is involuntary, with the proportion rising sharply from about 35% in 1983 to 65% in 2018. This notable increase in involuntary part-time work points to a deepening state of instability in the Italian (and to a lesser extent, the French) labour markets, possibly highlighting a shift towards more precarious employment conditions.

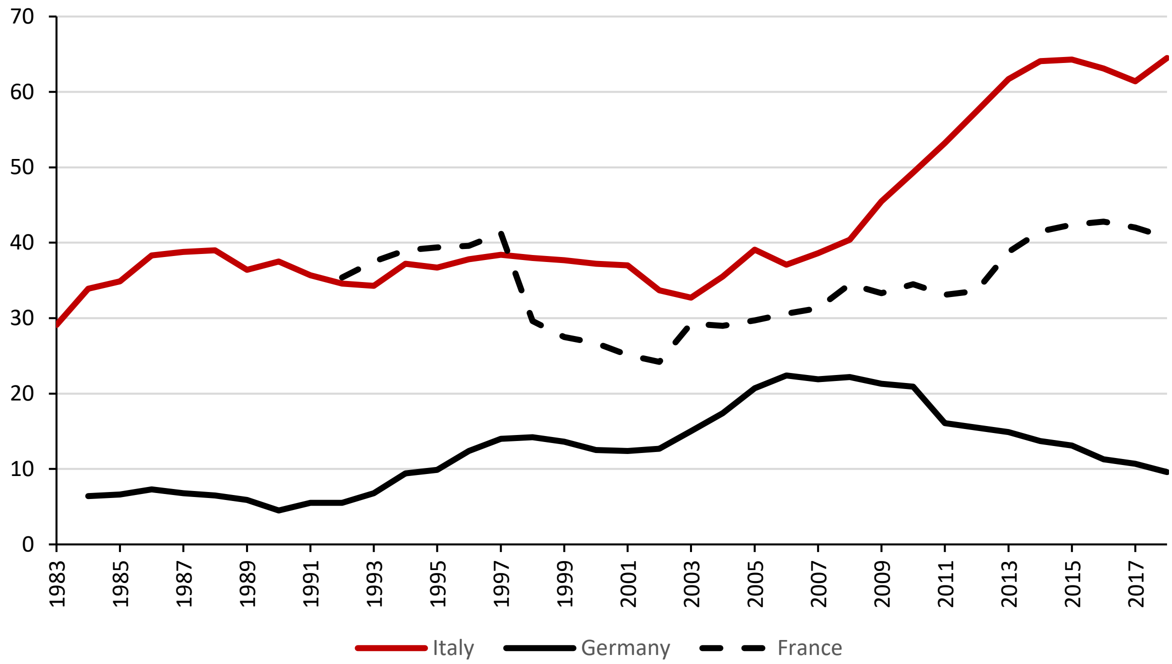

Figure 26: *Involuntary part-time employment as a share of total part-time employment in Italy, Germany, and France between 1979 and 2018. Source: Eurostat; own calculations.*

Debt dynamics and inflation

Another important discussion we must have when analysing the evolution of the Italian economy concerns two major economic variables which have been key criteria in steering Italy's policy strategies in the past few decades: the debt-to-GDP ratio and the rate of inflation.

The potential long-term repercussions of high national debt on economic growth have been a focal point in economic research particularly in the wake of the financial crisis of 2007-2008. While this thesis does not delve into the debt-growth nexus (Guarascio, Heimberger, and Zezza 2023, sec. 2 provides a brief review), it is vital to acknowledge that since adhering to the Maastricht Treaty, the debt-to-GDP ratio, and fiscal deficit, have emerged as key indicators of Italy's economic sustainability. *Figure 27* depicts the debt-to-GDP trajectory for Italy, Germany, and France.

From the graph, two key observations can be inferred.

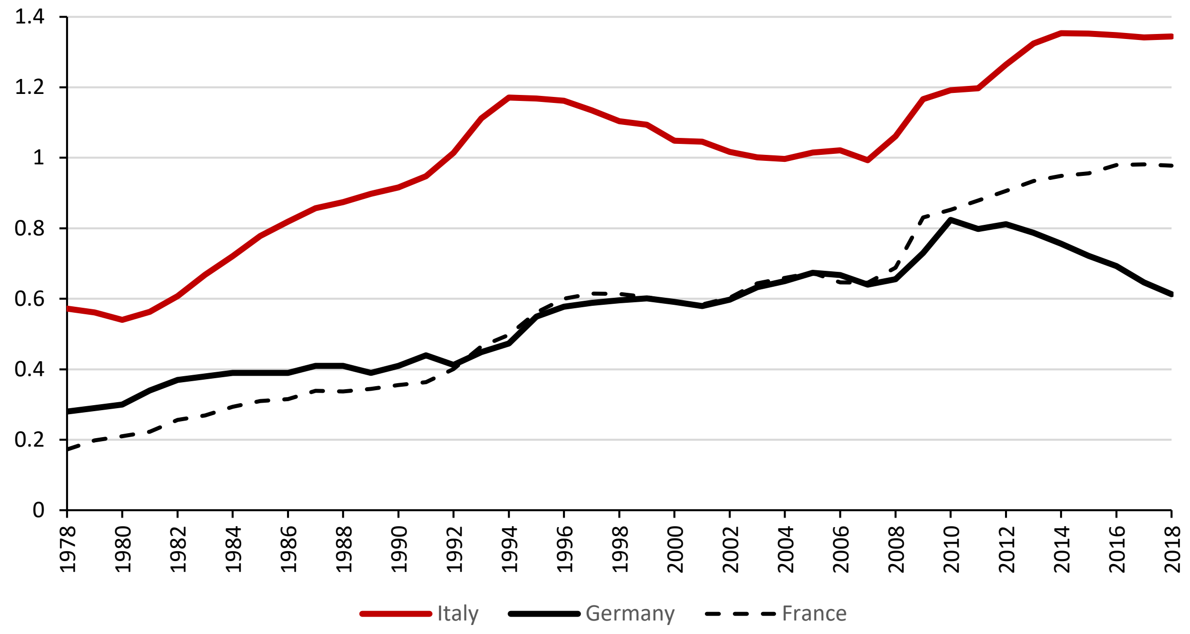

Figure 27: *Public debt to GDP ratio in Italy, Germany, and France between 1979 and 2018. Source: Macrohistory database.*

First, keeping the Italian economy as our reference, we can distinguish three phases. Between 1978 and the early 1990s, all three countries experienced climbing debt ratios, albeit at differing rates—with France's increasing by 170% from 1978 to 1993, followed by Italy and Germany with 90% and 60% rises, respectively, in the same period. A divergence in debt trajectories becomes apparent from 1994 to 2007, during which Italy managed to reduce its debt-to-GDP ratio by about 20% (from 1.17 in 1994 to 0.99 in 2007), while Germany and France saw their debt ratios climb by 40% and 30%, respectively. Post-financial crisis, Italy and France's debt ratios rose by 26% and 42%, respectively. Contrastingly, Germany, after a brief increase from 2008 to 2010, reverted to early 2000s levels.

Second, we must consider not just the change in debt ratios but their absolute values, given their significant implications for policy (as stressed by the Maastricht treaty). In fact, in the real-world economic landscape, despite a lack of definitive evidence for high debt directly impeding growth as pointed out by Heimberger (2023), the perception of such a link persists among policymakers. This perception, in turn, has often led to pre-emptive and conservative policy choices. In Italy, for example, the apprehension regarding high debt levels—fuelled by fears of adverse effects on growth—has driven austerity measures. These policies, intended to avoid the forecasted negative outcomes, may have inadvertently hindered growth, essentially resulting in a self-fulfilling prophecy. In light of these considerations, countries maintaining debt ratios within, or close to, accepted international benchmarks, such as Germany's adherence to the Maastricht Treaty's 60% target, enjoy greater flexibility to embark on ambitious public spending initiatives (i.e. they are granted a wider economic policy space)[2]. Under this "policy space hypothesis", a comparison of debt-to-GDP

[2] Certainly, while the debt-to-GDP ratio is a significant factor in defining a nation's "policy space", it is not the only determinant. Other crucial elements such as the economy's overall size and its position in international trade and global value chains (GVCs) also play a vital role. A comprehensive exploration of this idea is outside the scope of this study and my expertise. Nonetheless, it represents an intriguing and potentially rewarding direction for future research.

ratios in 2018 paints a less favourable scenario for Italy as opposed to Germany, which emerges as the clear front-runner, and France, which occupies a relatively comfortable middle ground.

Turning our attention to inflation, which has been a significant concern for Italian policymakers since the 1970s, we can identify three distinct phases in *Figure 28*. Initially, from 1978 until the late 1980s, Italy and France grappled with considerable inflation, with rates reaching peaks of approximately 20% and 14%, respectively. Germany, in contrast, maintained a relatively stable price environment during this time. Moving into the early 1990s and continuing until 1997, the three nations converged towards an inflation rate of about 2%—a rate that had become the widely accepted benchmark for price stability among many central banks worldwide. Lastly, the period from 1998 through 2018 shows that the inflation rates of these three countries have mostly been anchored to this target.

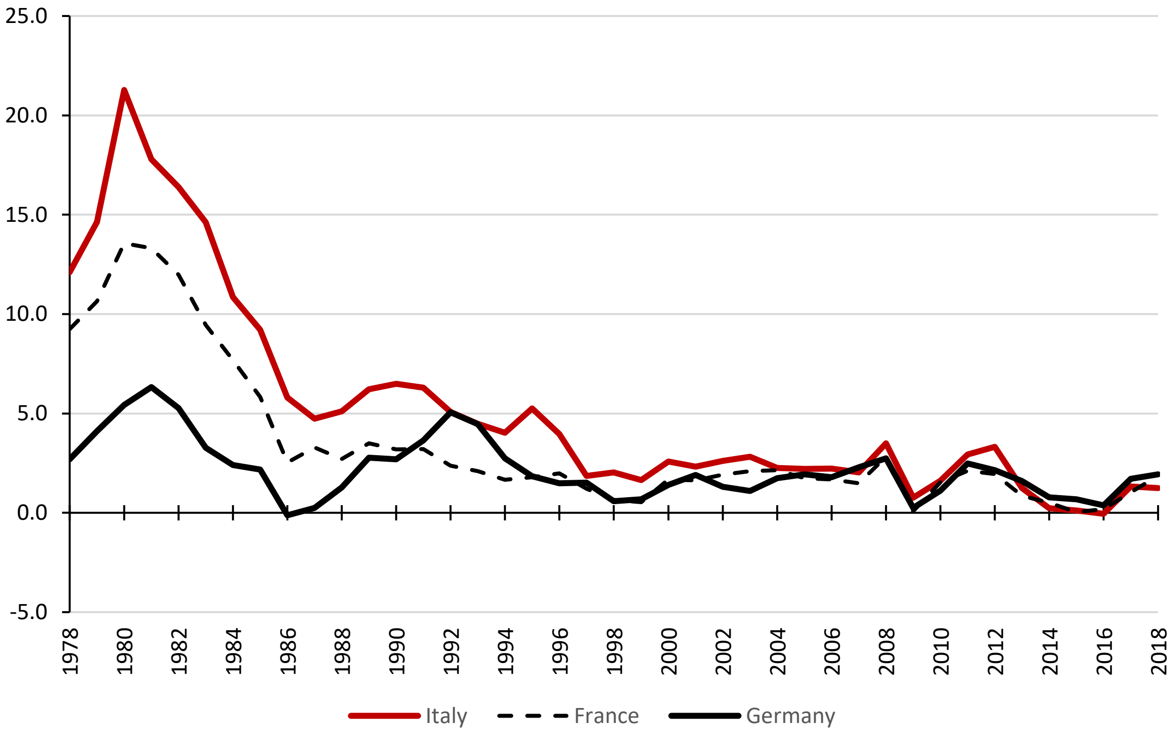

Figure 28*: Consumer Prices Index (CPI) annual growth rate in Italy, Germany, and France between 1979 and 2018. Source: Macrohistory database; own calculations.*

Table 6 summarises the stylised facts discussed above for the Italian economy across four decades[3].

	1979-1988	1989-1998	1999-2008	2009-2018
Real GDP growth	2.57	1.62	1.23	-0.3
Potential GDP growth	2.3	1.8	0.97	-0.11
Labour productivity growth	2.72	1.63	0.83	-0.41
Unemployment rate	9.22	10.92	8.54	10.54
NAWRU	7.83	9.25	9.29	9.48
Employment rate	56.81	56.56	62.17	62.64
Participation rate	61.71	62.73	67.49	69.5
Part-time employment	5.15	6.11	10.95	17.21
Involuntary part-time employment	35.67	36.66	36.9	58.45
Public debt-to-GDP ratio	0.7	1.06	1.03	1.29
Annual inflation rate	12.04	4.57	2.42	1.27

***Table 6**: Italy's stylised facts between 1979 and 2018.*

Looking for the roots of Italy's lost growth

The narrative that has emerged from the stylised facts delineated in the previous subchapter points to a concerning trend: Italy's economic woes are not merely a matter of lagging behind its closest Eurozone counterparts. More critically, Italy's "economic engine" appears to have lost its capacity to fuel robust and inclusive growth in absolute terms.

The reasons behind Italy's economic decline have sparked extensive debate across academic and political realms, leading to numerous policy recommendations. Despite these efforts, the core challenges obstructing Italy's economic path remain unresolved. The vast literature on this topic generally divides the explanations into two main categories: those that highlight supply-side or structural issues, and those that emphasise the importance of demand-side factors, namely the dynamics of aggregate demand.

[3] A more comprehensive table, including data on France and Germany is shown in *Appendix B*.

From the supply-side viewpoint, Italy's economic landscape is seen as being constrained by various elements that prevent the emergence of truly competitive markets, which are crucial for nurturing innovative and profit-driven industries. Key among these constraining factors are the dominance of small and medium-sized enterprises (SMEs) in the Italian economy, an insufficiently flexible labour market, the instability and corruption pervading the political system at multiple levels (national, regional, provincial), and the significant influence of mafia-type organisations contributing to the persistent economic divide between the northern and southern regions.

In line with this conceptual framework, which had strong ties with the political visions championed by the Reagan and Thatcher administrations in the U.S. and UK during the 1980s, policymakers advocated for a diminished governmental role in the economy, encouraging steps toward liberalisation and privatisation, and a move towards a more flexible labour market by curbing the influence of unions and promoting temporary employment contracts as a way to give companies more hiring flexibility.

Within the framework of supply-side economics, the call for more flexible labour markets has been a cornerstone of Italy's economic policy since the late 1970s. This movement towards labour flexibility, along with its associated impact on moderating wages, traces its roots to the tumultuous period known as the Italian Years of Lead, spanning from the late 1960s to the early 1980s. During this period of intense social conflict, terrorism, rapid industrial and economic transformation, and political instability, labour unions, particularly those with left-leaning orientations, played a crucial role in mobilising workers. They became central figures in the push for social and political reform, often clashing with the government and extremist factions.

The significant influence of organized labour, coupled with the social unrest and rising inflation during the Years of Lead, set the stage for a growing acceptance of policy measures aimed at curbing wages. This shift found support in the prevailing belief that wage growth was a prime source of price instability necessitating moderation. Over time, wage moderation emerged as a common goal across Italy's political spectrum and among industry leaders, underscored by the adoption of numerous deregulation and flexibility policies in recent decades, as detailed by Guarascio et al (2023, p.21 footnote 7).

Italy not only underwent significant labour market restructuring but also implemented extensive structural reforms, such as privatisation and fiscal consolidation, far exceeding the efforts of its euro area counterparts (Storm, 2019; Guarascio et al., 2023). Yet, despite these comprehensive reforms, the Italian economy has struggled to achieve notable improvements in growth performance and resilience to economic downturns, as the fallout from the financial crisis and the Eurozone crisis has shown.

Two points are crucial in understanding the impact of supply-side factors on Italy's long-term growth capacity. First, an exclusive emphasis on these factors does not clarify the quickening pace of Italy's economic downturn beginning in the early 1990s. This acceleration is puzzling, especially considering Italian policymakers’ stronger commitment to supply-side measures in line with the convergence criteria of the Maastricht Treaty and subsequent European Monetary Union (EMU) regulations. Secondly, attributing long-term growth to supply-side dynamics overlooks the growing recognition of hysteresis mechanisms by economists from various schools of thought in recent years (see Chapter 3). Thus, while supply-side factors undoubtedly contribute to explaining persistent challenges and growth sources, demand-side factors are equally vital. They underpin cycles of investment, innovation, and growth, even over the medium to long term.

To comprehensively understand Italy's economic trajectory over recent decades, it is essential to adopt a framework that integrates both supply-side and demand-side factors. This balanced approach is exemplified in the works of Guarascio et al. (2023) and Storm (2019), and is supported by a broader literature on the subject, including contributions from Cesaratto and Zezza (2018), Tridico (2014), and Cesaratto (2020, Ch. 6,7).

According to these sources, a thorough analysis of Italy's economic decline that takes into account demand dynamics must highlight the following points. Firstly, while it is true that increasing real wages can lead to higher prices and reduced cost-competitiveness in international markets due to labour market arrangements, the impact of wages extends beyond these effects. Higher wages can encourage firms to invest in labour-saving innovations, thereby enhancing the economy's productivity and innovative capacity. Additionally, increased wages stimulate consumption, which boosts aggregate demand and creates a positive cycle of growth expectations and new investments.

Secondly, a symmetric formulation of hysteresis suggests that positive shifts in aggregate demand can enhance potential output growth, while decreases in aggregate demand can stifle it. Therefore, any austerity measures that reduce aggregate demand without appropriate countermeasures can lead to a loss of productive capacity, innovation, and technological competitiveness.

This argument does not imply abandoning supply-side initiatives, such as increased investment in research and development. However, the growing literature on hysteresis demonstrates that an economy's productive potential is not independent of demand dynamics. Depending on the historical, institutional, and other specific forces at play, demand-side factors may be crucial in shaping a country's productive capacity. Although it is challenging to determine definitively whether an economy is demand-led or supply-led due to the complexity of various influencing factors and paradigms, it is essential to recognise the significant role that demand-side factors can play in shaping long-term economic evolution.

IV. Conceptual model analysis

The fascination with understanding economic growth, its causes, mechanisms and the variations in growth patterns across different countries is a cornerstone of economic research, dating back to classical economists like Adam Smith, David Ricardo, and Karl Marx (see Blecker and Setterfield, 2019, ch. 1).

What is key in this research, however, is that varied interpretations of economic growth and its underlying mechanisms lead to divergent policy prescriptions. These policies, in turn, do not merely respond to economic realities but actively shape the future trajectory of economies. This phenomenon underlines the performative nature of economic models, which not only analyse or predict economic outcomes but also have the power to bring about the very conditions they forecast (Heimberger, Huber, and Kapeller, 2020; Heimberger, and Kapeller, 2017). In essence, economic models do more than describe the world; they are active agents in its creation, shaping economic landscapes and growth trajectories through the policies they inspire. This performative capability highlights the profound impact of economic (growth) theory on the material conditions of our lives, demonstrating that the abstraction of models can, and often does, translate into tangible economic, social, and institutional changes.

It is possible, therefore, to argue that even the simplest model can profoundly shape the course of real-world policymaking once decision-makers – even if unconsciously- believe it to be capable of capturing some underlying truth in the workings of society[4].

Keeping this last consideration in mind, the present chapter will describe the simple macroeconomic model, which will form the analytical basis of this thesis. As it will be apparent from the following discussion, given the simplicity of its framework, the model's goal is not to provide a detailed description of the (macro)economic reality. Instead, it aims to support a different pedagogical understanding of macroeconomic growth mechanisms.

Given that the expected audience of this work will be prominently composed of non-economists, I will avoid focusing on a detailed description of the model's theoretical background. The reader interested in having a more nuanced understanding can refer to the three foundational papers for this chapter and the literature mentioned there (Fazzari, Ferri and Variato, 2020; Fazzari, and Gonzales, 2023; Fazzari, Ferri and Variato, 2013).

The chapter is structured in the following way. Initially, we present a simplified, static version of Fazzari, Ferri and Variato (2020)'s dynamic model, and introduce the concept of balanced steady-state equilibrium. This simplified framework allows for a detailed examination of the equilibrium's properties and the mechanisms that may contribute to the stability of the system under study.

Following this, we will delineate the complete model, providing a more comprehensive view of its structure and components.

[4] "[…] the ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed, the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back." (Keynes, 1936, p.383)

Subsequently, we undertake dynamic simulations to explore the evolution of key macroeconomic variables, such as the unemployment rate and potential output growth, over time. These simulations, informed by parameter values from both Fazzari, Ferri, and Variato (2020) and Fazzari and Gonzales (2023), will focus, among other things, on exploring the key role of autonomous demand and the implications of a lower bound on the unemployment rate.

Simplified model

In presenting a straightforward conceptualisation of the economic model used in this thesis, I follow a path similar to that suggested by Fazzari and Gonzales (2023), simplifying our complex economic system into a few key relationships.

First, real consumption spending is a linear proportional function of current income:

$$C_t = (1 - s)\, Y_t$$

where s is the (constant) average propensity to save out of real income (Y_t).

Next, we consider that the total demand in the economy, termed aggregate demand, is the sum of consumption spending and autonomous demand:

$$Y_t^D = C_t + F_t$$

where F_t symbolises autonomous demand, which can be thought of as the spending that occurs regardless of current income levels and the (real) interest rate. Autonomous demand includes, but is not limited to, government expenditures or autonomous investments.

Under the assumption that supply does not constrain demand at any point in time, at least in any reasonable time horizon, we can say that:

$$Y_t = Y_t^D < Y_t^S$$

where Y_t^S is the supply-determined potential output and is calculated as follows:

$$Y_t^S = A_t\, N_t$$

where A_t and N_t denote, respectively, the level of labour productivity and labour supply.

Reflecting on the discussions from the previous chapter on hysteresis mechanisms, it is imperative to acknowledge that the evolution of supply-side factors, namely labour productivity and labour supply, is not isolated from the influence of demand-side dynamics. In simpler terms: (aggregate) demand dynamics can affect the evolution of potential output (or the supply side). This interplay is encapsulated by the equations:

$$\hat{A}_t = \rho_0 - \rho_1\, u_t$$

$$\widehat{N}_t = \theta_0 - \theta_1\, u_t$$

Where u_t is the unemployment rate which can be analytically defined as follows:

$$u_t = \frac{N_t - L_t}{N_t} = 1 - \frac{L_t}{N_t} = 1 - \frac{A_t\, L_t}{A_t\, N_t} = 1 - \frac{Y_t}{Y_t^S}$$

Where L_t denotes the employed labour force for a given level of output Y_t ($= A_t\, L_t$) and (labour) productivity A_t. From this mathematical definition, we see that the unemployment rate is neither purely a demand-side nor a supply-side variable. Instead, it reflects the interaction between demand and supply, indicating the extent to which the economy is operating below its maximum productive capacity, as measured by potential output.

The simplicity of this framework arises from the hypothesis that all variables evolve and interact simultaneously, essentially making it akin to a static model that disregards the element of time. In addition to this, this first formulation does not consider the role of (non-autonomous) business investment as a contributing factor to aggregate demand which will be introduced later as part of the final model.

However, before moving on to further exploration of this simplified static formulation of our model, it is important to highlight the hysteresis mechanisms at play according to Fazzari, Ferri and Variato (2020), which determine the evolution of labour productivity growth ($\hat{A}$) and potential labour supply growth ($\widehat{N}$). On the one hand, labour supply is thought to decline due to the rising difficulty of finding an acceptable job match as unemployment rises (often referred to as the discouragement effect). On the other hand, labour productivity depends negatively on unemployment since, as unemployment rises, the incentives for labour-saving innovation decrease. Simultaneously, labour productivity is positively affected by investment in new or replacement capital, as dissemination of technical progress and learning-by-doing effects are embodied in the new capital stock.

With this simplified framework in place, we turn our attention to *Figure 29*, which presents a causal loop diagram of the model. This visual aid illuminates the intrinsic mechanisms at play.

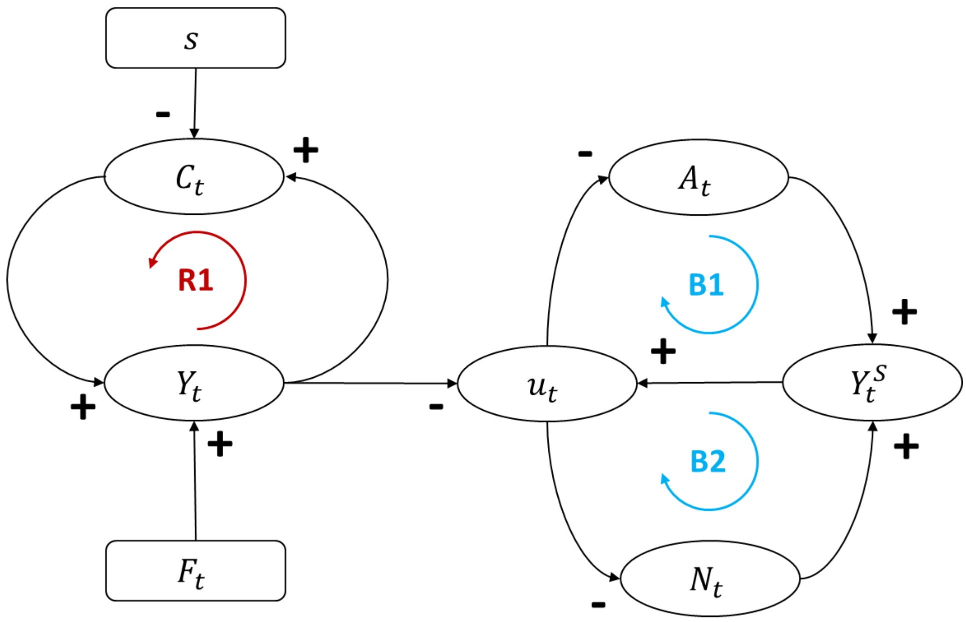

Figure 29: *Causal loop diagram (CLD) representing a simplified version of our demand-led model. Source: Author's illustration.*

In the depicted Causal Loop Diagram (CLD), a positive shock to autonomous demand (F_t) triggers a series of interconnected dynamics that affect aggregate demand, unemployment and potential output. The reinforcing feedback loop R1 captures the process by which an initial increase in autonomous demand fuels aggregate demand and income, which then further boosts consumption spending, leading to an additional increase in aggregate demand. Simultaneously, stronger demand leads to a reduction of unemployment. Reduced unemployment then exerts a dual influence: it can increase labour supply since previously discouraged workers are encouraged to re-enter the labour market and resume their job search; and it can spur labour-saving innovations, thereby enhancing labour productivity. Both outcomes, through the channels of labour supply and productivity, contribute to an increase in potential output (Y_t^S) leading to a rise in unemployment.

The system's response to a simple positive shock in autonomous demand is multifaceted, particularly with respect to unemployment's trajectory. The introduction of hysteresis mechanisms, specifically the direct relationships between unemployment, labour productivity, and labour supply, consolidates a link between potential output—often deemed independent of economic fluctuations—and demand-determined output. This complex interplay suggests that the system's adjustments to shocks in autonomous demand are not straightforward but rather dynamic and nuanced, with potential for counterintuitive outcomes.

In addition to analysing the (qualitative) dynamic behaviour of the proposed economic model, it can be interesting – following Fazzari and Gonzales (2023) – to explore possible (balanced) steady-state properties of the model.

In particular, the model above will result in a balanced steady-state growth path when the growth rates of aggregate demand and supply (i.e. potential output) are equivalent:

$$\hat{Y}_e = \hat{Y}_e^S$$

This balanced steady-state path is of particular interest since along this path the unemployment rate is constant. This implication follows straightforwardly from the definition of the rate of unemployment:

$$u_e = 1 - \frac{Y_e}{Y_e^S}$$

Deriving its growth rate, we get the anticipated result:

$$\hat{u}_e = -\left(\hat{Y}_e - \hat{Y}_e^S\right) = \hat{Y}_e^S - \hat{Y}_e = 0$$

which implies that $u_e = \bar{c}$ along the balanced path.

To further simplify the analysis of the balanced steady-state growth path, it is possible to assume – equivalently to Fazzari and Gonzales – that autonomous demand has a constant growth rate over time:

$$\hat{F}_t = \hat{F}$$

Given this specification, we can get the growth rate of aggregate demand from the following derivations. First, knowing that actual output will be equal to aggregate demand:

$$Y_t = Y_t^D = C_t + F_t = (1 - s)\, Y_t + F_t = \frac{1}{s}\, F_t$$

Therefore, the growth rate of aggregate demand will be equal to:

$$\hat{Y}_t = \hat{F}_t - \hat{s} = \hat{F}_t = \hat{F}$$

So, along the (balanced) steady-state growth path:

$$\hat{Y}_e = \hat{Y}_e^S = \hat{F}$$

Additionally, given the formulation of potential output, labour productivity and labour supply growth, we can write that:

$$\hat{Y}_e^S = \hat{A}_e + \hat{N}_e = \rho_0 - \rho_1 u_e + \theta_0 - \theta_1 u_e = \rho_0 + \theta_o - (\rho_1 + \theta_1)u_e$$

Therefore, the level of unemployment along the (balanced) steady state growth path is:

$$u_e = \frac{\rho_0 + \theta_0 - \hat{F}}{\rho_1 + \theta_1}$$

This equation underscores that, in this model, the equilibrium level of unemployment exists only if $\rho_1 + \theta_1 \neq 0$. This essentially means that for u_e to exist, the forces on the demand side—which are reflected through their impact on the unemployment rate—must significantly influence the evolution of supply-side factors, such as the growth of labour supply and labour productivity. Additionally, the strength of the hysteresis mechanism (represented by ρ_1 and θ_1) plays a crucial role. Specifically, given a certain autonomous demand growth rate ($\hat{F}$), if the system exhibits strong hysteresis (i.e. $\rho_1 + \theta_1 \geq 1$), this will lead to a lower steady-state unemployment rate compared to a scenario with weak hysteresis (i.e. $\rho_1 + \theta_1 < 1$). Therefore, *ceteris paribus*, stronger hysteresis brings the system closer to achieving full employment.

Fazzari and Gonzales (2023) have explored how the steady-state unemployment rate evolves under different scenarios of autonomous demand growth and, consequently, overall demand growth. This exploration is visually represented in *Figure 30*, which allows us to explore two critical insights.

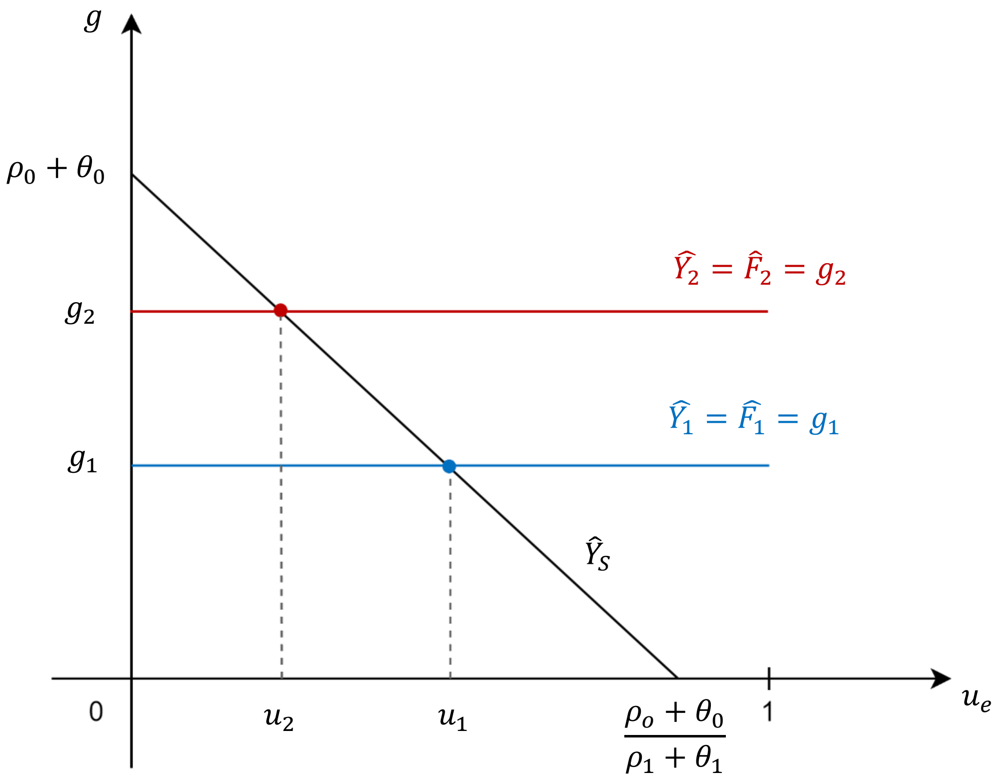

Figure 30: *Evolution of steady-state unemployment rate given different autonomous demand growth rates. Source: Author's illustration.*

Firstly, a positive shift in autonomous demand growth, which translates to an equivalent increase in aggregate demand growth ($g_2 > g_1$), leads to a new steady-state unemployment rate that is lower than the initial equilibrium ($u_2 < u_1$). However, it's crucial to recognize that the reduction in unemployment in response to demand growth is subject to limitations. Unemployment cannot fall below zero, and in practical terms, for most economies, the lower limit of the unemployment rate tends to be above zero, even during periods of rapid economic growth. For instance, in advanced economies, a "full-employment" scenario often corresponds to an unemployment rate of around 3%.

Therefore, the presence of a lower bound on unemployment, which cannot be less than zero, plays a pivotal role in determining the feasibility of achieving balanced steady-state paths. Changes in parameters affecting the slope of the potential output growth rate curve can significantly influence the existence of these paths.

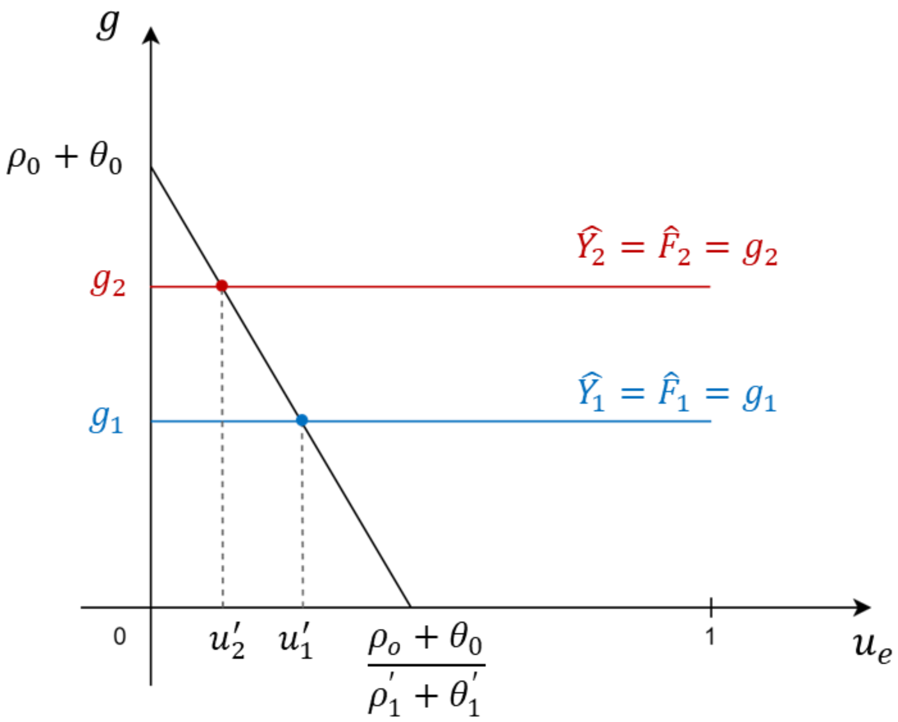

Figure 31: *Impact of variations in hysteresis parameters on the steady-state unemployment rate after a permanent shock to autonomous demand growth. Source: Author's illustration.*

Figure 31 further illustrates the impact of changes in the parameters ρ_1 and θ_1. An increase in these parameters steepens the aggregate supply growth curve. Consequently, for a given shock to autonomous demand growth, the difference between the new and initial steady-state unemployment rates is smaller than in the original scenario ($u_2 - u_1 > u_2' - u_1'$).

This finding is key when assessing the realistic attainment of steady-state paths within reasonable time frames. If reaching very low unemployment levels is required following a demand growth shock, it may not be practically feasible. Even if the post-shock steady-state unemployment rate (u_2) remains above zero or the "full-employment" threshold, low unemployment rates might trigger inflation concerns, potentially leading to restrictive monetary policies that curb demand.

Hence, the higher the values of ρ_1 and θ_1, the more likely it is that demand growth shocks will result in adjustments in the steady-state unemployment rate that are deemed reasonable. The notion of "sufficiently large" values for ρ_1 and θ_1 refers to the capacity of aggregate supply (i.e. potential output) to respond sensitively to demand conditions, as indicated by changes in the actual unemployment rate, thereby supporting the existence of stronger hysteresis mechanisms.

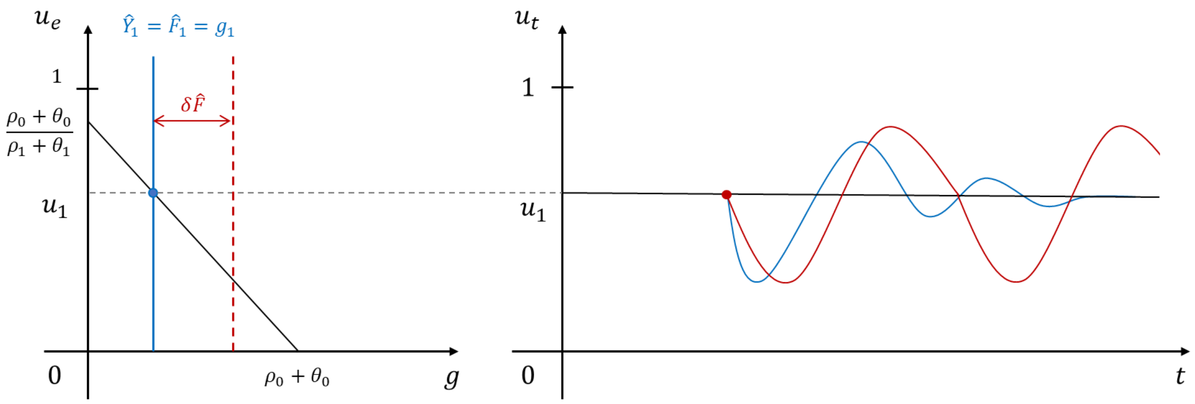

Figure 32: *Dynamic response of the unemployment rate around the steady-state after a temporary shock to autonomous demand growth. The blue line conceptually represents the scenario with a stable steady-state solution, while the red line depicts the evolution of an unstable steady-state equilibrium. Source: Author's illustration.*

While establishing the existence of equilibrium positions, such as balanced steady-state growth, it is equally important to consider their stability. An equilibrium is stable if any (reasonable) deviation leads to adjustments that steer the system back to equilibrium. To conceptualize this, consider a scenario where the system is subjected to a temporary shock to autonomous demand growth as in *Figure 32*. If the initial equilibrium path is stable, the system will adapt and eventually return to the original unemployment level as exemplified by the blue path. Conversely, an unstable equilibrium path will not converge back to the initial state as shown in the case of the red path.

If autonomous demand growth experiences a permanent shock, assuming stable equilibrium conditions, the system will adjust and move towards a new steady-state path as depicted in *Figure 33*.

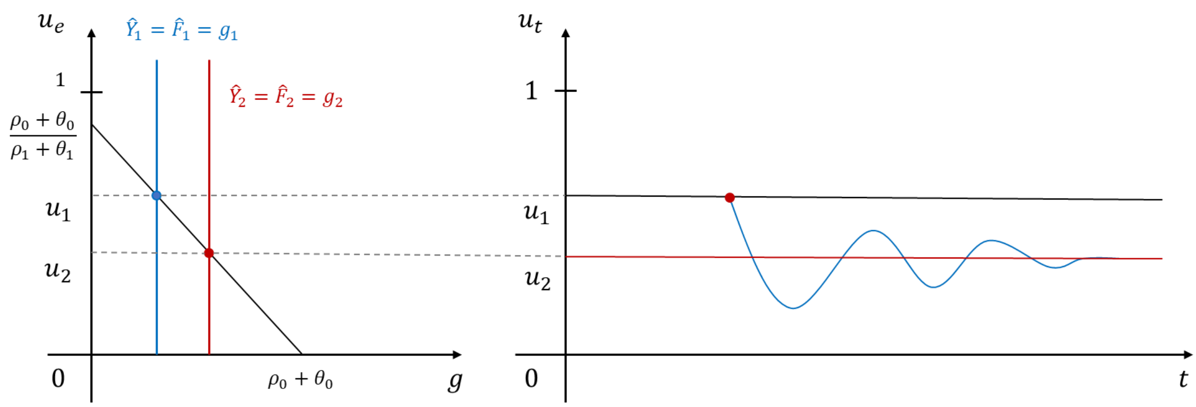

Figure 33: *Dynamic response of the unemployment rate around a stable steady-state equilibrium after a permanent shock to autonomous demand growth. solution, while the red line depicts the evolution of an unstable steady-state equilibrium. Source: Author's illustration.*

The dynamics illustrated in *Figures 32* and *33*, though simplified, align with the cyclical and stable nature of the dynamics around steady-state equilibrium solutions for a broad range of parameter values, as described by Fazzari, Ferri, and Variato (2020).

At this stage, a particularly intriguing question arises: under what conditions does a steady-state equilibrium maintain dynamic stability? To address this, a detailed examination of how key variables (such as the unemployment rate) evolve in response to various combinations of model parameter values (e.g., different values for ρ_1, θ_1 , etc.) is indispensable. However, at this preliminary stage of conceptual analysis, we can gain an initial understanding of these "stability conditions" by reviewing the causal loop diagram presented in *Figure 29*.

Let's recapitulate, as we already did before, the paths that connect a positive (and temporary) shock in autonomous demand growth with changes in the unemployment rate:

i.	**Path 1**	$F_t \uparrow$	→	$Y_t \uparrow$	→	$u_t \downarrow$				
ii.	**Path 2**	$F_t \uparrow$	→	$Y_t \uparrow$	**→**	$C_t \uparrow$	→	$Y_t \uparrow$	→	$u_t \downarrow$
iii.	**Path 3**	$u_t \downarrow$	**→**	$A_t \uparrow$	→	$Y_t^S \uparrow$	→	$u_t \uparrow$		
iv.	**Path 4**	$u_t \downarrow$	**→**	$N_t \uparrow$	→	$Y_t^S \uparrow$	→	$u_t \uparrow$		

Regarding these sequences, three points merit emphasis. Firstly, as previously mentioned, paths 2, 3, and 4 are illustrative of a reinforcing feedback loop (R1) and two balancing loops (B1 and B2), respectively. Secondly, certain connections within these sequences are designated in bold to indicate that, while modelled as occurring simultaneously, they should realistically be considered to have delayed effects. For example, in path 4, it is impractical to assume immediate adjustments in the labour supply in response to changes in the unemployment rate within the same period. It is more plausible that previously discouraged workers re-enter the labour force only upon observing sustained improvements in labour market conditions. Thus, it is the prolonged, not the immediate, reductions in unemployment that positively influence labour supply. This notion of delayed effects is incorporated into the broader model which we will explore in the next section through an equation linking the unemployment rate to labour supply growth:

$$\widehat{N}_t = \theta_0 - \theta_1 u_{t-1}$$

Lastly, it is critical to recognise that while some links in these paths represent straightforward accounting relationships or definitions (e.g. $Y_t = Y_t^D = C_t + F_t$), others entail assumed relationships between macroeconomic variables whose parameters are to be empirically determined, for instance, through statistical analysis.

Therefore, revisiting the question of the (dynamic) stability of steady-state equilibrium positions, an additional, significant insight emerges. Namely, the dynamic stability following a demand shock fundamentally hinges on the interactions between the outlined reinforcing and balancing mechanisms in *Figure 29*. This dynamic evolution is influenced not only by the quantitative aspects of these causal connections but also by their temporal dynamics, emphasising the significance of lagged variables in the progression of current dynamics.

Following this qualitative interpretation of a simplified version of Fazzari, Ferri and Variato (2020)'s model, the reader should have gained a first broad understanding of some important concepts that will be of fundamental importance for the analysis of the full model. With this in place, we are now ready to delve into a more detailed analysis of the model that constitutes the analytical heart of this thesis.

Full model

As outlined by Fazzari, Ferri, and Variato (2020), the construction of the full model is conveniently split into two interconnected sections: the demand side and the supply side.

Demand side

As previously emphasised, on the demand side, aggregate demand (or total expenditure) comprises the sum of consumption spending influenced by overall income (C_t) and autonomous demand (F_t), with the addition of business investment (I_t). Therefore, the formula for aggregate demand becomes:

$$Y_t^D = C_t + I_t + F_t$$

Even for those elements already included in the simplified version of the model, certain adjustments are necessary. Notably, consumption spending is now considered a function of *expected income*:

$$C_t = (1-s)\, EY_t = (1-s)(1+Eg_t)\, Y_{t-1}$$

Here, Eg_t represents the expected growth in output between periods $t-1$ and t, derived from a simple adaptive rule that incorporates historical growth rates as follows:

$$Eg_t = (1-\alpha)\, g_{t-1} + \alpha\, Eg_{t-1} = (1-\alpha)\sum_{j=0}^{n} \alpha^j g_{t-j-1}$$

In this equation, g_{t-1} denotes the growth in output between the periods $t-2$ and $t-1$, mathematically expressed as $g_{t-1} = \frac{Y_{t-1}}{Y_{t-2}} - 1$; α is a parameter that adjusts the speed at which expected growth aligns with past actual growth; and n indicates the maximum number of past periods factored into growth expectations.

An essential point to note is that in the model presented by Fazzari, Ferri, and Variato (2020), aggregate income (i.e., real GDP) is not only reduced by savings but also by other leakages from demand, due to local and national taxes. Consequently, our average propensity to save should be viewed as encompassing the tax rate, resulting in an empirical value of s that is higher than the propensity to save alone. Although this point may seem minor now, it will become crucial when we discuss the empirical findings derived from this model.

The formulation of business investment stems from a set of considerations concerning the accumulation of productive capital stock by firms. Starting from the so-called law of motion for capital, it is possible to say that:

$$K_{t+1} = (1 - \delta)\, K_t + I_t$$

Here K_t and K_{t+1} capture the capital stock in two subsequent periods (t and $t + 1$); and δ is the geometric depreciation rate of the capital stock which is the rate at which the value of physical assets decreases over time due to wear and tear or obsolescence[5].

In addition to this, according to Fazzari, Ferri and Variato (2020)'s formulation, firms invest in new productive capital to reach a certain capital-output target based on their expectations of future demand (EY_{t+1}):

$$\bar{v}_{t+1} = \frac{K_{t+1}}{EY_{t+1}}$$

Finally, the authors assume that the target capital-output ratio adjusts partially in each period towards a long run value (v^*) which depends both on the technical requirements of production and strategic choices by firms about excess capacity:

$$\bar{v}_{t+1} = (1 - \lambda)\, v_{t-1} + \lambda\, v^*$$

Where $v_{t-1} = \frac{K_{t-1}}{Y_{t-1}}$ is the actual capital-output ration during period $t - 1$; and λ is the adjustment speed for v.

Given these last three equations, it is now possible to come to a final formulation for business investment:

$$I_t = \bar{v}_{t+1}\, EY_{t+1} - (1 - \delta)\, K_t = \bar{v}_{t+1}\, (1 + Eg_t)^2\, Y_{t-1} - (1 - \delta)\, K_t$$

Adding up all the different components forming aggregate demand, we have that:

$$Y_t^D = (1 - s)(1 + Eg_t)\, Y_{t-1} + \bar{v}_{t+1}\, (1 + Eg_t)^2\, Y_{t-1} - (1 - \delta)\, K_t + F_t$$

Assuming, as we also did in the previous sub-chapter, that aggregate supply (i.e. potential output) does not constrain aggregate demand, we can say that:

$$Y_t = Y_t^D = (1 - s)(1 + Eg_t)\, Y_{t-1} + \bar{v}_{t+1}\, (1 + Eg_t)^2\, Y_{t-1} - (1 - \delta)\, K_t + F_t$$

From this last equation, we can derive the so-called law of motion for demand-determined output growth:

$$1 + g_t = (1 - s)(1 + Eg_t) + \bar{v}_{t+1}\, (1 + Eg_t)^2 - (1 - \delta)\frac{K_t}{Y_{t-1}} + \frac{F_t}{Y_{t-1}}$$

Where $g_t = \frac{Y_t}{Y_{t-1}} - 1$.

By recalling the definition of the capital-output ratio ($v_t = K_t/Y_t$) and defining the ratio of autonomous demand to total output $f_t = F_t/Y_t$, we obtain:

[5] Wear and tear refers to the physical deterioration of assets over time through regular use, while obsolescence describes the loss of an asset's value due to technological advancements or changes in market preferences, making it outdated or less useful.

$$g_t = \frac{(1-s)(1+Eg_t) + \bar{v}_{t+1}\,(1+Eg_t)^2}{1+(1-\delta)v_t - f_t} - 1$$

While a thorough investigation of demand-determined output growth requires dynamic simulations of our model, we can still make a few ceteris paribus observations.

Firstly, output growth decreases as the propensity to save (s) increases. This is intuitive since higher savings represent an outflow from the economy that cannot be used for consumption or investment. Secondly, expectations about growth positively influence actual growth. High expectations of economic growth lead to increased consumption and investment, thereby boosting actual growth. It is important to note that in our model, expectations are adaptive, formed based on past experiences of actual growth. Therefore, high growth expectations result from a history of high growth in previous periods.

Supply side

On the (aggregate) supply side of the full model, potential output is calculated as follows:

$$Y_t^S = A_t\, N_t$$

As in the case of aggregate demand, we are interested in getting to a law of motion for supply-determined potential output. This can be easily achieved by examining the growth of potential output:

$$\hat{Y}_t^S = \hat{A}_t + \hat{N}_t$$

As we have anticipated in the previous chapter, we can now introduce a full, and more meaningful, mathematical formulation of hysteresis mechanisms linking demand-side forces to the evolution of labour productivity and labour supply growth as expressed by Fazzari, Ferri and Variato (2020):

$$\hat{A}_t = \rho_0 - \rho_1 u_{t-1} + \rho_2(\hat{K}_{t-1} + \delta)$$

$$\hat{N}_t = \theta_0 - \theta_1 u_{t-1}$$

Hence, the law of motion of supply-determined (potential) output is:

$$\hat{Y}_t^S = \theta_0 + \rho_0 - (\theta_1 + \rho_1)\, u_{t-1} + \rho_2(\hat{K}_{t-1} + \delta)$$

This formulation underscores the impact of demand on an economy's potential output due to hysteresis mechanisms. When hysteresis effects are significant (i.e., ρ_1, θ_1, ρ_2 are not zero), demand-side factors can influence the growth of potential output both positively and negatively. For instance, if gross capital stock increases (i.e. $\hat{K}_{t-1} + \delta > 0$), potential output will rise, albeit with a one-year delay. Conversely, a decrease in gross capital stock will lead to a reduction in potential output. A similar argument applies to the unemployment rate.

What is crucial to stress again is that our model's hysteresis does not create an asymmetric response of potential output to demand-side forces. Instead, periods of high demand will boost potential output, with the extent of this increase depending on the strength of hysteresis mechanisms. Conversely, periods of low demand will equally suppress potential output.

Now that we have obtained both laws of motion (i.e. demand-side and supply-side), we can follow a similar path to the one used in the previous subchapter and move on to investigating the existence and the properties of balanced steady-state growth equilibria.

Balanced steady-state growth path

Given the formulation of the new (expanded) modelling framework, we can define the following conditions for a balanced steady-state equilibrium growth path:

$$\hat{Y}_e = \bar{c}$$

$$Eg_e = \hat{Y}_e$$

$$\bar{v}_e = v_e = v^*$$

$$u_e = \bar{c}$$

To have a better understanding of what kind of equilibrium position would satisfy such conditions, we can first solve the law of motion for demand-determined output given the first three conditions (steady-state conditions). Following some straightforward algebraic steps (see Fazzari, Ferri and Variato (2020) page 6) we obtain the following equation:

$$\hat{Y}_e = \frac{1}{v^*}(s - \frac{F_e}{Y_e}) - \delta$$

From this equation we can immediately notice that a steady-state solution exists only if aggregate demand grows at the same rate as autonomous demand ($\hat{F}_e = \hat{Y}_e$). Therefore, we can already slightly reformulate the previous equilibrium conditions to account for this:

$$\hat{Y}_e = \hat{F}_e = \bar{c}$$

$$Eg_e = \hat{Y}_e = \hat{F}_e$$

$$\bar{v}_e = v_e = v^*$$

$$u_e = \bar{c}$$

Moving to the third equilibrium condition, we can notice that if along the equilibrium growth path the (target) capital-output ratio is constant and equal to its long-run desired level this implies that:

$$\hat{v}_e = \hat{K}_e - \hat{Y}_e = 0$$

Therefore, along the steady-state path we have that:

$$\hat{K}_e = \hat{Y}_e = \hat{F}_e$$

Finally, from the last equilibrium condition (i.e. balanced growth condition), we can derive that:

$$\hat{u}_e = 0$$

Hence, this implies that:

$$\hat{Y}_e^S = \hat{Y}_e = \hat{F}_e$$

Given the insights we have just gained from analysing the balanced steady-state growth equilibrium conditions, we can now derive the equilibrium level of unemployment via the law of motion for supply-determined potential output growth:

$$\hat{Y}_e^S = \theta_0 + \rho_0 - (\theta_1 + \rho_1)\, u_e + \rho_2(\hat{K}_e + \delta)$$

But, given the previous insights, we can write that:

$$u_e = \frac{\theta_0 + \rho_0 - \hat{F}_e(1 - \rho_2) - \rho_2\delta}{\theta_1 + \rho_1}$$

From this last formula, it is apparent that the connection between equilibrium unemployment and the growth of autonomous demand remains largely unchanged, at least from a basic standpoint. It is essential to consider whether positive shocks to autonomous demand growth could lead to "realistic reductions" in equilibrium unemployment levels. This is quantified by the derivative of the equilibrium unemployment rate with respect to autonomous demand growth:

$$\frac{du_e}{d\hat{F}_e} = -\frac{1 - \rho_2}{\theta_1 + \rho_1}$$

Given benchmark parameters from Fazzari, Ferri, and Variato (2020), the derivative translates numerically to approximately -0.7. Thus, a 1% increase in autonomous demand growth is predicted to reduce the equilibrium unemployment rate by 0.7%. Economically, smaller absolute values of this derivative suggest a more feasible scenario, as large shifts in autonomous demand growth would only require minor adjustments in the equilibrium unemployment rate.

Focusing on this last point, it is important to recognise two aspects. First, the likelihood of adjustments towards the equilibrium unemployment rate is contingent on the parameters that govern the strength of hysteresis—the relationship between demand and supply dynamics. Therefore, if hysteresis intensifies, implying that shocks to aggregate demand lead to notable shifts in aggregate supply, the system is more capable of absorbing larger shocks to autonomous demand growth without hitting the lower boundary for unemployment. Second, the parameters θ_1, ρ_1, and θ_2 stem from empirical calibration using econometric techniques, meaning their values come with a range of possibilities, including benchmark or mean values, plus a confidence interval. Fazzari, Ferri, and Variato (2020) take this into account in their empirical analysis by providing ranges for each parameter. From these estimates, we can also infer the range of potential outcomes for our derivative of interest:

Parameter	Bottom of range	Benchmark value	Top of range
θ_1	0.10	0.20	0.30
ρ_1	0.30	0.50	0.70
ρ_2	0.30	0.50	0.70
$\frac{du_e}{d\hat{F}_e}$	-1.75	-0.70	-0.2
u_e	0.063	0.071	0.075

Table 7: *Range of hysteresis parameters as defined by Fazzari, Ferri, and Variato (2020, Table 1) along with the resulting empirical values for the derivative of steady-state unemployment with respect to autonomous demand growth, and the steady-state unemployment rate. Source: Own calculations.*

Altering these hysteresis-related parameters influences not just the derivative but also the level of equilibrium unemployment itself, as the last row of *Table 7* indicates, assuming a 4% autonomous demand growth rate.

To elaborate on these insights, we conducted dynamic simulations of the model, detailed in the next section. These simulations demonstrate the impact on unemployment when autonomous demand growth experiences a permanent increase $\hat{F} = 4\%$ to $\hat{F} = 6\%$ considering different magnitudes of hysteresis mechanisms, represented by the model parameters θ_1, ρ_1, and ρ_2. Specifically, we analyse the effect of this permanent increase in $\hat{F}$ across three different hysteresis scenarios: strong hysteresis with top-range parameter values, benchmark hysteresis with average values, and weak hysteresis with bottom-range values, as detailed in *Table 7*.

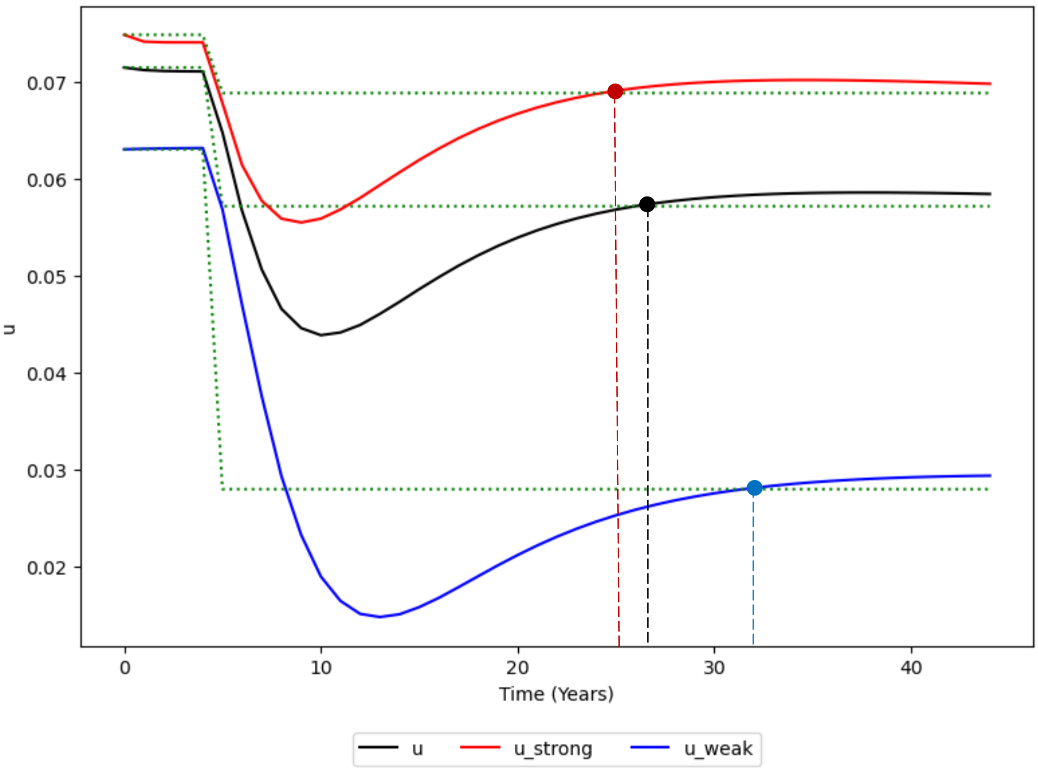

Figure 34: *Dynamic changes in the unemployment rate around steady-state equilibria after a permanent positive shock to autonomous demand, shown for different levels of hysteresis. Blue line represents weak hysteresis (parameters at their minimum values), black line represents benchmark hysteresis (parameters at their standard values), and red line represents strong hysteresis (parameters at their maximum values). Source: Own calculations.*

Figure 34 confirms our intuitive grasp of the model's steady-state equilibrium dynamics and brings an interesting aspect to light: as the hysteresis effect weakens, not only does this alter the balanced steady-state unemployment rate, but it also lengthens the time the system takes to reach a new equilibrium. In simpler terms, altering the intensity of hysteresis does not seem to change the strength of those equilibrating forces that lead the system towards equilibrium. Therefore, pushing the unemployment rate to very low levels (for instance, below 2% in the scenario of weakened hysteresis) following a shock to autonomous demand (growth) might not just be economically implausible—another layer of unfeasibility arises from the time taken for the system to stabilise at the new equilibrium. Meanwhile, autonomous demand growth could experience new shocks, preventing the system from ever fully reaching equilibrium.

While this preliminary analysis is informative, a comprehensive evaluation of the model's dynamics, considering the full range of estimated parameter values, is necessary to draw definitive conclusions about equilibrium stability and the nature of adjustment mechanisms. However, at this stage, we can also conceptually explore how these equilibrium mechanisms might work within the larger model through the causal loop diagram in **Figure 35**. Despite omitting temporal considerations, this diagram illuminates how different feedback loops might interact to drive the system towards equilibrium.

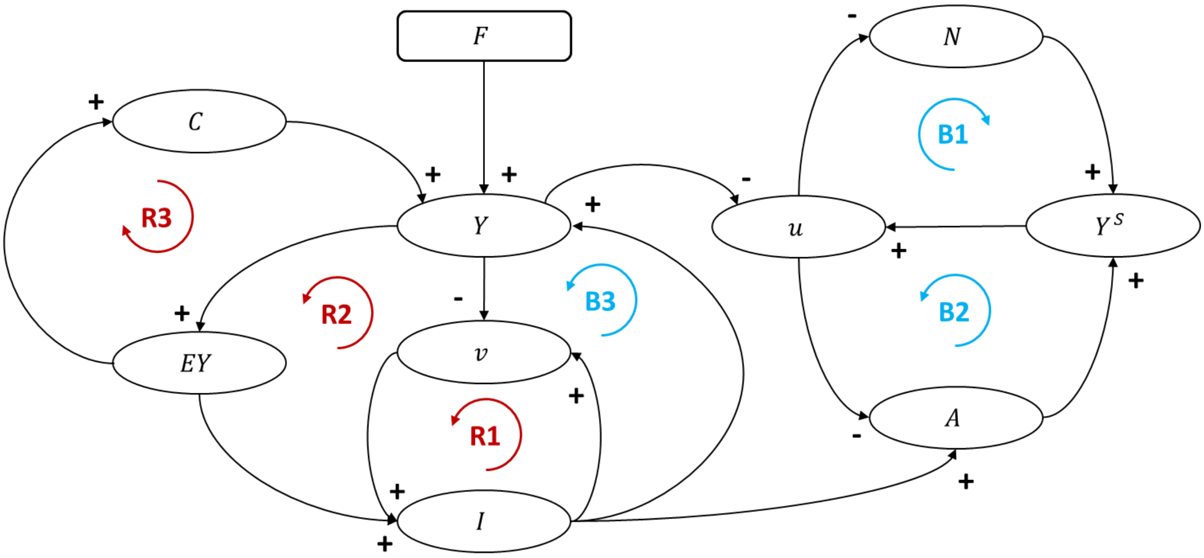

Figure 35: *Causal Loop Diagram (CLD) representing the model proposed by Fazzari, Ferri, and Variato (2020). Source: Author's own illustration.*

In particular, when we examine unemployment as our measure of equilibrium conditions – where at equilibrium $u_t = u_e = \bar{c}$ – we observe that a shock to autonomous demand triggers several pathways:

i. **Path 1**
$F\uparrow \rightarrow Y\uparrow \rightarrow u\downarrow$

ii. **Path 2**
$F\uparrow \rightarrow Y\uparrow \rightarrow EY\uparrow \rightarrow C\uparrow \rightarrow Y\uparrow \rightarrow u\downarrow$

iii. **Path 3**
$F\uparrow \rightarrow Y\uparrow \rightarrow EY\uparrow \rightarrow I\uparrow \rightarrow Y\uparrow \rightarrow u\downarrow$

iv. **Path 4**
$F\uparrow \rightarrow Y\uparrow \rightarrow v\downarrow \rightarrow I\downarrow \rightarrow Y\downarrow \rightarrow u\uparrow$

v. **Path 5**
$u\downarrow \rightarrow A\uparrow \rightarrow Y^S\uparrow \rightarrow u\uparrow$

vi. **Path 6**
$u\downarrow \rightarrow N\uparrow \rightarrow Y^S\uparrow \rightarrow u\uparrow$

When compared to the paths we identified for the simpler model, we can immediately notice how the inclusion of business investment, and the role played by the capital-output ratio in shaping this macroeconomic variable, bring to light two additional and contrasting dynamics within our model framework, as illustrated by Paths 3 and 4.

Of course, as mentioned before, to fully understand how these dynamics will play out requires going beyond this initial model conceptualisation to delve into an empirical analysis of the model's behaviour, as outlined by Fazzari, Ferri, and Variato (2020). A preliminary empirical exploration will be presented in the subsequent section.

Benchmark (dummy) model simulation

To enhance our intuitive grasp of the model's dynamics, we will initially carry out simulations using the benchmark parameters employed by Fazzari, Ferri, and Variato (2020), as well as those by Fazzari and Gonzales (2023) for the US economy, which are summarized in *Table 8*.

Moreover, the model is initialised at a point of balanced steady-state equilibrium. The user is required to input only a few parameters: the initial output level, the equilibrium growth rate of autonomous demand, and the initial levels of labour productivity (or labour supply). In my application of the model, these are set at $Y_0 = 100,\ \hat{F}_0 = 0.04$, and $A_0 = 1$.

Parameter	Symbol	Benchmark value
Propensity to save	s	0.50
Adjustment speed for expected growth	α	0.90
Adjustment speed for capital-output ratio	λ	0.09
Capital depreciation rate	δ	0.084
Long-run target capital-output ratio	v^*	1.20
Effect of exogenous factors on labour force growth	θ_0	0.008
Effect of unemployment rate on labour force growth	θ_1	0.2
Effect of exogenous factors on labour productivity growth	ρ_0	0.08
Effect of unemployment rate on labour productivity growth	ρ_1	0.5
Effect of capital replacement rate on labour productivity growth	ρ_2	0.5

Table 8: *Values for benchmark model parameters. Source: Fazzari, Ferri, and Variato (2020, Table 1); Fazzari and Gonzales (2023, Table 1).*

To aid our understanding, this brief empirical section will simulate three distinct scenarios: a lasting shift in constant autonomous demand growth, stochastic oscillations in autonomous demand growth, and the influence of a relative lower boundary on unemployment.

In *Figure 36*, the system's response to a permanent change in autonomous demand growth is shown. As previously discussed, if autonomous demand growth remains steady, then the system, provided stability conditions are met, will settle around a new equilibrium position, as depicted in *Figure 33*.

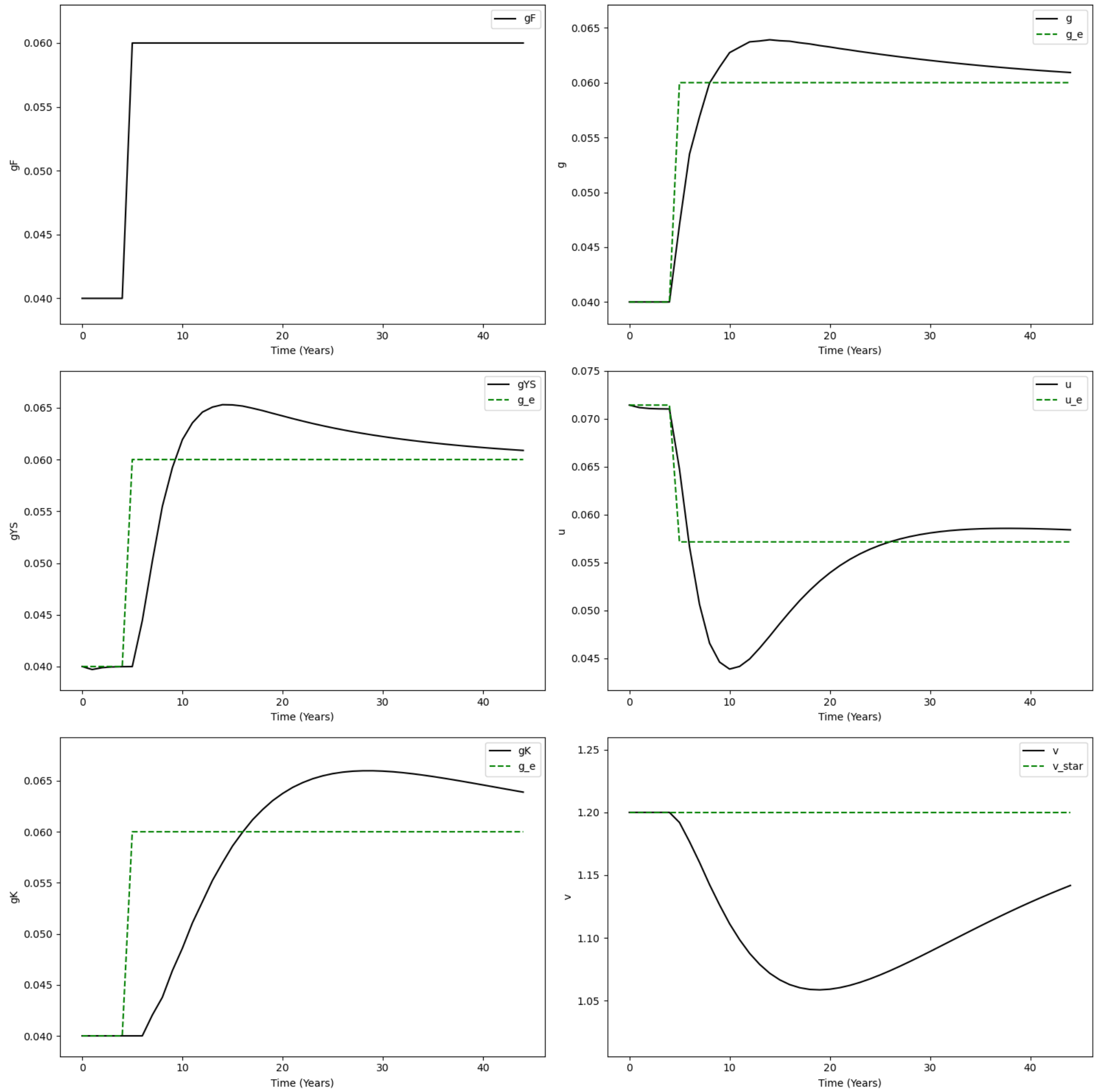

Figure 36: *Dynamic response of various model variables to a permanent shock in autonomous demand growth, initiated from a steady-state equilibrium. The variables are displayed in the following order: top left to bottom right – gF (autonomous demand growth rate); g (output growth rate); gYS (potential output growth rate); u (unemployment rate); gK (capital stock growth rate); and v (capital-output ratio). Source: Own calculations.*

However, what happens if autonomous demand growth varies over time? *Figure 37* captures this situation, where autonomous demand growth is simulated as a stochastic fluctuating process. It is evident that the system's trajectory will be driven by these variations in autonomous demand growth, preventing it from settling into an equilibrium. While initially seeming unrealistic, it's important to recall Fazzari, Ferri, and Variato's (2020) insight that since autonomous demand components grow at differing rates, total autonomous demand won't expand at a constant rate within any finite timeframe. Therefore, outcomes like those in *Figure 37*, although simplified, offer valuable insights into the potential behaviour of real-world economic growth patterns.

Figure 36 also raises an interesting observation regarding the capital-output ratio: it appears that the system does not fully return to a balanced steady-state position within the given timeframe. Of course, caution must be exercised in interpreting these results, as a closer numerical analysis may not support our initial graph-based inferences.

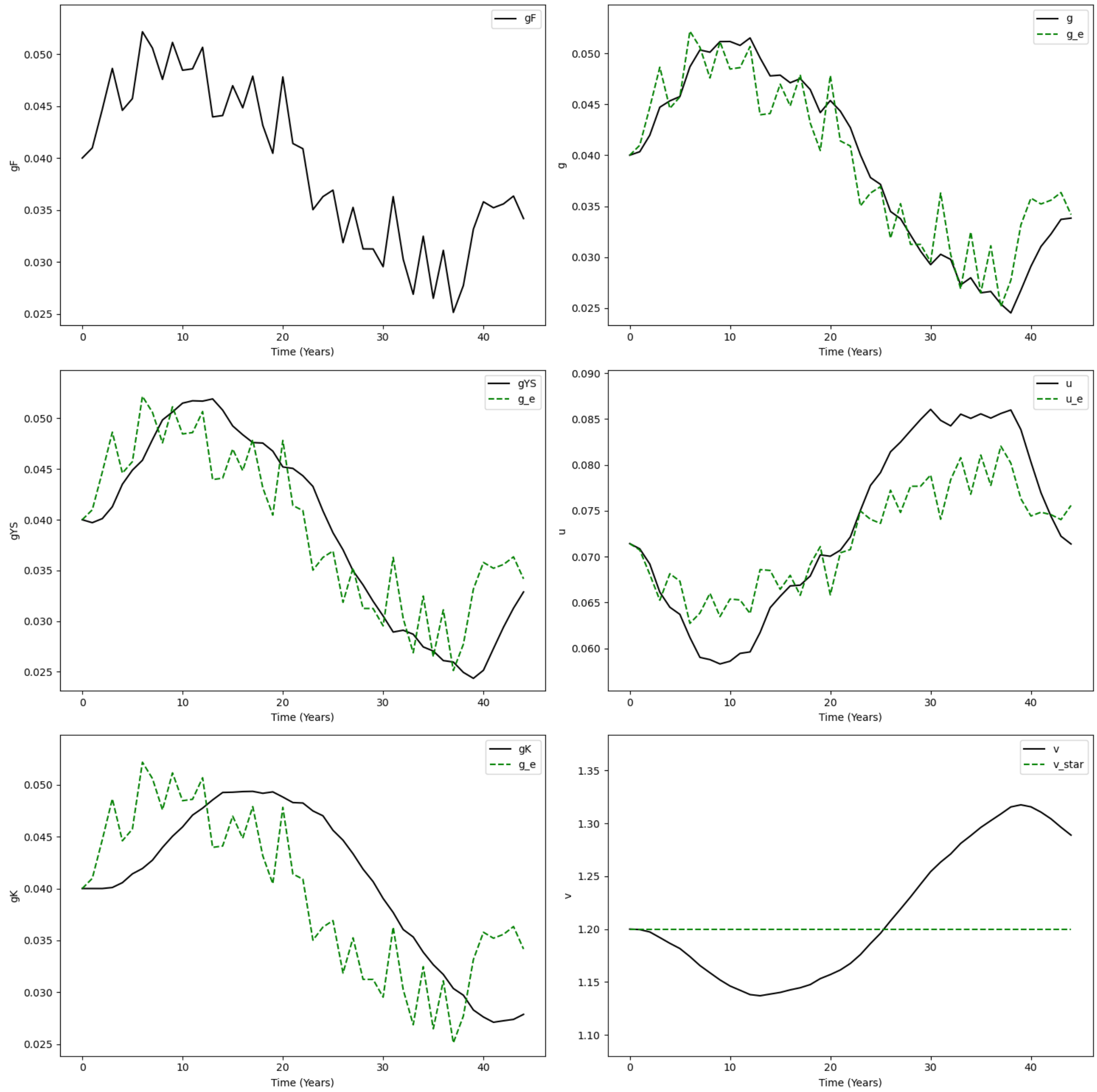

Figure 37: *Dynamic evolution of various model variables in response to fluctuating autonomous demand growth. The variables are displayed in the following order: top left to bottom right –* gF *(autonomous demand growth rate);* g *(output growth rate);* gYS *(potential output growth rate);* u *(unemployment rate);* gK *(capital stock growth rate); and* v *(capital-output ratio). Source: Own calculations.*

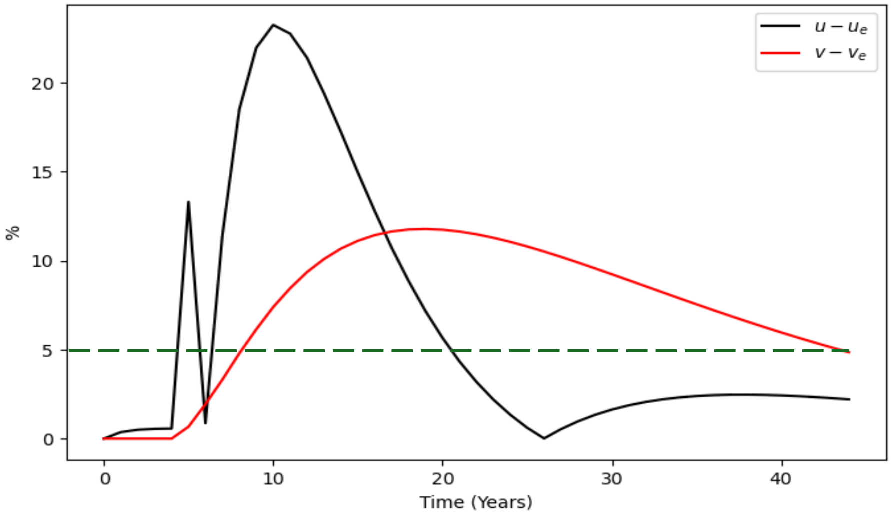

Figure 38: Absolute percentage difference between the unemployment rate and the capital-output ratio compared to their steady-state equilibrium values after a permanent shock to autonomous demand growth. Source: Own calculations.

A more precise understanding of convergence can be gained by examining the percentage difference between our variables of interest and their equilibrium levels over time. By defining a 5% deviation from the equilibrium level as our convergence threshold and focusing on the unemployment rate and capital-output ratio, we find that the unemployment rate stabilizes 15 years after the shock, while the capital-output ratio only does so towards the end of our 40-year observation period (see *Figure 38*). Thus, given the current model parameters, particularly the adjustment speed for the capital-output ratio (λ), reaching a balanced steady-state equilibrium would be unfeasible under more realistic patterns of autonomous demand.

Additionally, we must revisit the notion of a lower boundary for unemployment. Particularly when hysteresis is weak, any significant changes to autonomous demand growth could lead to economically untenable shifts in the equilibrium unemployment rate, potentially breaching a certain threshold. This threshold need not be zero but could be a low unemployment level that either prompts inflationary concerns or compels policymakers to restrict growth due to fears of future price instability. Although an absolute lower boundary isn't a critical aspect of this model, the relative boundary warrants further investigation.

This leads to three questions. First, at what level is this relative boundary? Second, how can we incorporate it into Fazzari, Ferri, and Variato (2020)'s model? Third, what impact does this boundary have on model dynamics?

While fully answering these questions exceeds the scope of this study, we can start with a simplified approach. The relative boundary for unemployment ($\bar{\bar{u}}$) will differ by country and historical time period; for example, Germany's boundary would likely be lower than Italy's during the period analysed by this thesis (1978-2018), as Germany has sustained stronger growth at lower unemployment levels for longer. Reflecting on earlier discussions in Chapter II, the (endogenous) NAIRU (Non-Accelerating Inflation Rate of Unemployment) might serve as a useful proxy for this boundary, beyond which monetary and fiscal authorities would likely take action to prevent inflation by restricting economic growth.

To model the effects of these growth-curbing tools within Fazzari, Ferri, and Variato (2020)'s framework, we can consider the actions central banks and governments might take, such as raising interest rates, or cutting government expenditures also in compliance with international treaties like the Maastricht Treaty. While modelling such policies is complex, we can assume that these policies will lead to reduction in investment and consumption once unemployment falls below its relative boundary[6].

Figure 39 demonstrates the model's behaviour with the inclusion of this relative unemployment boundary and the consequent policy measures. One key point stands out: introducing a lower boundary to unemployment inherently curbs economic growth, which in turn affects potential output growth due to hysteresis.

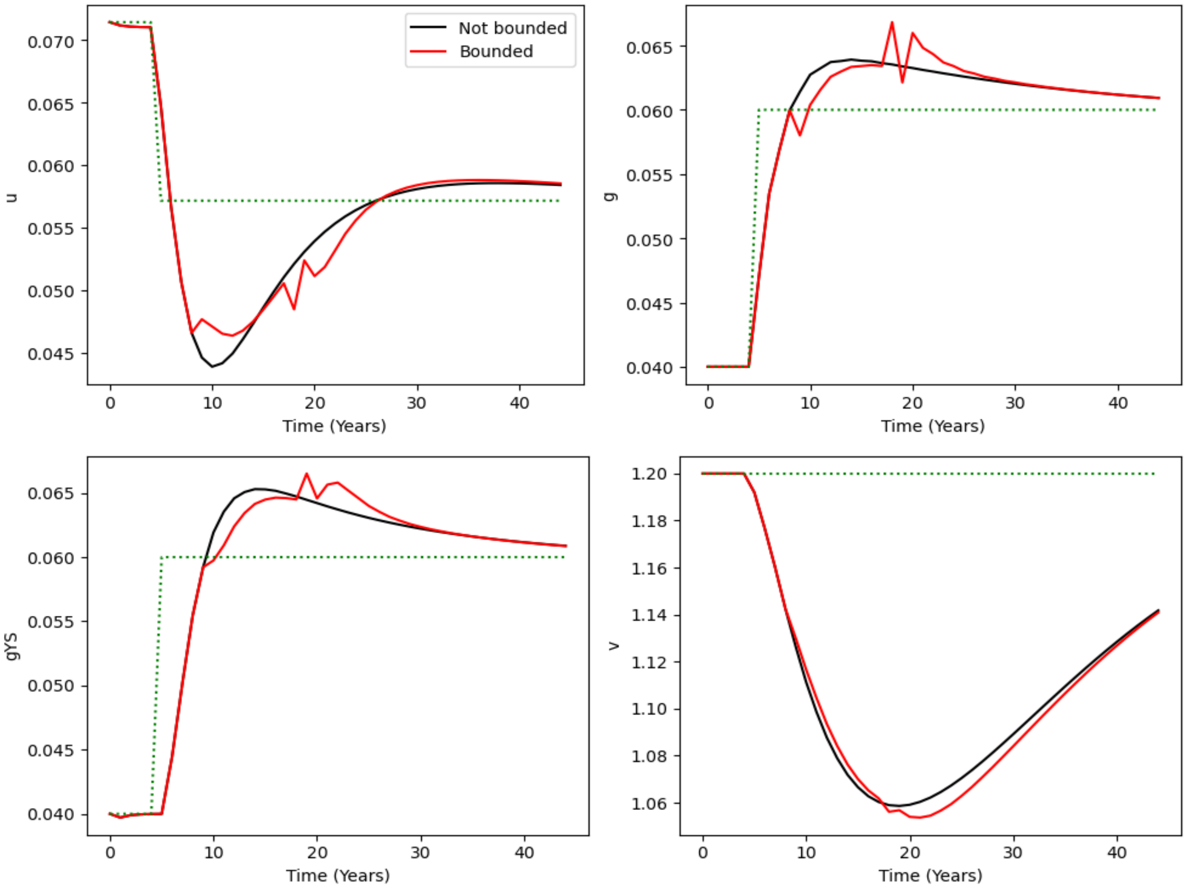

Figure 39: Dynamic evolution of various model variables in response to a shock in autonomous demand growth, taking into account the presence of a relative lower boundary. Red lines depict the evolution of key variables when the relative lower boundary is included in the simulation. The variables are presented in the following order, from top left to bottom right: u (unemployment rate), g (output growth rate), gYS (potential output growth rate), and v (capital-output ratio). Source: Own calculations

[6] In this first simulation exercise, I assumed that if $u_{t-1} < \bar{\bar{u}}$ then $I_t = (1 - \epsilon)\, I_t$ and $C_t = (1 - \epsilon)\, C_t$ where $\bar{\bar{u}} = 0.05$ and $\epsilon = 0.005$.

V. Empirical model analysis

This chapter builds on the exploration of Fazzari, Ferri, and Variato's (2020) model, extending our previous empirical analysis of stylised scenarios presented in Chapter IV. While these simplified scenarios were instrumental in understanding the foundational elements and dynamics of the model, they fall short of providing insights into its applicability to real-world economic growth scenarios.

This chapter is structured around the insights distilled into *Figure 35*, which visually summarises our understanding of the model. It is crucial to acknowledge that the dynamics of the model hinge on two primary factors: firstly, autonomous demand, which acts as the exogenous driver; and secondly, the set of model parameters, such as the propensity to save (s) and the adjustment speed for expected growth (α). These parameters are vital in shaping the dynamic behaviour of the model.

Furthermore, it is important to note that the existence of a balanced steady-state equilibrium is contingent upon the condition of constant growth in autonomous demand. We will demonstrate in the first section of this chapter that this condition does not hold in real-world settings. This observation might suggest that pursuing analyses of potential equilibria and system stability is futile since such equilibria do not exist in practice. However, there remains a compelling argument for the relevance of these analyses in our research, despite their theoretical limitations.

If, at any point in time, the system is characterized by the existence of stable steady-state equilibria, then even if autonomous demand follows a constantly irregular growth path, the system will still evolve, trying to catch these equilibrium positions as they change over time. If, on the other hand, the system is characterized by unstable equilibria, it will diverge from these solutions. This dynamic adjustment towards or away from equilibrium positions is crucial for understanding the system's behaviour in response to fluctuations in autonomous demand.

Moreover, steady-state equilibria can be helpful for understanding the long-run evolution of an economy if any regular behaviour is observed for autonomous demand growth in the long run. In other words, if the evolution of autonomous demand over many years can be well approximated by a functional form with a constant growth rate, then it remains useful to study the system's evolution under the hypothesis that autonomous demand growth is effectively constant at each point in time. By exploring these steady-state equilibria, we gain a deeper understanding of the system's potential paths and behaviours, which is crucial for theoretical and practical analyses of economic dynamics.

The chapter proceeds along two parallel empirical pathways. Firstly, we will examine the evolution of our model under real-world scenarios characterised by non-constant autonomous demand. Secondly, we will explore a hypothetical scenario where autonomous demand grows at a constant rate, thus ensuring the existence of a balanced steady-state equilibrium.

In both scenarios, we will conduct simulation experiments based on various combinations of uncertain model parameters, sampled from their empirical ranges as defined in the works of Fazzari, Ferri and Variato (2020) and Fazzari and Gonzales (2023). A key distinction from the simulation approach of Fazzari, Ferri, and Variato (2020) is that we will not modify uncertain input factors one-at-a-time (OAT) while keeping others constant. Instead, considering the non-linear structure of our model, we recognize that OAT methods can yield unrealistic results by neglecting the combined effects of interacting parameters. Thus, our analysis will employ an All-Factors-At-a-Time (AAT) methodology, varying inputs across their entire feasible range to provide a more robust and realistic assessment of model dynamics. This approach allows us to explore the implications of parameter interactions thoroughly, offering deeper insights into the model's behaviour under various economic scenarios.

Model-based real-world benchmark

As a first step in establishing the empirical foundations of our modelling exercise, it becomes necessary to critically understand how Fazzari, Ferri and Variato (2020) derived the magnitudes of their variables from real-world empirics. Given the critical role played by autonomous demand in our model pushes us to examine how the theoretical definition of autonomous demand will be empirically translated in this thesis.

Fazzari, Ferri and Variato (2020, p.3) define autonomous demand as "spending with dynamics independent of the state of the economy that does not build productive capacity". Despite the various ambiguities that arise in the literature concerning which components of demand can actually be deemed autonomous, most scholars agree that autonomous demand is primarily shaped by government expenditure, autonomous consumption spending, autonomous (business) investment, and exports[7] (Girardi and Pariboni, 2015; Fazzari and Gonzales, 2023).

During this analysis, autonomous demand (F) will be empirically defined following Girardi and Pariboni (2015)'s interpretation:

$$F_t = X_t + G_t + C_t^0$$

Where X stands for exports, G stands for government expenditures, and C^0 captures autonomous consumption spending. In turn, government expenditures are defined as the sum of final consumption expenditure and gross fixed capital formation of government, while autonomous consumption is defined as residential construction spending.

Based on this empirical definition, *Figure 40* shows the evolving composition of autonomous demand between in Italy 1979 and 2018.

What *Figure 40* tells us is twofold. Firstly, among the four components shaping autonomous demand, two groups can be identified: on the one hand, residential construction spending (i.e. autonomous consumption) and government gross fixed capital formation which together contribute to less than 20% of total autonomous demand; on the other, government final consumption expenditure and exports which represent the largest share of autonomous demand.

Secondly, focusing on the two most influential components of autonomous demand, it is clear that their weight over time has followed opposite directions. In fact, while government final consumption expenditure has shrunk over time (as a percentage of autonomous demand) by approximately 8%

[7] Including exports in the definition of autonomous demand requires further explanation, as it may initially seem counterintuitive. While exports can meet the first criterion of autonomous demand—spending unaffected by (domestic) economic conditions—they seemingly do not fulfill the second, which is: spending that does not enhance productive capacity. Despite exports being transfers to foreign entities, they might still drive capacity-building processes. Literature on international competitiveness and trade shows that exporting firms benefit from technological and knowledge spillovers and often reorganise their operations to maintain or grow their market share abroad (Freixanet and Federo, 2023). Thus, if we consider productive capacity as both the quantity and quality of human and physical resources, exports could indeed foster long-term improvements in these areas. Therefore, a refined definition of autonomous demand could be: "Spending independent of (domestic) economic conditions that doesn't immediately build productive capacity."

(from 41% in 1979 to 33% in 2018), exports have become the largest share of autonomous demand in absolute terms growing from 35% to around 56%.

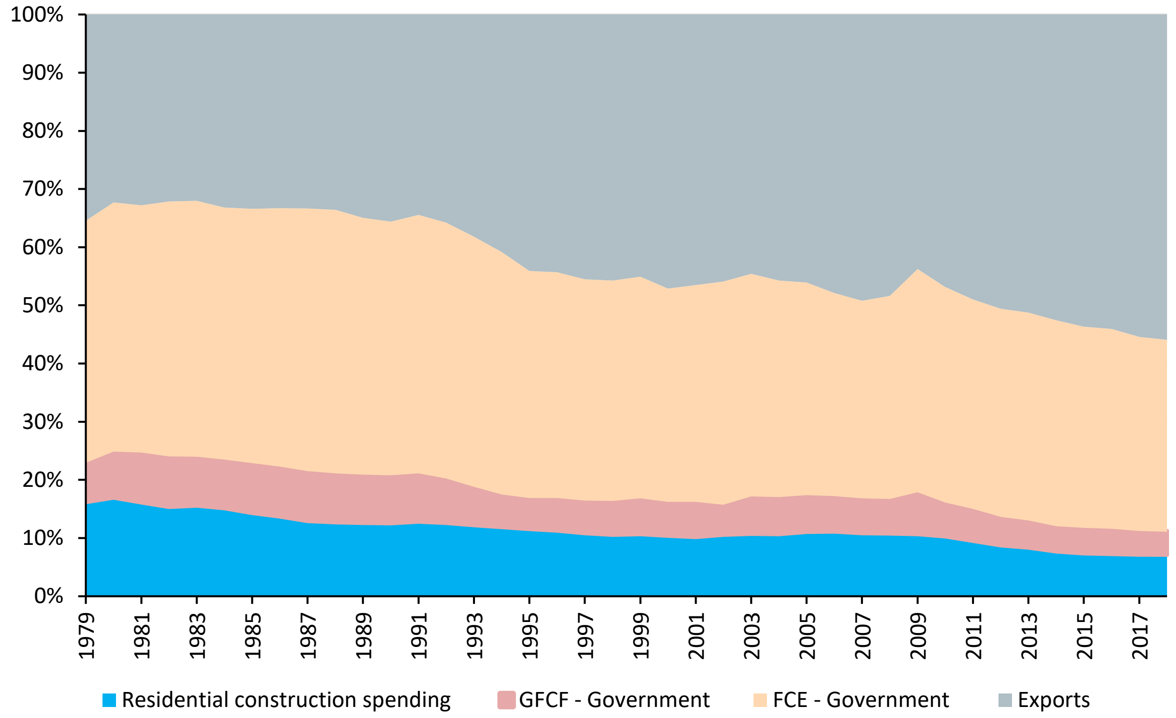

Figure 40: *Stacked composition of autonomous demand between 1979 and 2017. The graph illustrates the relative proportions of residential construction spending, government gross fixed capital formation (GFCF), government final consumption expenditure (FCE), and exports over the specified period. Source: AMECO Database.*

While these considerations might appear of little relevance to our analysis, it is important to note that this can have quite profound implications for our modelling exercise for two key reasons. First, in light of the equilibrium discussion outlined in Chapter IV, we must remember that in order for the system to have a (balanced) steady-state equilibrium, autonomous demand growth must be constant over time. Therefore, given the insights derived from *Figure 40*, we can already conclude that real-world systems, if they indeed were to adhere to the rules outlined by our model, will never converge to a steady state but, under the assumption of equilibrium stability, will rather continuously gravitate around evolving and exogenously determined equilibria (i.e. equilibrium positions determined by autonomous demand). The intuitive understanding we gained from *Figure 40* is further substantiated by the analysis of autonomous demand's components growth rates across four decades as summarised by *Table 9*.

	1979-1988	1989-1998	1999-2008	2009-2018
$\hat{F}$	2.69%	2.28%	2.37%	0.13%
$\hat{C}^0$	0.20%	0.41%	2.62%	-3.86%
$\hat{X}$	2.52%	5.57%	3.03%	1.81%
$\widehat{GFCF}$	5.01%	-1.22%	2.94%	-3.72%
$F\hat{C}E$	3.38%	0.48%	1.53%	-0.49%

Table 9: *10-years average growth rates of autonomous demand and its components between 1979 and 2018. Source: AMECO Database; own calculations.*

Second, if there are reasons to believe that not all exports, or not all government final consumption expenditure, are autonomous but rather only a share of these variables can be deemed effectively autonomous, this will result in a much larger model uncertainty compared to when the same reasoning applied is to residential construction spending and government gross fixed capital formation. Therefore, despite the fact that this is not part of the current analysis, future research should investigate the impact of different definitions of autonomous demand on the model dynamics.

In addition to the previous considerations, it is important to acknowledge that the model, using simplifications and definitions as per Fazzari, Ferri, and Variato (2020), will not precisely replicate real-world data. For example, their definition of aggregate demand diverges from the actual evolution of real GDP, because it does not account for the impact of imports—which typically reduce a nation's aggregate demand by channelling domestic income abroad. Consequently, our model's estimate of GDP will invariably exceed the real-world figures.

At this point, it may seem that discrepancies in aggregate output levels are not of primary concern when evaluating our model. This viewpoint is valid to an extent; our primary interest lies in understanding the dynamic behaviour of the system—how variables change over time rather than their absolute levels. However, some caution is warranted given the dynamic nature of our definitions. To illustrate this, let us consider the following simplified example.

Suppose there is an aggregate variable defined by the sum of three positive factors:

$$Y_t = X_{1,t} + X_{2,t} + X_{3,t}$$

Assume each component grows at the same rate over time:

$$X_{i,t} = (1 + g_t)\, X_{i,t-1} \qquad\qquad i = [1,3]$$

This implies:

$$Y_t = \sum_{i=1}^{3} X_{i,t} = (1 + g_t)\big(X_{1,t-1} + X_{2,t-1} + X_{3,t-1}\big) = (1 + g_t)\, Y_{t-1}$$

Now, if due to data limitations we exclude X_3 and redefine our aggregate variable as:

$$Y_t' = X_{1,t} + X_{2,t}$$

Assuming the growth rates remain consistent, while Y_t' is less than Y_t, their growth rates are identical, making Y_t' a suitable proxy for Y_t in analyzing growth patterns.

However, if X_3 grows at a different rate ($\rho_t \neq g_t$), the scenario changes:

$$Y_t = (1 + g_t)\, Y'_{t-1} + (1 + \rho_t)\, X_{3,t-1}$$

$$Y'_t = (1 + g_t)\, Y'_{t-1}$$

This shows that if the excluded component X_3 diverges in its growth rate, Y'_t may no longer reflect the overall growth pattern of Y_t, complicating its use as a proxy. Hence, when using proxies in models where component growth rates differ, we must exercise caution to ensure the validity of the proxy in reflecting the total aggregate variable's behaviour. *Figure 41* further substantiates this reasoning by displaying the evolution of real GDP growth based on real-world data and the definition used by Fazzari, Ferri and Variato (2020).

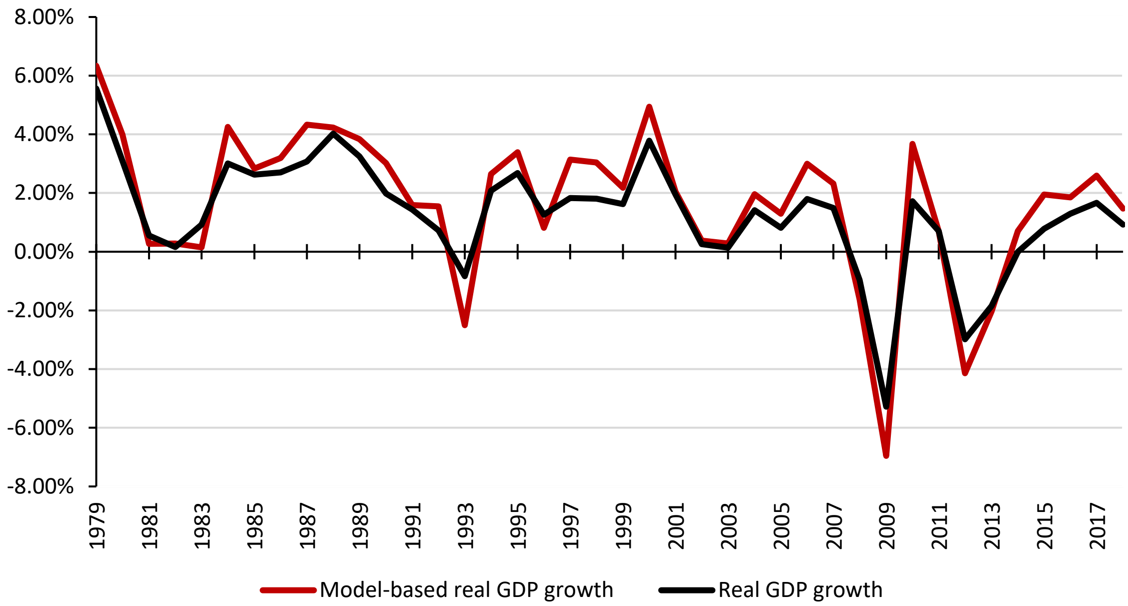

***Figure 41**: Comparison of real GDP Growth Rates (1979-2019). This graph shows the comparison between real GDP growth based on national accounting standards and model-based real GDP growth as defined by Fazzari, Ferri, and Variato (2020). Source: AMECO Database; own calculations.*

Hopefully, the previous simple example sheds light on why using Fazzari, Ferri and Variato (2020)'s definition of total demand for domestic output can both have static and dynamic implications (i.e. levels and growth rates). But, of course, this also implies that all variables directly linked to aggregate demand will be influenced by these simplifications.

Consider, for instance, labour productivity which can be defined as:

$$A_t = \frac{Y_t}{L_t}$$

Where Y_t stands for aggregate demand (i.e. real GDP), and L_t captures employment expressed either as the number of individuals employed or number of hours worked.

Given this definition, if aggregate demand is captured by a proxy variable ($Y_t' = Y_t - \Delta_t$ where $\Delta_t > 0$) while L_t remains the same, then:

$$A_t' = \frac{Y_t'}{L_t} \neq A_t$$

In addition to this, considering our previous example, we can say that:

$$\hat{A}_t' = \hat{Y}_t' - \hat{L}_t \neq \hat{A}_t = \hat{Y}_t - \hat{L}_t$$

The same reasoning could be extended to other variables, such as potential output, but the "formal" derivation of these reasoning will be omitted for the sake of brevity.

What is relevant to observe, in addition to the just mentioned considerations concerning static and dynamic discrepancies, is that these reasonings are based on the choice of keeping some variables fixed while allowing others to differ from the real-world values. In this analysis, the values of L_t and N_t (i.e. potential labour force given as the sum of employed and unemployed workers) are considered real-world inputs, while labour productivity (A_t) is calculated based on model data ($A_t{}' \neq A_t$).

While this choice might appear subjective at first, it is consistent with Fazzari, Ferri and Variato (2020)'s specification of hysteresis mechanisms given that these are dependent on the level of unemployment on the one hand, and on labour productivity growth on the other.

In addition to these factors, it is relevant to note that due to data limitations, we had to simplify our assumptions about the initial state of the capital stock (K_{-1} in 1978). We assume a unitary capital-output ratio for 1978, expressed as:

$$v_{-1} = \frac{K_{-1}}{Y_{-1}} = 1$$

However, this initial assumption aligns with Fazzari, Ferri, and Variato (2020), who suggest a long-run capital output ratio of 1.2. Additionally, the expected growth for 1979 is set based on the weighted average of actual growth rates from 1975 to 1979, calculated as follows:

$$Eg_0 = \frac{1}{\mu} \sum_{j=0}^{3} \alpha^j g_{-j-1} \qquad \text{where } \mu = 1 + \alpha + \alpha^2 + \alpha^3$$

Having established the initial conditions based on our assumptions and their inherent limitations, we are now ready to present the first empirical findings of this chapter. We will compare what we term *model-based real-world data*, derived from the definitions of autonomous demand, aggregate demand, and potential output by Fazzari, Ferri, and Variato (2020), against *simulation-based data*, which is generated by running the model with real-world initial conditions. *Table 10* displays these data for key macroeconomic variables in our model over four decades.

		1979-1988	**1989-1998**	**1999-2008**	**2009-2018**
	$\hat{Y}$	2.89	2.06	1.39	0.16
Model-based	$\hat{F}$	2.69	2.28	2.37	0.13
real-world	$\hat{A}$	2.04	2.14	0.41	0.74
data	$\hat{N}$	1.15	0.12	0.43	-0.19
	u	7.95	9.83	7.93	9.86

Simulation-based data	$\hat{Y}$	2.17	2.58	2.53	-0.68
	$\hat{F}$	2.69	2.28	2.37	0.13
	$\hat{A}$	2.48	3.12	2.88	0.33
	$\hat{N}$	-0.48	-0.34	-0.39	-1.10
	u	7.35	5.89	5.89	9.42

Table 10: *10-years average values of key macroeconomic variables (1979-2018) This table presents the ten-year average values of key macroeconomic variables, comparing model-based real-world data and simulation-based data from 1979 to 2018. Source: AMECO Database; own calculations.*

While initially, our model's predictions, based on benchmark parameter values, seem to significantly deviate from empirical data as visually examined in *Table 10*, it would be premature to dismiss the model's usefulness in exploring economic growth. In fact, this initial assessment could radically change if we reconsider the suitability of the benchmark parameters. Additionally, even if our model appears limited for the original purpose, it prompts valuable questions: How accurate are our simulation-based predictions, and how do different parameter values affect this accuracy? These inquiries will guide the exploration in subsequent sections.

Assessing model accuracy

Given that we have now established a (model-based) real-world blueprint for our modelling exercise, it is possible to address a pivotal question: How accurately does our model replicate the dynamics of the Italian economy?

To tackle this question, it is imperative to carefully select a set of model variables. These variables will represent the outputs of interest and serve as benchmarks for assessing the model's accuracy. Among the various potential variables, the unemployment rate stands out as a logical choice since it acts as a critical bridge between demand-side and supply-side economic factors, as highlighted in *Figure 35*, *Chapter IV*. Once we have chosen the unemployment rate as our primary focus, further consideration is required to determine when the model can be deemed adequate for analysing real-world unemployment dynamics.

Intuitively, we could evaluate model accuracy using two primary criteria. Initially, we consider the model to have high accuracy if it minimises the sum of squared residuals between the observed and the simulated unemployment rates:

$$SSR_1 = \sum \left(u_i - u_i^{sim}\right)^2$$

This approach evaluates what might be termed a static aspect of model accuracy. In fact, the SSR_1 indicator evaluates how u changes over time, but it cannot assess the direction of these changes. For example, if the actual u increases while u^{sim} decreases, yet the difference between them is minor, the SSR_1 value will be low. Conversely, if both actual u and u^{sim} increase, but their difference is substantial, the SSR_1 value will be high.

However, this static perspective may not be sufficient. The model simplifies several relationships, notably those concerning the growth of labour productivity and the potential labour force. Due to these simplifications, simulated data might not fully capture the complex interactions occurring in the actual economy. Therefore, it can be argued that a model's ability to replicate the dynamic behavior of real-world data is more crucial. Rather than solely focusing on minimizing SSR_1, attention should also be given to minimising the following sum of squared residuals, which considers the growth rates of unemployment:

$$SSR_2 = \sum \left(\hat{u}_i - \hat{u}_i^{sim}\right)^2$$

Here, $\hat{u}$ represents the growth rate of the unemployment rate. Unlike SSR_1, minimizing SSR_2 focuses on aligning the directions of change in the data, encompassing the dynamics and potentially the momentum of the unemployment trends. This dual approach can, at least in theory, provide a more comprehensive assessment of the model's performance in capturing both the static and dynamic facets of the economic indicators under study.

What is key to notice is that the sum of squared residuals based on growth rates (SSR_2) is sensitive to numerical outliers, a significant disadvantage when used to evaluate model accuracy. Given that SSR_2 calculates the squared differences between the growth rates of actual and simulated unemployment data, this formula can lead to disproportionately large values due to the typically small denominators involved (i.e. numerically small unemployment rates). This sensitivity means that minor fluctuations in unemployment figures can result in large changes in calculated growth rates, potentially leading to misleading conclusions about a model's accuracy if these become outliers.

On the other hand, the sum of squared residuals based on unemployment values (SSR_1) provides a more straightforward and robust measure, focusing directly on the differences in actual versus simulated unemployment levels. Its simplicity makes it particularly useful where accurate prediction of unemployment levels is more crucial than understanding dynamic changes.

Keeping these considerations into account, it now should be clear that while using both metrics might provide a comprehensive analysis, in many practical scenarios, the stability and clarity of SSR_1 make it the preferable choice for assessing model accuracy.

Instead of dismissing the concept of dynamic accuracy entirely, it is feasible to assess it through an additional objective function, the Mean Absolute Error (MAE_2) between the actual and simulated growth rates:

$$MAE_2 = \frac{1}{T-1}\sum_{i=2}^{T}\left|\hat{u}_i - \hat{u}_i^{sim}\right|$$

In this formula, T denotes the number of years in the dataset, which amounts to 40 years. A notable advantage of this metric is that it provides a clearer and more direct measure of the average error magnitude because it does not square the errors, treating all errors uniformly. This characteristic makes MAE_2 less sensitive to outliers compared to SSR_2.

Employing both SSR_2 and MAE_2 can be beneficial for gaining insights into different aspects of the error distribution. Specifically, SSR_2 is useful for highlighting models that effectively minimise larger errors, while MAE_2 offers a reflection of the overall error level across all predictions.

However, given that our analysis primarily focuses on the average general performance of our model's dynamic behaviour, relying solely on MAE_2 might be adequate. This approach not only simplifies the evaluation process but should also enhance the clarity of the communication of our findings. Future studies should rigorously assess the validity of this decision.

To illustrate our initial question with an example, *Figure 42* visually compares the unemployment rate over time using actual data and simulated outcomes from 1979 to 2018, applying various hysteresis parameters. Additionally, *Table 11* presents the values of SSR_1, SSR_2, and MAE_2 for our three hysteresis scenarios.

Objective function	Weak hysteresis	Benchmark	Strong hysteresis
SSR_1	0.0289	0.0338	0.0439
SSR_2	0.992	1.38	1.56
MAE_2	0.105	0.128	0.137

Table 11: *Objective functions' values under three different hysteresis scenarios. Source: Own calculations.*

From both the graph in *Figure 42* and the data in *Table 11*, it appears that the *weak hysteresis* scenario most closely mirrors actual data on the rate of unemployment. Of course, given that this conclusion is based on a (very) small set of experiments, we should not generalise these findings. However, one point about this is worth exploring further.

Although the weak hysteresis scenario minimises all three objective functions listed in Table X compared to the other two scenarios, this does not necessarily mean it is realistic. Two key issues cast doubt on the realism of this scenario.

Firstly, according to simulations with weak hysteresis, unemployment would have risen from 6.6% to 12% between 2008 and 2009. While such a sharp increase is not unheard of—in the Italian economy, for instance, unemployment soared from approximately 6.3% in 2008 to 12% by 2014—the rate at which unemployment grows in this model appears unrealistic. *Figure 42* suggests this criticism applies equally to the other scenarios, even though stronger hysteresis appears to somewhat mitigate the rapid expansion of unemployment following exogenous shocks to autonomous demand.

The second issue is common to all three scenarios: the model's dynamics from 1980 to 1990 produce an unemployment rate trajectory that moves in the opposite direction to real-world data. Therefore, it seems that regardless of the strength of the hysteresis mechanisms we incorporate, if we maintain the ceteris paribus condition (i.e., keeping all other model parameters constant while altering the hysteresis parameters), our model fails to generate realistic simulations.

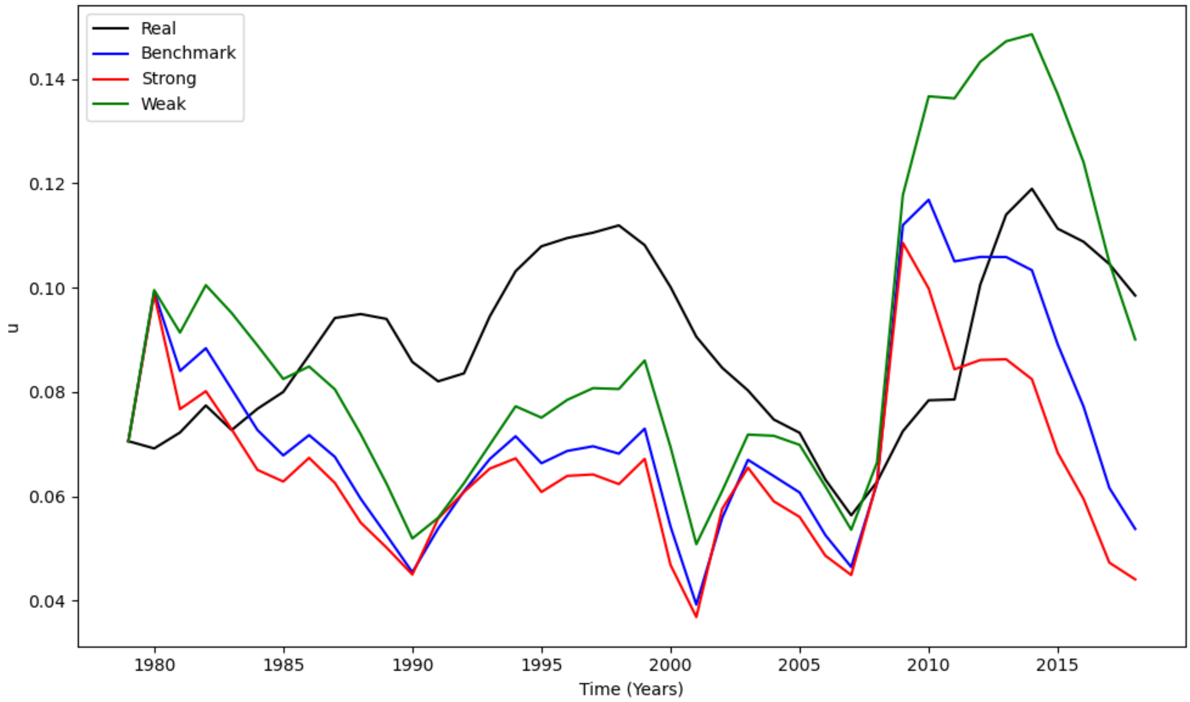

Figure 42: *Evolution of the unemployment rate under different hysteresis scenarios. This graph depicts the evolution of the unemployment rate across three hysteresis scenarios (weak, benchmark, and strong) in comparison with real-world data. Source: Own calculations.*

Parameters optimisation

Having established how to assess model accuracy, we now face an interesting question: Which combination of model parameters (i.e. which *scenario*) results in the most accurate predictions? By employing optimization techniques from the Scipy Python library, we can quickly find answers. However, it is important to note that since we have defined two distinct measures of accuracy—SSR_1 for *static accuracy* and MAE_2 for *dynamic accuracy*—the optimal parameter sets are likely to differ depending on the accuracy measure guiding the optimization.

The outcomes of this optimisation are summarized in *Table 12*. These results support our initial suspicion: If we examine the columns optimized for SSR_1 and MAE, it is evident that different accuracy criteria lead to different optimal parameter values. This difference can have significant real-world implications, particularly when we consider changes in one of our key parameters, ρ_2. This parameter represents the *elasticity* of labour productivity growth with respect to the capital replacement rate. A change in ρ_2 from 0.80 to approximately 0.60 means that an identical increase in the capital replacement rate would result in an increase in labour productivity growth that is 20% smaller.

Variable	Symbol	Benchmark	SSR optimal	MAE optimal	SSR Optimal (Larger bounds)	MAE Optimal (Larger bounds)
Propensity to save	s	0.50	0.450	0.462	0.458	0.442
Long-run target capital output ratio	v^*	1.20	1.50	1.44	1.50	1.27
Adjustment speed for expected growth	α	0.90	0.950	0.950	0.950	0.950
Adjustment speed for capital-output ratio	λ	0.09	0.0645	0.107	0.068	0.149
Effect of exogenous factors on labour force growth	θ_0	0.008	0.009	0.006	0.00	0.00993
Effect of unemployment rate on labour force growth	θ_1	0.20	0.172	0.100	0.10	0.109
Effect of exogenous factors on labour productivity growth	ρ_0	0.02	0.03	0.0221	0.00	0.043
Effect of unemployment rate on labour productivity growth	ρ_1	0.50	0.70	0.30	0.444	0.385
Effect of capital replacement rate on labour productivity growth	ρ_2	0.50	0.70	0.581	0.811	0.602
Sum of squared residuals (Unemployment rate)	SSR_1	0.0338	0.0107	0.120	0.01	0.244
Mean Average Error (Growth rate of unemployment)	MAE	0.128	0.0836	0.055	0.079	0.059

Table 12: *Optimal input factor combinations. This table lists the optimal combinations of input factors identified using an optimisation algorithm for different objective functions, including scenarios with larger value ranges. Source: Own calculations.*

Despite the differences in parameter optimization for static and dynamic accuracy, one might think further analysis of these scenarios could reveal which parameter set yields the most accurate model. However, numerous challenges prevent such straightforward analysis. For instance, we cannot be entirely sure that the parameter ranges outlined in *Table 7* are the most accurate, especially since these ranges were derived from data pertaining to the U.S. economy rather than the Italian economy. Although we might speculate that macroeconomic dynamics in these two economies do not significantly differ, this remains a hypothesis lacking empirical verification. To illustrate the uncertainty of these parameter ranges, *Table 12* includes results from scenarios using expanded ranges for supply-side parameters. The differences in results between these and the initial optimization scenarios highlight the significant impact of parameter range uncertainty on the results.

Moreover, the effectiveness of optimization algorithms, which minimize the residuals between real-world data and model simulations, depends on the availability of comprehensive real-world data for the period under study (1979-2018). This dependency leads us to question: What if data were only available for a limited timeframe within this period? Would we observe fundamentally different optimal scenarios? While I will not attempt a formal empirical analysis here, hypothetically, limited data availability could indeed result in different optimal scenarios. These differences might arise because the model would be optimised based on a narrower set of economic conditions, potentially leading to optimisations that are less generalisable across other time periods.

Given these constraints, it becomes evident that limiting our analysis to a few select scenarios might not fully capture the model's potential or its limitations. Instead, a more thorough approach would involve exploring a wide range of plausible scenarios that fit within established parameter boundaries. In the next section, this comprehensive exploration will not only aid us in determining which parameter combinations produce the most accurate model configurations but will also help us identify scenarios that yield unrealistic predictions. This detailed analysis will deepen our understanding of the model's dynamics and its relevance to real-world applications. Moreover, by using a broad set of parameters, the model becomes adaptable to different economic environments, extending its usefulness beyond specific case studies. As a result, this approach not only broadens the scope of this study but also enriches our insights into the economic phenomena under investigation.

Despite these considerations, a deeper analysis of the optimal scenarios in *Table 12* reveals two additional insights. Firstly, integrating MAE_2 as an additional metric for assessing our model's accuracy does not seem to offer substantial benefits compared to using SSR_1 alone as the primary metric. This conclusion might have been apparent from the mathematical definitions of these metrics, but the data in *Table 12* clarify this. Specifically, scenarios optimised for SSR_1 consistently show low MAE_2 values; however, the reverse is not true. Optimising for MAE_2 involves compromises, particularly with SSR_1 values rising above 0.1 in both optimal scenarios. *Figure 43* visually supports this, illustrating that while MAE_2 optimisation enhances the dynamic accuracy of the simulation, it does so at the expense of static accuracy. Thus, from the next section onward, SSR_1 will be the primary metric used to evaluate the overall accuracy of our simulations.

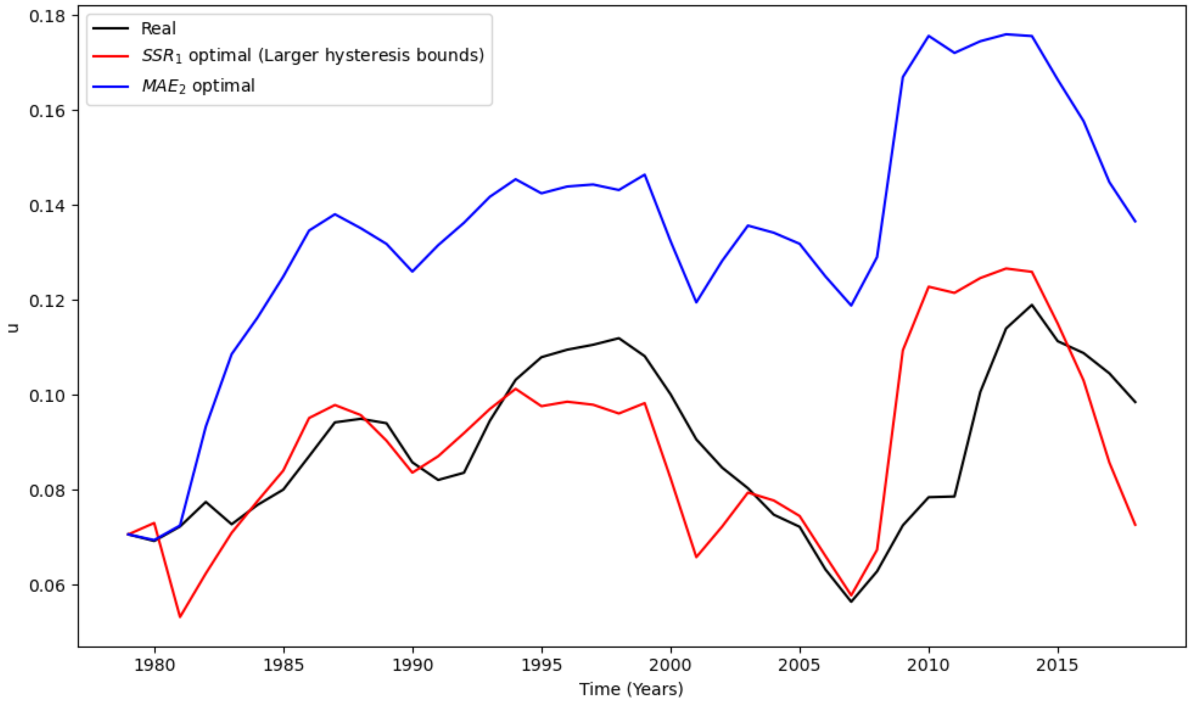

Figure 43: *Unemployment Rate dynamics for different optimal scenarios. This graph shows the evolution of the unemployment rate according to different optimal scenarios, including SSR_1 optimal (larger hysteresis bounds) and MAE_2 optimal, compared to real-world data. Source: Own calculations.*

Secondly, we can advance the hypothesis that since the SSR_1 optimised scenario closely mirrors real-world unemployment dynamics in Italy it can serve as a valuable new benchmark for our analysis. This scenario could be particularly crucial for providing an initial empirical estimation of hysteresis effects within the Italian economy, which we explore through three key parameters:

Hysteresis parameter	Symbol	Value
Effect of unemployment rate on potential labour force growth	θ_1	0.172
Effect of unemployment rate on labour productivity growth	ρ_1	0.70
Effect of capital replacement rate on labour productivity growth	ρ_2	0.70

These values would indicate a modest influence of hysteresis on potential labour force growth—a 1% increase in unemployment results in just a 0.17% reduction in potential labour supply growth. Conversely, labour productivity appears highly responsive to changes in demand-side factors, as demonstrated by the significant decrease in productivity growth triggered by increases in unemployment ($\rho_1 = \rho_2 = 0.70$).

It is important to note that these insights into hysteresis are contingent upon the reliability of our model and its assumptions. Should we extend the parameter ranges for optimising SSR_1, our understanding of hysteresis could shift dramatically. For instance, the impact of unemployment on labour productivity growth (ρ_1) weakens significantly in a broader parameter scenario, dropping from 0.70 to 0.44. Therefore, our current assessment of hysteresis should be viewed with caution and warrants further investigation with more sophisticated econometric techniques, such as those employed by Fazzari and Gonzales (2023) in their study of the US economy using the Simulated Method of Moments.

Moreover, nothing I have presented decisively supports the selection of SSR_1 as the optimal benchmark scenario. Indeed, meticulous readers may question the focus on the unemployment rate as the central variable in this model, preferring instead to spotlight a different metric. Given that an alternative focus could be equally legitimate, it can be valuable to extend our optimisation exercise to include two additional variables: actual and potential output (Y, Y^S). The results of this supplementary analysis are compiled in *Table 13*.

		Optimisation focus		
Variable	**Symbol**	**Unemployment**	**Actual output**	**Potential output**
Propensity to save	s	0.450	0.527	0.503
Long-run target capital output ratio	v^*	1.50	1.50	1.50
Adjustment speed for expected growth	α	0.950	0.944	0.950
Adjustment speed for capital-output ratio	λ	0.0645	0.150	0.150
Effect of exogenous factors on labour force growth	θ_0	0.009	0.008	0.006
Effect of unemployment rate on labour force growth	θ_1	0.172	0.20	0.30
Effect of exogenous factors on labour productivity growth	ρ_0	0.03	0.02	0.01
Effect of unemployment rate on labour productivity growth	ρ_1	0.70	0.50	0.70
Effect of capital replacement rate on labour productivity growth	ρ_2	0.70	0.50	0.30

Table 13: *Optimal model scenarios for different optimisation variables. Each scenario is derived using optimisation algorithms to minimise the sum of squared residuals between the simulated and real-world variables of interest. Source: Own calculations.*

As expected, adjusting our focus to different variables within the model has led to a variety of optimal scenarios. While I shall not delve into the detailed empirical differences between these scenarios, it is worthwhile to examine how each set of model parameters influences the evolution of key macroeconomic variables, as illustrated in *Figure 44*. Initially, it seems that scenarios centred on (potential) output might offer more realistic outcomes, as they tend to align more closely with the actual trajectories of the various macroeconomic variables included in *Figure 43*. Consequently, this reasoning suggests a potential shift away from SSR_1 to a new objective function that prioritises output (e.g., $SSR_Y = \sum\left(Y_i - Y_i^{sim}\right)^2$).

Nonetheless, a significant trade-off remains apparent in the unemployment rate dynamics. Scenarios that concentrate on optimising (potential) output depict an overly optimistic picture of the Italian economy, where unemployment has steadily declined over four decades. This portrayal contrasts sharply with the chronic high and structural unemployment highlighted in our analysis of the Italian macroeconomic context in Chapter III. It is also notable that, regardless of the chosen focus variable, no scenario fully captures the evolution of the potential labour force.

Therefore, in light of these findings, we will not simply abandon SSR_1. Instead, the next section will enhance our analysis by introducing a new measure of model accuracy that focuses on the evolution of actual output. To address the limitations of the sum of squared residuals (SSR), which tends to exaggerate the influence of larger errors due to its sensitivity to outliers, we will implement a new objective function:

$$MAPE_Y = \frac{1}{T}\sum_{i=1}^{T}\left|\frac{Y_i^{sim}}{Y_i} - 1\right|$$

which measures the average percentage error across all observations.

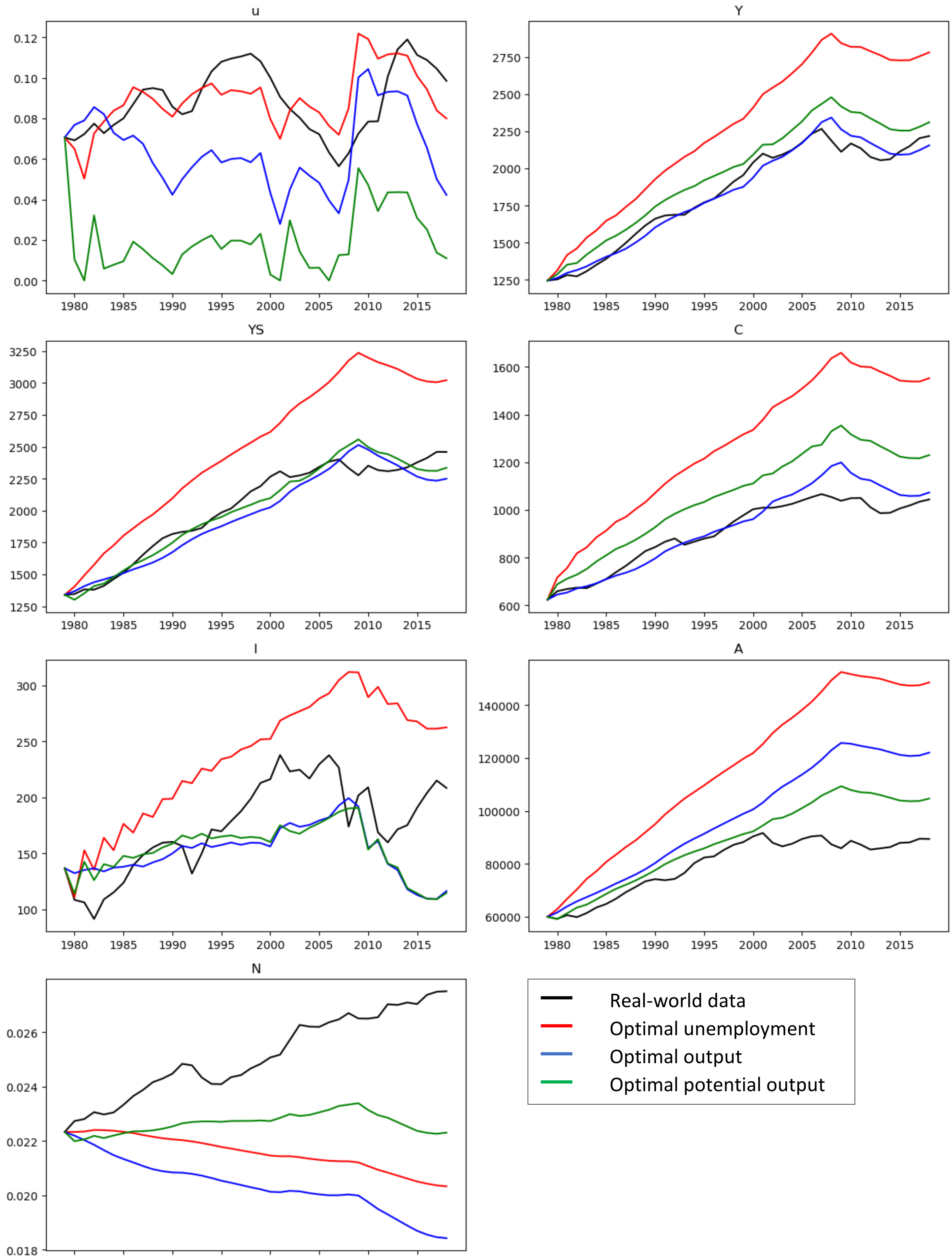

Figure 44: *Evolution of key macroeconomic variables across different optimal scenarios from Table 13. Source: Own calculations.*

Uncertainty analysis

In the previous section, we highlighted the need to explore how the model's output and behaviour change when the inputs vary across their entire feasible range (refer to *Table 14*). To accurately quantify our model's output uncertainty and ensure the robustness of our analysis, we will conduct simulations using 10000 distinct scenarios, each representing different combinations of uncertain input factors[8]. We will also assume that each input factor follows a uniform distribution for broader applicability.

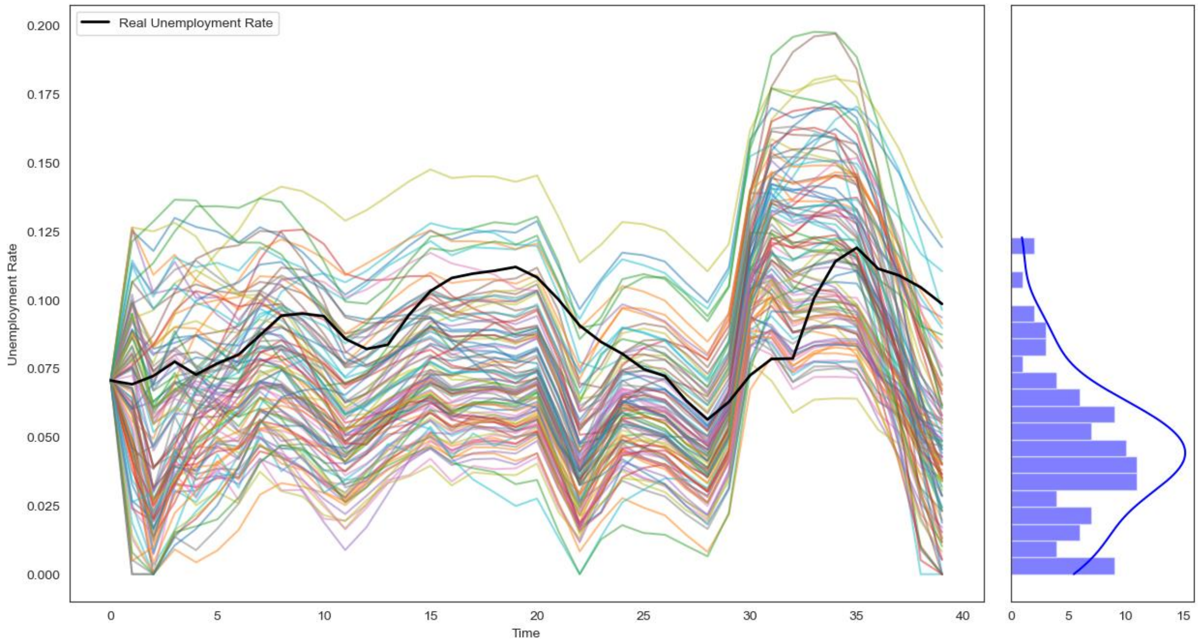

Figure 45: *Evolution of the rate of unemployment across 100 random scenarios, with the black line representing the real unemployment rate. The histogram on the right displays the distribution of the final unemployment values. Source: Own calculations.*

To illustrate the potential outcomes of this empirical investigation, *Figure 45* shows how the unemployment rate evolves across 100 scenarios. This simple analysis already offers valuable insights into the model's behaviour. For instance, the graph reveals how differing combinations of input values can immediately set the unemployment rate on divergent trajectories. While some scenarios result in a sharp rise in unemployment, others lead to a drastic decline, sometimes reaching full employment conditions ($u = 0$). This suggests a scenario where the system's aggregate demand meets its potential output[9].

Beyond merely quantifying model output uncertainty, it is crucial to identify which input combinations cause these unrealistic trends. We will delve deeper into this analysis in the next

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[8] Input factors must be understood in the broader sense of the term as "any element that can be changed before model execution. […] Examples of input factors are the parameters appearing in the model equations, the initial states, the boundary conditions or the input forcing data of a dynamic model; as well as non-numerical factors like the model equations themselves or, in the case of dynamic models, the time/spatial grid resolution for numerical integration." (Pianosi et al. 2016, 215).

[9] Remember that $u_t = 1 - Y_t/Y_t^S$ and $Y_t = \min(Y_t^D, Y_t^S)$, where Y_t stands for actual economic output (i.e. real GDP); Y_t^D stands for aggregate demand; and Y_t^S stands for aggregate supply or potential output. Hence, if $u = 0$ this implies that $Y_t = Y_t^D = Y_t^S$(i.e. aggregate demand equals aggregate supply)

section, introducing the concept of scenario discovery to determine which scenarios lead to various model outcomes and behaviours.

Variable	Symbol	Bottom of range	Top of range
Propensity to save	s	0.44	0.53
Long-run target capital output ratio	v^*	1.40	1.60
Adjustment speed for expected growth	α	0.75	0.95
Adjustment speed for capital-output ratio	λ	0.00	0.15
Effect of exogenous factors on labour force growth	θ_0	0.006	0.009
Effect of unemployment rate on labour force growth	θ_1	0.10	0.30
Effect of exogenous factors on labour productivity growth	ρ_0	0.01	0.03
Effect of unemployment rate on labour productivity growth	ρ_1	0.30	0.70
Effect of capital replacement rate on labour productivity growth	ρ_2	0.30	0.70

Table 14: *Empirical range model input factors. Source: Fazzari, Ferri, and Variato (2020); Fazzari, and Gonzales (2023).*

To begin our uncertainty analysis, we quantified the uncertainty of our primary objective function (SSR_1) across a broad spectrum of scenarios. From 10000 model experiments, the distribution of SSR_1 provides a detailed view of how our model typically performs relative to the optimal SSR_1 scenario.

The average SSR_1 value from these experiments is 0.05, which is notably higher than the optimal value of 0.0107, indicating that our model often yields larger residuals and deviates from optimal performance. The standard deviation of SSR_1 is 0.0377, indicating moderate variability in the data. While many experiments yield results near the average, outcomes still vary significantly, with the best-performing experiments nearly matching the optimal at a minimum SSR_1 value of 0.011.

The distribution's shape is further defined by the quartile values: the first quartile is 0.0316 and the third quartile is 0.0754, capturing the central 50% of the data and indicating that many experiments result in SSR_1 values above the optimal. The median SSR_1 of 0.058 highlights that half of the experiments achieve values below this, yet they are still substantially higher than the optimal.

The range from the minimum to the maximum value, peaking at 0.641, demonstrates a wide variance in outcomes, from nearly optimal to significantly poorer. Despite some experiments aligning well with the optimal, the overall data suggest our model's limited ability to consistently achieve optimal performance. The mean SSR_1 being significantly higher than the optimal, coupled with a broad spread of values, points to inconsistencies in the model's predictive accuracy.

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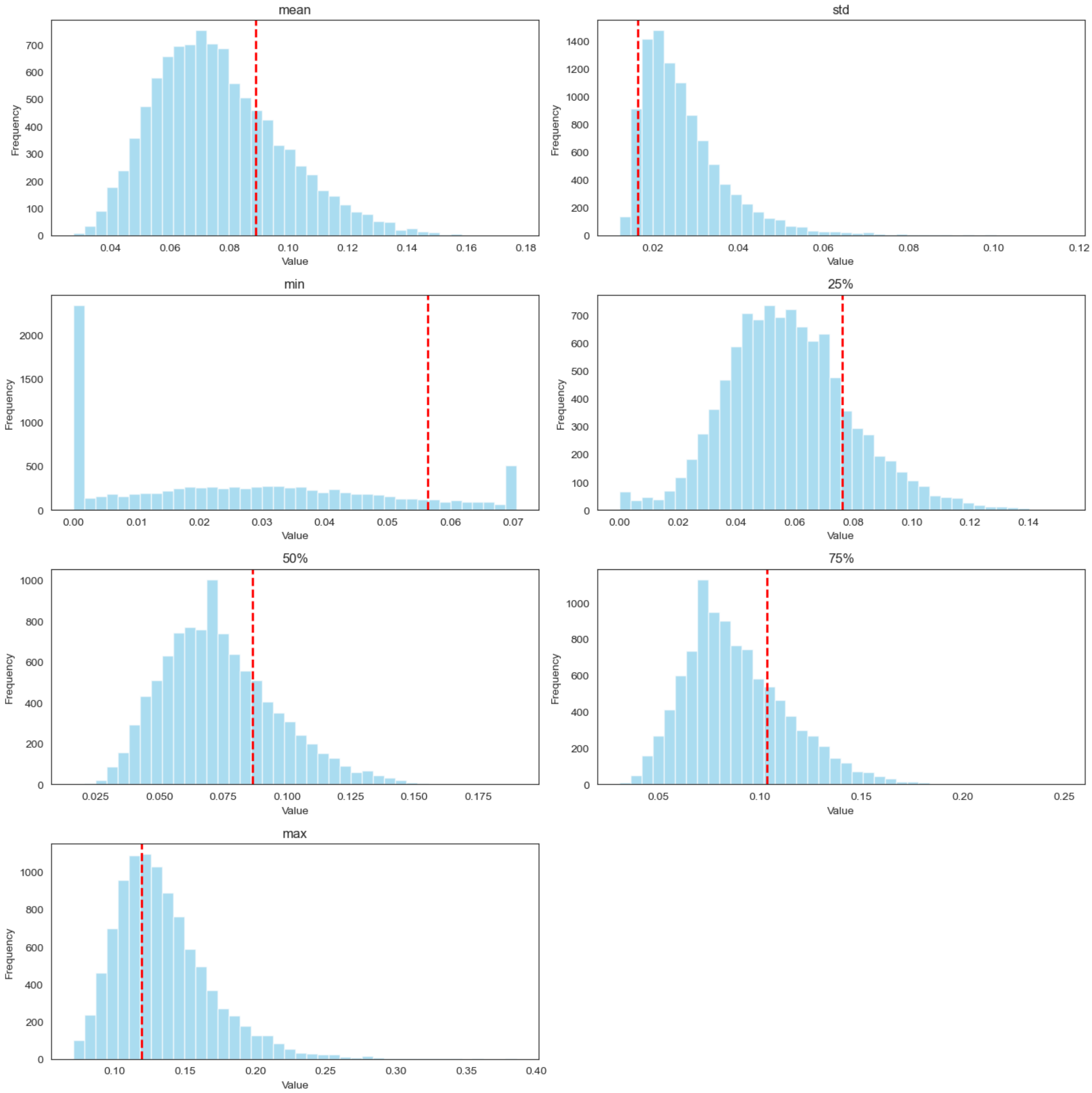

Figure 46: *Distribution of time-series properties for 10000 simulated unemployment time-series. This set of histograms illustrates the distribution of various statistical properties of 10000 simulated unemployment time-series. The properties shown are the mean, standard deviation, minimum, first quartile, median, third quartile, and maximum values. The red dashed lines indicate the corresponding values for the real-world unemployment time-series. Source: Author's calculations*

Moreover, the distribution of the Mean Absolute Percentage Error ($MAPE_Y$), derived from the same set of experiments, offers valuable insight into the models' predictive accuracy regarding real-world output. The mean $MAPE_Y$ of 0.100 indicates that, on average, the simulations deviated from the actual values by about 10%. This deviation is further elucidated by the standard deviation of 0.0657, pointing to a moderate spread in the accuracy of the simulations across different experiments. The range of $MAPE_Y$ extends from a minimum of 0.023 to a maximum of 0.324, demonstrating some variability in performance, with certain simulations achieving high accuracy while others show more significant deviations.

The quartile analysis reveals that 25% of simulations have errors of 4.38% or less, indicating excellent accuracy for these outcomes. Meanwhile, the median value of 0.0786 suggests that half of the simulations achieve an error rate of 7.86% or less. The third quartile value of 0.148 indicates that 75% of the simulations have errors of 14.8% or less. This distribution underscores generally good predictive accuracy with moderate variability, suggesting that while the models perform well on average, there are still opportunities for enhancing consistency and reliability.

Based on the new distribution of your simulations as illustrated in the attached figure, here is the adapted text for your empirical exercise:

In addition to this, the histograms in Figure 46 offer a detailed comparison between the summary statistics of the real-world unemployment time-series and those from our 10000 simulated time-series. These histograms reveal important insights about the model's ability to replicate real-world unemployment dynamics.

The mean of the simulations generally aligns closely with the real-world mean, but it shows a slight underestimation, indicating that the model tends to produce slightly lower average unemployment rates compared to actual observations. This suggests that while the model is somewhat accurate, there is a tendency to underestimate the mean unemployment rate marginally.

The standard deviation values from the simulations show a broad distribution, with many values extending beyond the real-world standard deviation. This suggests that the model often generates a wider range of unemployment outcomes, potentially indicating that the model may be too sensitive or reactive to the influencing factors, resulting in more pronounced variability compared to the real-world data.

Regarding the minimum values achieved in the simulations, there is a notable spread, with a significant number of simulations reaching extremely low unemployment rates. This result may be unrealistic given the historically high context of unemployment for the Italian economy, indicating a potential area where the model might be overly optimistic about achieving very low unemployment levels.

The 25th and 50th percentile (median) values of the simulations also show that the model tends to produce slightly lower unemployment rates in the lower half of the distribution compared to real-world data, reinforcing the observation that the model underestimates unemployment rates in this range.

Conversely, the maximum values from our simulations extend beyond the corresponding real-world values. This indicates that the model has a tendency to overpredict the higher end of the unemployment rate spectrum, often surpassing observed peaks. This overestimation of higher unemployment rates suggests that the model may introduce more extreme scenarios than typically observed in reality.

Overall, these findings suggest that while the model captures some aspects of the real-world unemployment dynamics, it tends to underestimate the lower and middle range of unemployment rates and overestimate the higher range. This indicates significant fluctuations in the simulated unemployment rates, characterized by lower minimums and higher maximums than what is typically observed, highlighting areas for potential refinement in the model to better mirror actual unemployment trends.

To enhance our analysis of the simulated unemployment time series, it is useful to visually inspect how key macroeconomic variables evolve across our range of uncertain input factors. Specifically,

Figure 47 displays the evolution of different variables under various scenarios, emphasizing those that meet specific accuracy criteria: $SSR_1 < 0.031$, highlighted with light blue lines on the left of *Figure 47*, and $MAPE_Y < 0.044$, highlighted with red lines on the right. The time series meeting these criteria represent the top 25% most accurate simulations according to our objective functions, highlighting the most reliable regions of our results.

Our visual analysis underscores a critical point we already came across before: selecting simulations based on the SSR_1 criterion yields a broad range of economic variable values, many are unrealistically high compared to actual economic developments in Italy. For example, some scenarios satisfying $SSR_1 < 0.031$ show consumption demand values more than double that of the real-world Italian economy. This reveals a limitation in the SSR_1 objective function's ability to faithfully represent Italian real-world economic growth.

Conversely, simulations deemed accurate under the $MAPE_Y$ criterion more closely mirror real-world data, suggesting that $MAPE_Y$ is a more effective and realistic objective function for capturing economic dynamics.

However, relying solely on $MAPE_Y$ does not resolve all issues. For instance, the range of unemployment data deemed accurate by $MAPE_Y$ is significantly broader than that defined by the SSR_1 criterion, highlighting the limits of this objective function. Furthermore, regardless of the objective function used, the simulations produce a wide range of outcomes for labour productivity and potential labour supply. In most cases, if we focus on the potential labour supply, accurate simulations according to SSR_1 and $MAPE_Y$ criteria even contradict its real-world trends.

To address the limitations identified in our current model, it is valuable to explore whether a subset of scenarios can accurately simulate not only unemployment and output but also labour productivity and labour supply. To achieve this, we introduce two additional objective functions specifically targeting labour productivity and labour supply. These functions are the Mean Absolute Percentage Error for labour productivity ($MAPE_A$) and labour supply ($MAPE_N$)[10]. We then select scenarios where these objective functions fall within their respective first quartiles, ensuring that they represent the most accurate simulations for interpreting supply-side dynamics.

[10] The formulas for these objective functions are $MAPE_A = \frac{1}{T}\sum_{i=1}^{T}\left|\frac{A_i^{sim}}{A_i} - 1\right|$ for labour productivity, and $MAPE_N = \frac{1}{T}\sum_{i=1}^{T}\left|\frac{N_i^{sim}}{N_i} - 1\right|$ for labour supply.

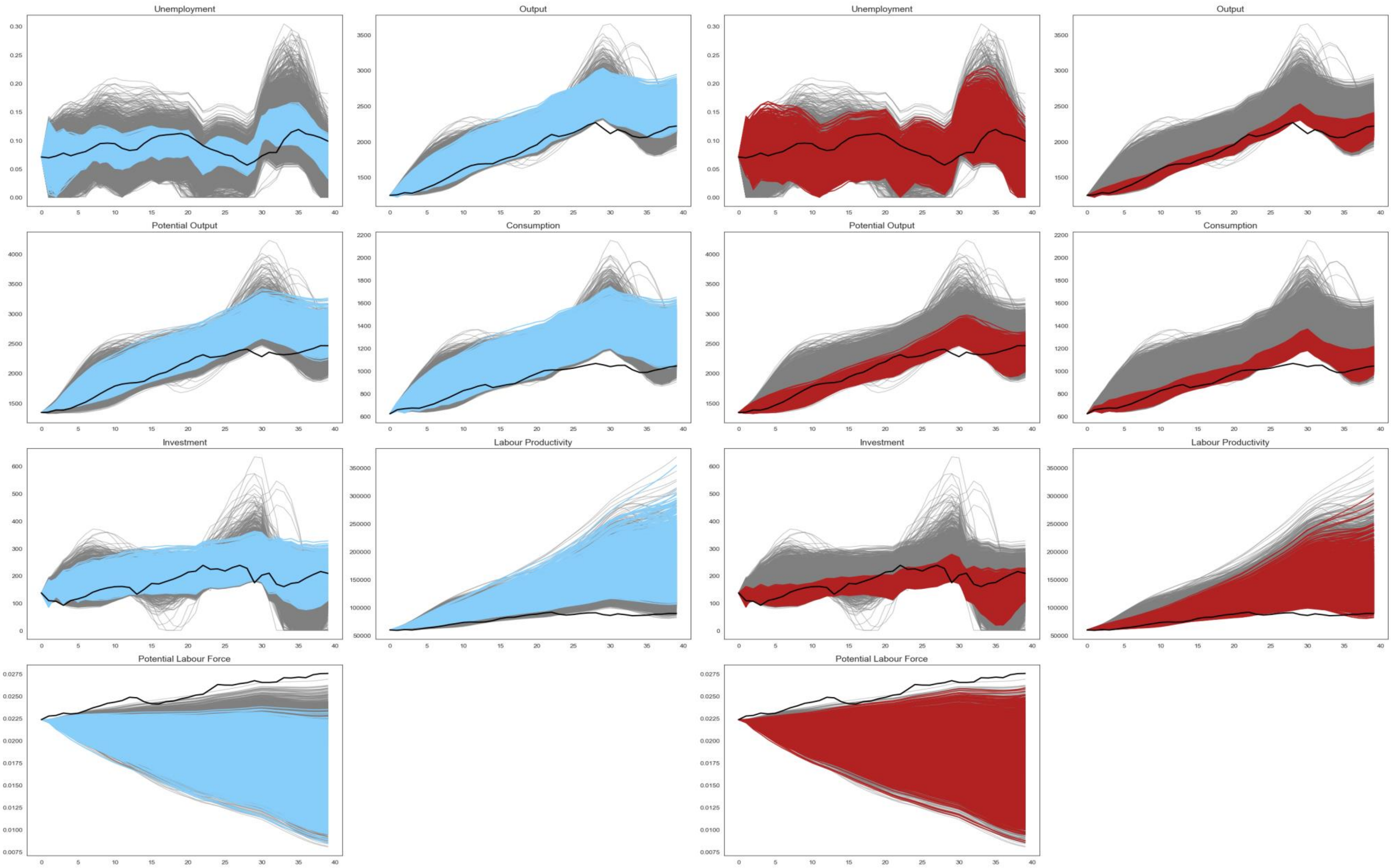

Figure 47: *Accurate scenario clusters for unemployment and output across 10000 scenarios. This figure presents the trajectories of key macroeconomic variables, including unemployment, output, potential output, consumption, investment, labour productivity, and potential labour force, across 10000 simulated scenarios. The plots are divided into two groups: those that show the most accurate simulations based on* SSR_1 *(highlighted in light blue), and those based on* $MAPE_Y$ *(highlighted in red). Source: Author's calculations.*

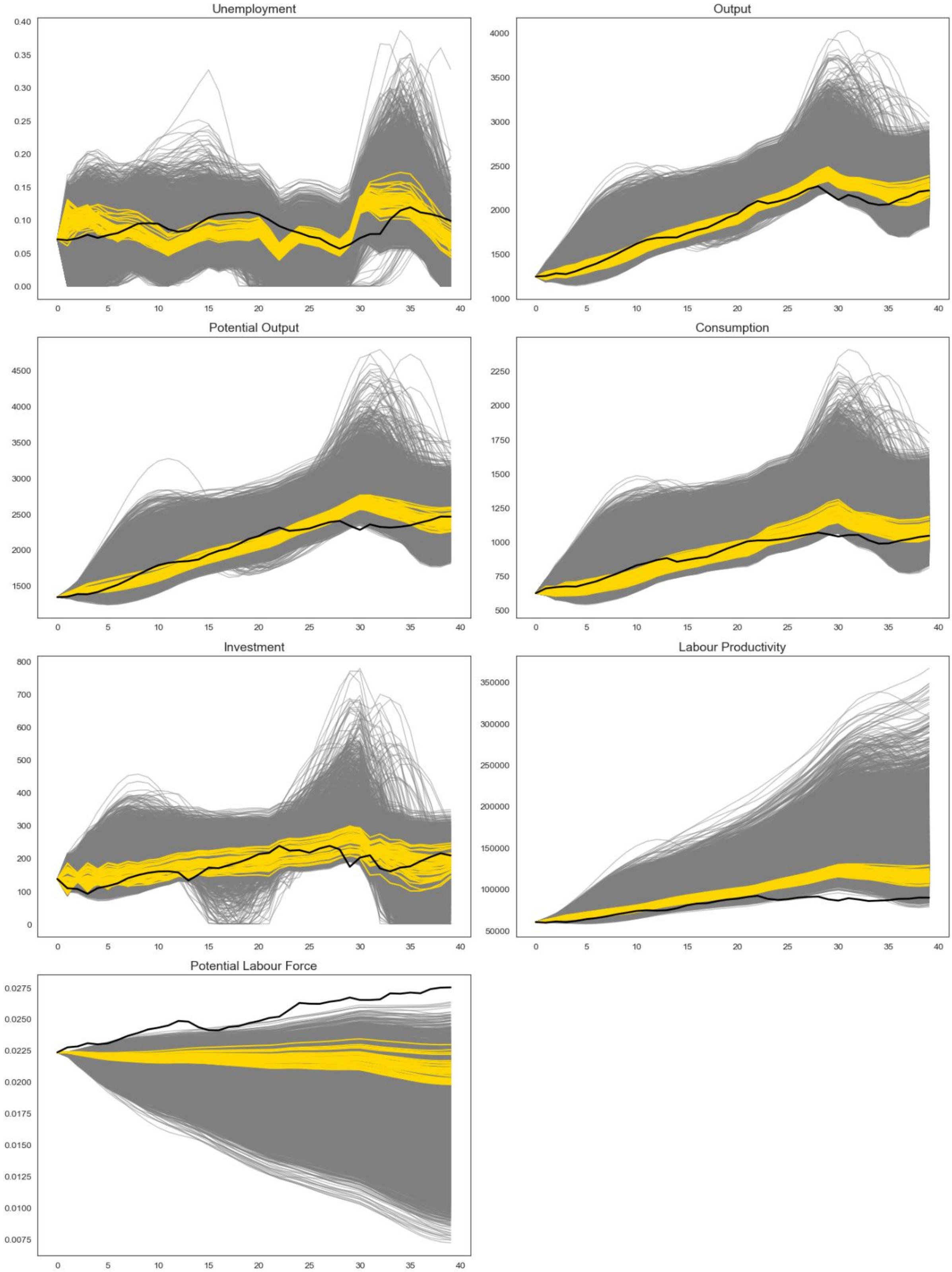

Figure 48: *Accurate scenario clusters for unemployment and output across 10000 scenarios. This figure presents the trajectories of key macroeconomic variables, including unemployment, output, potential output, consumption, investment, labour productivity, and potential labour force, across 10000 simulated scenarios. The highlighted simulations are the top 25% most accurate simulations regarding unemployment, output, labour productivity and labour supply dynamics. Source: Author's calculations.*

Furthermore, we investigate whether these scenarios overlap with those that yield the most accurate simulations for unemployment and output, specifically scenarios where SSR_1 and $MAPE_Y$ are also within their first quartiles. By applying this method, we identify approximately fifty scenarios that fall within the top 25% most accurate simulations across unemployment, output, labour productivity, and labour supply. Figure 48 visually depicts these scenarios.

Two key observations arise from this analysis. First, despite the model's limited number of variables and relationships, it demonstrates a commendable ability to produce accurate results, particularly regarding demand-side dynamics. Second, the labour productivity and labour supply dynamics from these accurate scenarios reveal the model's limitations in simultaneously describing both demand-side and supply-side dynamics. Specifically, the model fails to capture the stagnant behaviour of labour productivity observed since the early 2000s. Moreover, the most accurate simulations for labour supply depict a stagnant or slightly declining trend, which contradicts the real-world trend of labour supply growing at an average annual rate of approximately 0.5%.

These findings underscore the need for further refinement of the model to better align its predictions with real-world economic trends, particularly in accurately reflecting both demand-side and supply-side dynamics.

Equilibrium analysis

In this section, we focus on the dynamics of equilibrium and stability conditions. Although real-world data on autonomous demand suggest that our system never settles into a unique, balanced steady-state equilibrium, understanding these dynamics remains crucial. This stems from our findings in Chapter IV, which highlighted that the equilibrium positions, particularly the unemployment rate, are sensitive to both model parameters and the growth rate of autonomous demand. The formula for the unemployment rate equilibrium is given by:

$$u_e = (\theta_0 + \rho_0 - \hat{F}_e\,(1 - \rho_2\,) + \rho_2\,\delta)/(\theta_1 + \rho_1\,)$$

It is evident that varying model parameters and autonomous demand growth rates can result in different unemployment equilibria. These equilibria depend on both supply-side factors (e.g., hysteresis parameters θ_1, ρ_1, ρ_2) and demand-side variables (e.g., the growth rate of autonomous demand, $\hat{F}_e$). While this multiplicity of equilibria is an integral characteristic of our model, our primary interest lies in exploring the stability of these equilibria.

Despite similarities with the comprehensive analysis of dynamic stability in the work of Fazzari, Ferri, and Variato (2020), our approach includes several key distinctions. We assume a constant autonomous demand growth of 2%, aligned with the average real-world Italian data, and introduce a temporary shock to autonomous demand, increasing its growth to 3% at time $t = 1$.

Our stability analysis diverges further by employing an 'All-Factors-At-A-Time' (AAT) method, which is particularly suited for nonlinear systems where interaction effects are significant. This approach allows us to simultaneously vary all model parameters within their feasible ranges, unlike the single-parameter variations studied by Fazzari, Ferri, and Variato (2020).

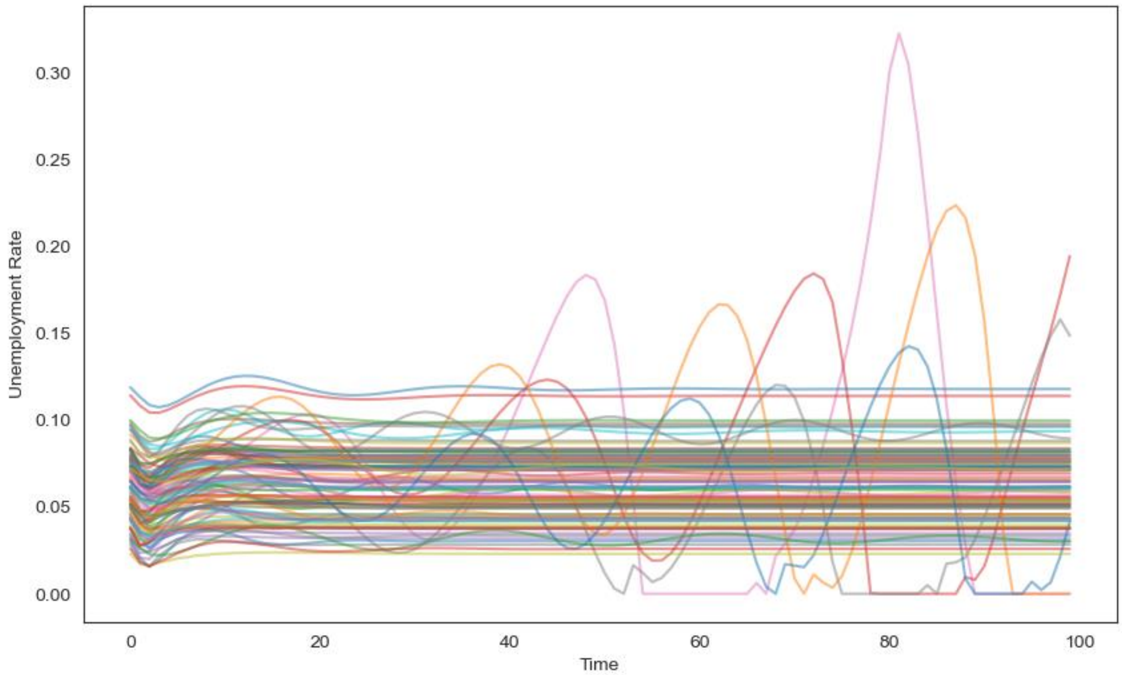

Figure 49: *Evolution of unemployment rate after a temporary shock to autonomous demand growth. This plot shows the evolution in the unemployment rate over time for various steady-state solutions following a temporary shock to autonomous demand growth. Source: Author's calculations.*

Figure 49 visually demonstrates the unemployment rate across 100 different scenarios, highlighting the existence of multiple equilibria and their mostly stable nature, though some scenarios do lead to instability.

To deepen our understanding, we extend our analysis across 10000 scenarios, examining the dynamic stability of the model's equilibria. An equilibrium is considered stable if the unemployment rate converges within a 5% range of its equilibrium value. Our findings confirm that the vast majority (73%) of equilibria are dynamically stable within a ten-year period, while another 22% return to equilibrium within 40 years. However, a small minority (approximately 3%) result in unstable equilibria.

Figure 50 further illustrates these unstable equilibria, highlighting the specific ranges of model parameters associated with instability using red dots edged in yellow, providing a clear visual insight into the conditions that lead to unstable outcomes. *Table 15* contains their empirical ranges.

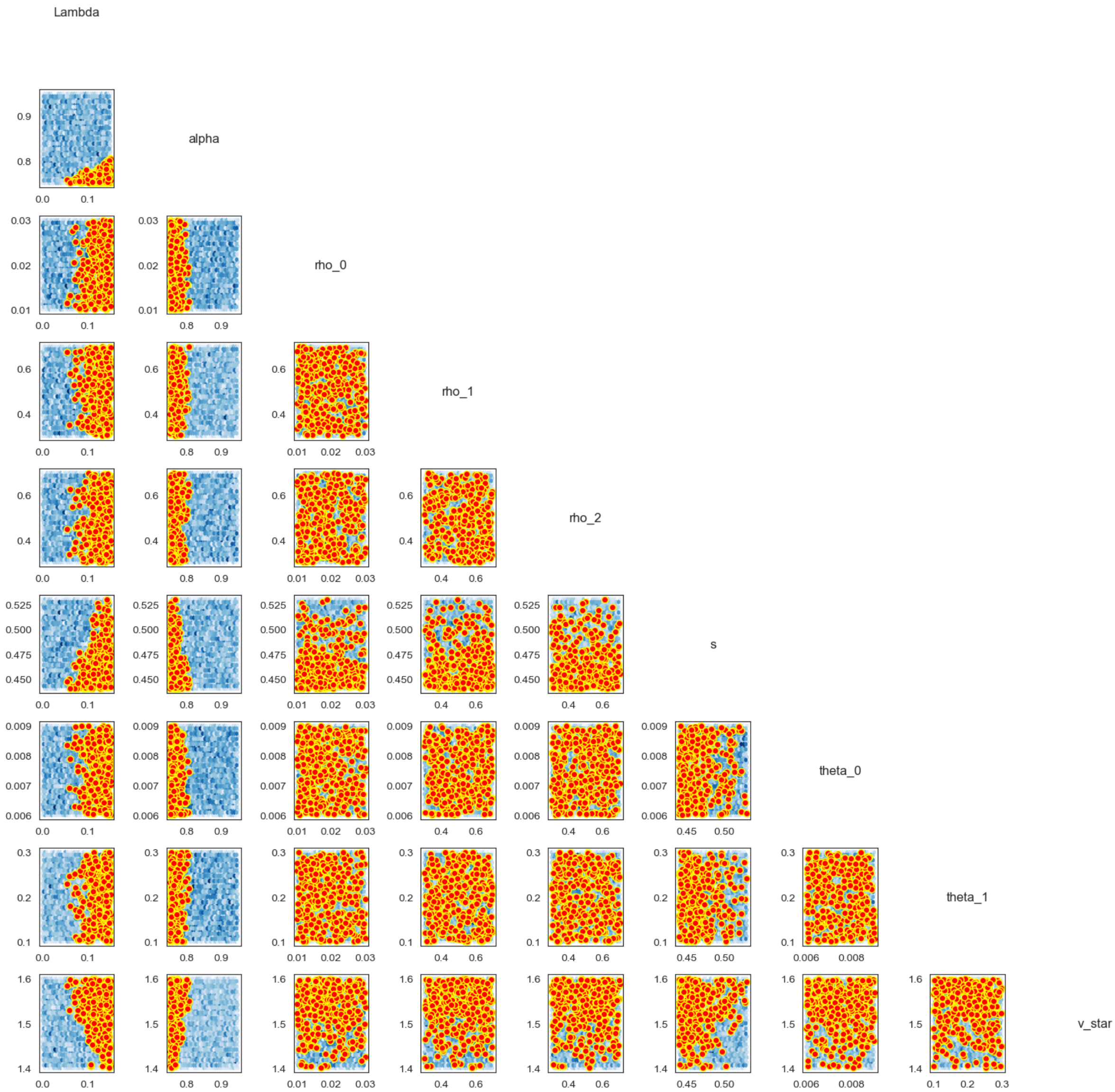

Figure 50: *Unstable steady-state equilibria clusters. This grid of scatterplots identifies scenarios leading to unstable steady-state solutions. Points within the uncertainty space that meet our instability condition are marked with red dots edged in yellow. Source: author's calculations.*

Variable	Symbol	Full range	Unstable equilibria range
Adjustment speed for capital-output ratio	λ	$[0, 0.15]$	$[0.053, 0.15]$
Adjustment speed for expected growth	α	$[0.75, 0.95]$	$[0.75, 0.81]$

***Table 15**: Ranges for unstable steady-state scenarios. This table presents the ranges for key variables in scenarios associated with unstable steady-state equilibria. The variables include the adjustment speed for the capital-output ratio (λ), and the adjustment speed for expected growth (α). The full range and the specific range for unstable equilibria are both shown. Source: author's calculations.*

At a glance, the findings from our stability analysis appear similar to those presented by Fazzari, Ferri, and Variato (2020, Table 2). We observe that the main parameters influencing the stability or instability of equilibria—namely the adjustment speed for expected growth (α), and the adjustment speed for the capital-output ratio (λ)—remain critical. According to Fazzari, Ferri, and Variato (2020), the influence of these parameters is straightforward: adjustments in parameters that increase the sensitivity of induced demand – elements of aggregate demand excluding autonomous components – to economic conditions tend to destabilise equilibria. Specifically, lower persistence in expectation formation (a lower value of α) and quicker capital adjustments (a higher value of λ) contribute to this instability.

Despite the apparent similarity of our results to those of Fazzari, Ferri, and Variato (2020), it is crucial to highlight a key conceptual difference.

Fazzari, Ferri, and Variato (2020) begin with the premise that a specific scenario, which they refer to as the benchmark, best replicates real-world dynamics. From this starting point, they identified the values for both parameters in Table 15 beyond which the model exhibits unstable equilibria, while keeping all other variables fixed at their benchmark values. Essentially, they identified stability thresholds for each parameter.

Our approach, however, takes a different methodological perspective. We examined an uncertainty space, which is essentially defined by the parameters' ranges in Table 14. Within this space, we determined that only a portion contains scenarios associated with unstable equilibria. This does not mean that every point within this smaller space corresponds to unstable equilibria. Rather, it means that if the input factors defining our economic system fall within this "unstable equilibria" space, there is a chance—determined by the proportion of unstable equilibria scenarios among all scenarios sampled from that hyperspace—that our system will exhibit an unstable steady-state solution.

In our specific case, the probability that our model's equilibria will be unstable within the uncertainty space defined by the ranges in *Table 15* is approximately 15%.

An essential point we have yet to address arises from these questions: Are the scenarios that best describe Italian economic dynamics associated with unstable equilibria? If not, what parameter changes in Table 15 would lead them into the unstable equilibria domain?

To resolve this, we summarise the results of our optimisation exercise presented in Table 13, focusing on our two variables of interest (λ, α).

	Optimisation focus			
Variable	Unemployment	Output	Potential output	Unstable equilibria range
λ	0.0645	0.150	0.150	$[0.053, 0.15]$
α	0.950	0.944	0.950	$[0.75, 0.81]$

Table 16: *Comparison of optimal scenarios and unstable equilibria ranges. This table presents three optimal scenarios from Table 13 alongside the corresponding ranges for unstable equilibria. Source: Author's own calculations.*

According to the data in Table 16, of our two variables only the adjustment speed for capital-output ratio (λ) falls within its unstable equilibria range. Notably, since α is significantly outside its unstable range (recall that in our model, α ranges between 0.75 and 0.95), we can confidently state that the three optimal scenarios in Table 16—and any scenarios in their vicinity—are linked to stable equilibria.

It is crucial to understand whether the empirical value of α in these scenarios could change enough to fall within its unstable equilibria range. While this question needs further investigation, it is still valuable to explore the role of this parameter.

As discussed in the previous chapter, the value of α essentially reflects the memory of past economic growth, which households and firms use to form their future growth expectations. A higher α value indicates that firms and households consider a longer history of past growth. Conversely, lower α values suggest that expectations are based on a shorter history.

The high empirical values of α found in our three optimal scenarios imply unrealistically long memories of past growth rates. Specifically, an α of 0.95 means that the output growth rate from ten years ago still significantly influences growth expectations (empirically, the growth rate from ten years ago would account for around 60% in future growth expectations). On the other hand, an α of 0.75 would considerably reduce the impact of past growth rates (the growth rate from two years ago would account for about 50% in future growth expectations).

Hence, even though our optimal scenarios fall outside the unstable equilibria domain, this outcome largely depends on the condition of α, which assumes unrealistically long memory for both firms and households when forming their growth expectations. This reliance on an inflated α value raises questions about the practical validity of our stable scenarios and underscores the importance of further research to evaluate how more realistic α values might influence economic dynamics and stability. By refining our understanding of this parameter, we can enhance the robustness of our model and its applicability to real-world economic conditions.

NAIRU and austerity

In the final step of our empirical analysis, it is useful to reflect on our model within the context of the insights discussed in Chapters II and IV. From the outset, our model's "demand-led" nature has been a key aspect, meaning that demand-side dynamics and parameters primarily drive the model's outcomes.

Our analysis in this chapter has confirmed this. Regardless of the focus—whether it is model accuracy or equilibrium stability—demand-side parameters and forces have consistently played a crucial role in our results, which is expected given the model's design and mathematical formulation.

However, it is important to acknowledge the significant role of the supply side. As previously stated, potential output acts as an upper limit for actual economic output, thereby constraining economic growth. Yet, beyond this "ceiling" effect, there is no interaction from supply to demand when aggregate demand is below potential output (i.e., when full employment is not achieved).

Our theoretical exploration in Chapter II does not preclude the possibility that supply to demand interactions might occur even before reaching full employment conditions. To this end, we recall the policy implications surrounding the concept of the NAIRU (Non-Accelerating Inflation Rate of Unemployment). As explained in Chapter II, the NAIRU represents an inflationary threshold for the actual unemployment rate. When unemployment falls below the NAIRU, the economy is supposedly “running hot,” leading to inflation and adverse effects on economic growth. To prevent this, independent monetary authorities monitor the gap between actual unemployment and the NAIRU (the unemployment gap) and implement restrictive policies (e.g., raising interest rates) to curb economic growth before surpassing the inflationary barrier identified by the NAIRU.

Similarly, despite different underlying reasons detailed in Chapter II for E(M)U countries, fiscal authorities (i.e., governments) should follow a similar policy course. They should implement austerity measures, such as raising taxes or cutting government expenditures, to prevent inflationary pressures.

Whether the link between the NAIRU and inflationary pressures is realistic is not our key concern. What matters is that, at least for E(M)U countries, fiscal and monetary authorities operate as if this relationship exists. Hence, their actions, especially the implementation of austerity measures, should follow this rule according to the monetary and fiscal playbook shared by E(M)U countries.

Given the importance of these rules and their institutionalisation within the E(M)U context, we can argue that linking the supply side to the demand side might better represent the economic environment we are examining. To achieve this, as briefly mentioned and tested in Chapter IV, we can introduce a relative lower boundary for the unemployment rate, effectively serving as the NAIRU. When the unemployment rate falls below this lower boundary, fiscal and monetary authorities, concerned about rising inflation, will implement austerity measures to limit induced demand (the sum of consumption and investment demand).

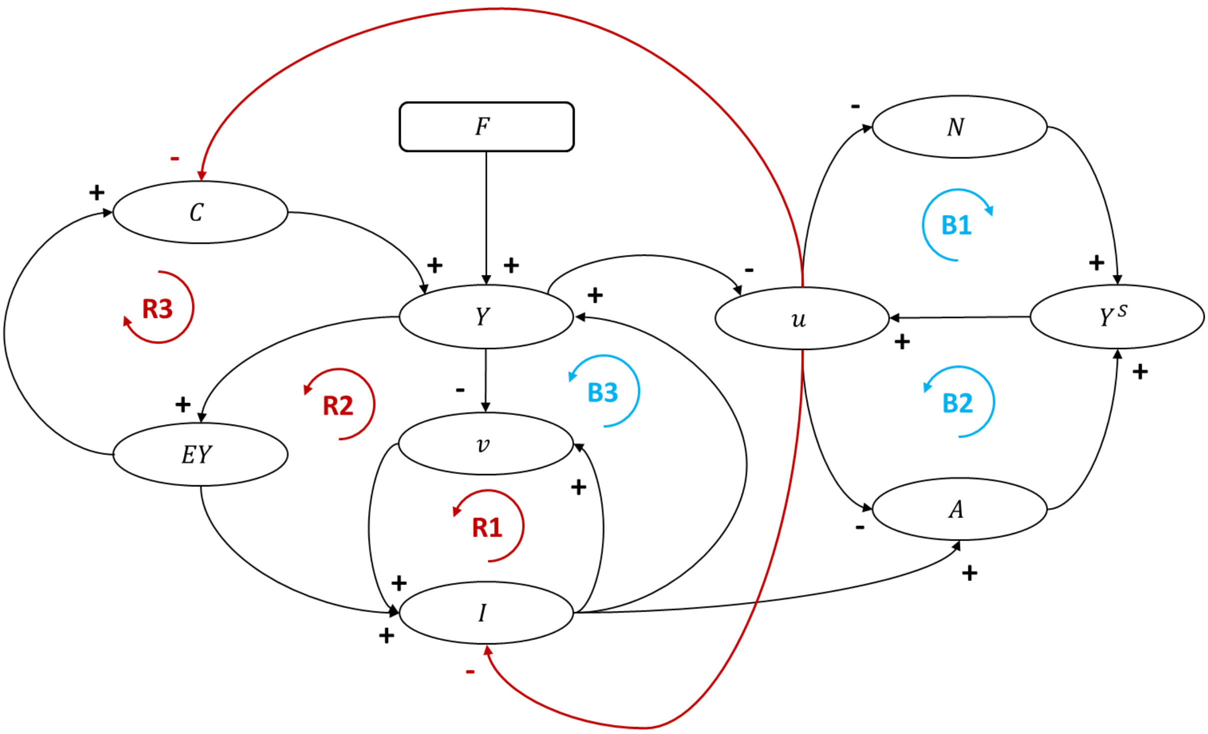

Figure 51: *Causal loop diagram (CLD) of the model with a lower boundary on the unemployment rate. The newly added causal links in this diagram (red links) differ from others in the CLD. Specifically, only a decrease in unemployment below the NAIRU (u_N)—its relative lower boundary—prompts fiscal and monetary policymakers to implement austerity measures aimed at reducing consumption and investment demand. Therefore, a negative sign is shown between unemployment and consumption/investment. Whenever $u > u_N$, these two red links can be imagined as disappearing from the diagram. Source: Author's illustration.*

Figure 51's causal loop diagram visually illustrates how our system changes when incorporating this reasoning.

A key question arising from this new conceptualisation is: What will be the empirical values of this relative lower boundary and the magnitude of the resulting austerity measures?

To address this, we can reconfigure the optimisation exercise conducted in a previous section to account for this lower boundary and the associated austerity policies. Specifically, we aim to find the optimal combination of input factors – now including the NAIRU (u_N) and the percentage decrease factor (ϵ) applied to both consumption and investment as a proxy for austerity – that minimises the sum of squared residuals between simulated and real-world unemployment.

As a result of this exercise, we find that the optimal NAIRU is 8% and ϵ is approximately 1%. These results are quite realistic. In our analysis of the Italian economy in Chapter III, the NAIRU ranged from 7% to around 9%. For the magnitude of austerity policies, Fair (2021)'s U.S. model suggests that a 1%-point increase in the interest rate reduces output by 0.5%-points after 1 year and by 1%-point after 11 quarters. In our model, if the central bank raises the interest rate by 2%-points, demand would decrease by 1%-point after 1 year. Additionally, since ϵ also reflects potential fiscal austerity actions by the government, our approximation of this input factor is likely close to real-world dynamics.

Although a more comprehensive analysis is necessary to fully understand the implications of this new conceptualisation, we can focus on one key point: determining if the results of our equilibrium stability analysis change significantly or remain largely the same. To investigate this, we conducted a limited stability analysis, running 1500 experiments. In this analysis, we incorporated the presence and hypothesised policy implications of the NAIRU, using the empirical values derived from our optimisation exercise.

This investigation reveals that introducing the NAIRU reduces the average time to reach equilibrium from approximately nine years in the original model configuration to around six years. Additionally, the number of unstable equilibria decreases slightly, from ten in the original model to six in the NAIRU model.

However, these results should be interpreted cautiously for two key reasons. Firstly, different scenarios represent distinct economic settings. Each economy has unique characteristics, especially concerning the NAIRU, which varies due to labour market conditions, price dynamics, and the interaction of demand and supply-side factors. Therefore, applying a single NAIRU across diverse macroeconomic scenarios is unrealistic. Furthermore, acknowledging hysteresis suggests that the NAIRU can change over time in response to both demand and supply influences.

Secondly, our model does not account for the relationship between the unemployment gap (the difference between actual unemployment and the NAIRU) and austerity policies. Regardless of the unemployment gap, fiscal and monetary authorities consistently reduce consumption and investment demand by 1%. Moreover, interventions only occur when unemployment is below the NAIRU, with no action taken when it is above. This asymmetric policy stance contradicts the widespread theoretical interpretation of the NAIRU, which posits that central banks should aim to maintain unemployment at the NAIRU to ensure price stability. A more realistic model would adjust this policy behaviour to reflect symmetric responses.

Despite the limitations of our current NAIRU analysis, it is crucial to keep in mind a key structural insight from our model. Reducing aggregate demand, given the presence of hysteresis mechanisms, also reduces potential output. Consequently, austerity measures intended to be temporary can have lasting negative effects on an economy's productive capacity.

In conclusion, while our findings indicate that the NAIRU can enhance model stability and reduce equilibrium time, the applicability of these results is limited by the model's assumptions and the unique economic contexts of different scenarios. Future research should incorporate more dynamic and realistic representations of the NAIRU and policy responses to improve the model's robustness and accuracy across various economic settings.

VI. Discussion

Having analysed the model proposed by Fazzari, Ferri, and Variato (2020) both conceptually and empirically, and supplemented this analysis with an exploration of the unique factors and evolution of the Italian economy, we can now reflect more broadly on our findings. Crucially, a reader without an economic background—if they have persevered to this point—might wonder how this research differs from other purely economic studies on this topic. Moreover, such a reader might have hoped that our modelling would yield robust and insightful policy recommendations regarding economic growth. Addressing these concerns and advancing additional considerations is the primary aim of this chapter. Furthermore, we will examine the limitations of this research, which will lay the groundwork for suggestions for further research to be outlined in the concluding chapter.

Framework and model

As the reader will have gathered from the second chapter, the discipline of economics, like any social science, lacks a unanimous consensus on the best theoretical framework for studying and understanding the drivers of economic growth. Summarising what we explored in detail, various economic schools attribute different levels of importance to various real-world factors in explaining why some economies achieve higher levels of material wellbeing (i.e., the ability to produce a large quantity of goods and services benefiting consumers). Economists typically categorize these factors into demand-side and supply-side influences and often argue that one of these categories entirely drives long-term economic growth. In other words, potential output is seen as either supply-side or demand-side determined. While this division might seem trivial to non-economists, those even marginally familiar with economic literature will recognize its significance.

Economists, particularly theorists, may find the nuances of different economic schools fascinating. However, practitioners and policymakers must move beyond the often-contentious debates that dominate economic discussions. This does not mean ignoring the existence of different interpretations of the same phenomena. On the contrary, recognising diverse interpretations is essential in social sciences. The key is to avoid perpetuating unproductive debates that present conflicting views as the only correct interpretations of reality.

The approached followed by this thesis already represents a step beyond these sharp contrasts. In this regard, while emphasizing the role of autonomous demand, the key conceptual contribution of Fazzari, Ferri, and Variato (2020)'s model is the introduction of hysteresis mechanisms. By recognising the interactions linking demand-side dynamics to the evolution of what is usually defined as supply-determined potential output, our model opens up new avenues for discussion, moving beyond the traditional dichotomy.

Consider the mathematical formulation presented for the growth rate of potential output:

$$\hat{Y}_t^S = \theta_0 - \theta_1 u_{t-1} + \rho_0 - \rho_1 u_{t-1} + \rho_2\,(\hat{K}_{t-1} + \delta)$$

Here, θ_0 and ρ_0 reflect the impact of exogenous factors on labour force growth and labour productivity growth, respectively. Parameters θ_1 and ρ_1 represent the effects of the unemployment rate on these growth factors. The term ρ_2 captures the influence of the capital replacement rate (i.e., $\hat{K}_{t-1} + \delta$) on labour productivity growth, where $\hat{K}_{t-1}$ denotes the growth of fixed capital from period $t-2$ to $t-1$, and δ is the capital stock depreciation rate.

This formulation incorporates hysteresis mechanisms, suggesting that parameters bridging demand-side dynamics with potential output evolution (θ_1, ρ_1 and ρ_2) are not null. Simultaneously, it retains elements akin to models advocating a supply-side determined potential output. Specifically, θ_0 and

ρ_0 capture the impact of exogenous supply-side factors, such as labour protection legislation, and possibly other demand-side influences, including economic distribution features.

Thus, this simple model, acknowledging hysteresis, does not negate supply-side considerations. These considerations align with those from other simple growth models, like the widely recognised Solow-Swan model[11], therefore opening up a floor for insightful discussions with different conceptualisation of economic growth.

Given these considerations, one might initially assume that the main value of this research lies in utilising the model developed by Fazzari, Ferri, and Variato (2020). This could lead to questions about the genuine contribution of this thesis, particularly since the original model remains unaltered. How, then, did we contribute to the study of economic growth if we have not modified the original model?

The key contribution of this research lies in our unique approach. Unlike traditional economic analyses, this work integrates both conceptual analysis and empirical testing to evaluate the model's accuracy and stability.

A significant aspect of our conceptual analysis is the use of Causal Loop Diagrams (CLDs). CLDs provide a visual representation of feedback loops and interdependencies within the model, making complex relationships easier to understand and communicate. This method enables a clearer exploration of the model's dynamics and potential outcomes, which is particularly valuable for identifying leverage points and areas for intervention.

Using CLDs compels us to create a simplified visual representation of our model's operation. By visualising our model, we become acutely aware of its boundaries and the uncertainties surrounding certain causal mechanisms. For example, there might be uncertainty concerning the direction of causality itself. These visual interpretations can be effectively used in comparative studies across different growth models. An interesting application could be to collect various CLDs based on different growth models, applying certain constraints such as the number of parameters used. These could then be used as part of a Comparative Cognitive Mapping (CCM) study.

CCM involves comparing cognitive maps—essentially visual representations of knowledge and assumptions—across different models or paradigms. This technique is useful in studying different modelling approaches to economic growth as it helps highlight the similarities and differences in underlying assumptions, causal relationships, and model structures. By comparing these cognitive maps, researchers can gain deeper insights into the strengths and weaknesses of various growth models, potentially leading to more robust and comprehensive theories (Hermans et al., 2018).

Furthermore, CLDs are rarely used in economic research, distinguishing this work by integrating a tool more commonly found in systems thinking and engineering.

[11] The Solow-Swan model is a fundamental model in economics education, used widely to illustrate the principles of long-term economic growth. It describes growth through three main factors: capital accumulation, population or labour force growth, and technological progress. The model underscores the concept of diminishing returns to capital, meaning that as more capital is added, the incremental gains in output decrease. Technological advancement is presented as crucial for sustaining economic growth in the long run. According to this model, long-run growth (potential growth) is essentially driven by supply-side factors. However, this presents a limitation in a world that recognises the importance of hysteresis, where demand-side dynamics also play a critical role in shaping economic potential.

On the empirical side of our analysis, we recognised that non-linear systems—of which our model is one example—cannot be treated using the same approach as linear ones when it comes to uncertainty and stability analyses. A key characteristic of non-linear systems is the presence of interaction effects. Interaction effects occur when the effect of one variable depends on the level of another variable, making it essential to account for these when conducting empirical analyses of non-linear systems. Therefore, unlike Fazzari, Ferri, and Variato (2020), who relied on ceteris paribus changes in model parameters (changing one parameter at a time while keeping the others fixed at their benchmark values), this research implemented an All-Factors-At-a-Time (AAT) approach, where all model parameters vary simultaneously across their feasible empirical ranges.

The significance of this difference lies not only in the suitability of AAT methods for studying non-linear systems but also in the conceptually different results produced by this analysis. Whereas Fazzari, Ferri, and Variato (2020) identified thresholds for key (demand-side) parameters beyond which equilibrium becomes unstable, our analysis identified a space (defined by specific ranges of uncertain input factors) within which the likelihood of encountering scenarios leading to unstable equilibrium is higher than in the remaining input space. However, our findings do not provide empirical proof that crossing into this specific unstable space guarantees an unstable equilibrium for every scenario (i.e. a scenario falling within the unstable space is a necessary but not sufficient condition for unstable equilibria).

In addition to methodological considerations, it is essential to highlight the significance of our empirical analysis of Fazzari, Ferri, and Variato (2020). This study used Italy as a case study to test the model's applicability to economic environments distinct from the US economy, which served as the original context for Fazzari, Ferri, and Variato (2020)'s work. Our research went beyond merely employing Italian data on key macroeconomic variables to test the model's descriptive capacity. An entire chapter is dedicated to analysing and discussing Italy's economic performance between 1979 and 2018, highlighting the evident decline starting from the early 1990s.

A pertinent question arises: has this supplementary analysis of the Italian economy added value to our empirical model, or could the same insights have been achieved without extensive examination of Italy's specific economic traits? Both perspectives hold some validity.

On one hand, a straightforward empirical description of Italy's key macroeconomic indicators could have sufficed to illustrate the country's economic stagnation. This approach would have focused on primary variables included in our model, such as investment, consumption, and labour productivity.

On the other hand, our comprehensive analysis of Italy's economic context has revealed several crucial insights. Firstly, many factors that have significantly influenced Italy's economic and institutional policies are not captured by our model. For instance, the analysis of debt-to-GDP and inflation is critical, as these indicators have driven austerity measures. High inflation in the 1970s and 1980s prompted Italian policymakers to implement wage restrictions to control inflation. Meanwhile, the debt-to-GDP ratio has become a key criterion for assessing economic health, influencing decisions by the European Commission and the Italian Treasury.

Secondly, the socio-political and institutional landscape in Italy has undergone profound changes over the four decades of our study (1979-2018). Italy's adherence to the Stability and Growth Pact in 1997, for example, significantly altered the policy environment. These transformations challenge the validity of our model, which assumes constant key parameters (such as hysteresis) over time, thus failing to account for deep socio-economic, political, and institutional shifts.

In summary, while a more focused empirical description might have sufficed, our broader analysis provides valuable insights into the limitations of our model and the complex factors shaping Italy's economic trajectory.

A final notable strength of our model lies in its innovative conceptualisation of potential output. Traditionally, potential output represents the path around which an economy evolves, indicating the growth trajectory associated with real-world economic output dynamics. From this perspective, it seems logical for policymakers to steer the economy as close as possible to its potential path. This means minimising the output gap – the difference between potential and actual output – as deviations from this path can affect the general price level of goods and services. Specifically, if actual output exceeds potential output, prices tend to rise, and vice versa.

While this traditional view offers an intuitive understanding of the relationship between quantities and prices of goods and services in an economy, recent inflation trends have raised significant doubts about its validity. As discussed in Chapter II, critical studies have shown that the output gap (or the related unemployment gap) often fails to predict inflationary pressures. These gaps have only explained price changes retrospectively, requiring additional ad-hoc assumptions or the inclusion of other macroeconomic variables, such as the vacancy ratio (Storm, 2023), to predict price movements accurately.

Our model presents a clear advantage over the traditional formulation of potential output. While retaining the central concept of potential output, our model redefines it as an upper boundary for real-world production of goods and services, without any direct link to price dynamics. This approach facilitates a broader dialogue between traditional and heterodox growth theories. It encourages economists from both perspectives to recognise that price dynamics are driven by more complex, detailed, and case-specific factors, as exemplified by Weber's (2023) formulation of sellers' inflation.

Policy considerations

Up to this point, this research has offered limited insights for policymakers. This aligns with the initial formulation of the model by Fazzari, Ferri, and Variato (2020), which lacks the necessary elements to serve as an effective policy-support tool. Specifically, the model overlooks critical factors for the Italian economy, such as price dynamics and the debt-to-GDP ratio, which are vital for real-world policymaking. Additionally, it fails to address crucial trade-offs in the economic debate, such as distributional considerations (the division of national income between wages and profits) and inequality (the unequal distribution of income across different classes). Additionally, our analysis has shown that while Fazzari, Ferri, and Variato (2020)'s model accurately describes demand-side dynamics—mainly consumption and investment demand, with autonomous demand components taken as exogenously determined—it falls short in describing labour productivity dynamics and labour supply. Notably, it does not capture the stagnant behaviour of labour productivity observed in the Italian economy since the early 1990s. Consequently, any policy recommendations derived from this model should be critically assessed for their validity.

Does this mean the work has no value for policymakers? Certainly not. Although this work has spent much time on empirically analysing Fazzari, Ferri, and Variato (2020)'s model, our critical literature review and conceptual analysis of potential output and hysteresis provide valuable insights for policymakers.

Recognising hysteresis suggests that the traditional separation between demand and supply is more theoretical than practical. Modellers should explicitly hypothesise how hysteresis mechanisms operate in their specific contexts, drawing on reviews of these mechanisms, such as those summarised in Table 2. By clearly describing and incorporating relevant hysteresis mechanisms into decision-support models, policymakers can better understand the implications.

For monetary policymakers, acknowledging hysteresis necessitates abandoning the notion of money neutrality. If demand-side forces affect potential output, the idea that monetary policy has no long-term impact on the real economy is no longer tenable. For fiscal policymakers in the Eurozone, whose rules are based on a supply-side view of potential output, recognising hysteresis underscores their broader influence. Current fiscal policies focus on aligning the economy with a potential path affected only by structural reforms. However, incorporating hysteresis reveals that fiscal decisions on aggregate demand significantly impact the potential path, potentially reversing or delaying expected outcomes of structural interventions.

A broader piece of advice for policymakers can be drawn from Banerjee and Duflo (2019, p. 19): "The world is sufficiently complicated and uncertain that the most valuable thing economists often share is not their conclusions, but the journey they took to reach them—the facts they knew, the way they interpreted those facts, the deductive steps they took, and the remaining sources of their uncertainty."

This reflection underscores a central theme of this thesis. The primary benefit of economic models is not to provide ready-made, quantitatively backed policy solutions for current economic issues. Instead, economic models offer tools that enhance our ability to critically examine the deep mechanisms driving societal evolution, which are inherently historically determined (i.e., they are valid in specific contexts, although general insights can be useful in various circumstances).

In essence, economic models should serve as platforms for debate and forums for generating collective intelligence on various topics, inevitably leading to multiple interpretations. Thus, policymakers should not seek the ultimate model but rather acknowledge the coexistence of different models and articulate why insights from a particular model are preferable in a specific context. Ultimately, the goal is not to predict the future accurately—a task more suited to magicians than economists—but to demonstrate to the public that decision-makers have rigorously applied scientific scepticism and transparently explained the strengths and limitations of their decision-support tools.

Limitations and Future Research

While this research has provided valuable insights, it is important to acknowledge several limitations related to both technical-methodological and conceptual aspects. Technical-methodological limitations pertain to the design, execution, and analytical methods used in the study. Conceptual limitations relate to the theoretical framework and assumptions underlying the study, including the scope and definitions of key concepts. This section will outline these limitations and discuss opportunities for future research.

Technical limitations

First, the accuracy of our model simulations was benchmarked against real-world conditions by making two critical assumptions due to the lack of initial data for the period of interest. Specifically, we assumed the initial capital-output ratio (v) to be one in 1978 and calculated the expected output growth rate (Eg) in 1979 as a weighted average of actual growth rates from 1975 to 1979. These assumptions, while necessary for initializing the model, may not accurately reflect the true conditions of the Italian economy. Future research could benefit from including these assumptions as part of a broader uncertainty analysis to assess their impact on model performance. For other economies with complete data on gross capital, the first assumption could be eliminated, but the second remains essential for model initialization.

Second, the empirical strategy employed in this thesis, although intuitive, might lack the mathematical rigor required to fully ensure the robustness and validity of the results. For instance, the choice of objective functions and real-world variables used to assess model accuracy could be contentious among more technically oriented readers. Future research should engage experts in dynamic non-linear systems to refine these methods and incorporate best practices, thereby enhancing the mathematical foundation and credibility of the empirical approach.

Third, our research recognizes the necessity for more complex econometric techniques to derive robust empirical values for model parameters. As exemplified in Fazzari and Gonzales (2023), where a Simulated Method of Moments (SMM) extended for time-series analysis was used to calibrate a model for the US economy, similar advanced techniques could provide more reliable parameter estimates for the Italian context. Future work should continue this exploration, applying sophisticated econometric methods to improve parameter accuracy and model reliability.

Additionally, the current range selected for sensitivity analysis in our model is notably broad. While this breadth allows the model to be tested across various scenarios, including those that might be unrealistic for the Italian economy, it can offer insights into other economies. However, future research should aim to narrow this range to focus on more realistic and relevant scenarios for the Italian economy, enhancing the practical applicability of the findings.

Also, the method used in this thesis to determine which conditions lead to the most accurate scenarios and to identify potentially unstable steady-state solutions was qualitative. While this qualitative approach facilitates understanding and communication of results to non-technical audiences, it might limit the robustness of the findings. Future research should complement these qualitative analyses with more sophisticated techniques, such as scenario discovery methods available in EMA Workbench (Kwakkel, 2017). Incorporating behaviour-based scenario discovery methods (Steinmann, Auping, and Kwakkel, 2020) could also provide a more nuanced understanding of the conditions leading to accurate and stable model outputs, thereby enhancing the comprehensiveness and robustness of the analysis.

Finally, given the simplicity of our model, evaluating its ability to replicate real-world dynamics using yearly data, as done by Fazzari, Ferri, and Variato (2020), might be overly optimistic. Due to the model's simple structure and limited number of variables, a more appropriate approach would be to assess its accuracy based on its ability to replicate moving averages of key macroeconomic variables, such as 5-year moving averages or longer.

This reasoning extends to our broader methodology as well. Our empirical simulations used yearly autonomous demand as an exogenous input. While this approach is useful, particularly for analysing the stability properties of equilibrium positions, a more fitting method for this model would involve using the average evolution of autonomous demand over the period of interest. Specifically, we could have used an autonomous demand time-series characterised by its average growth rate between 1979 and 2018 (i.e., $F_t = (1 + g_F)\, F_{t-1}$, where g_F is the average growth rate of autonomous demand over four decades). Alternatively, a smoothed version of real-world autonomous demand data could have been employed.

In summary, the model's simplicity should have been considered from the outset by focusing on longer-term dynamics rather than year-to-year variations.

Conceptual limitations

According to our simulation results, our model can be deemed capable of producing quite realistic and accurate results for most variables. However, as discussed in the previous chapter, the current model formulation fails to optimally represent supply-side dynamics, particularly the stagnation of labour productivity from the late 1990s onwards and the evolution of labour supply. Despite this, the simplicity of the model's conceptualisation means it can, when appropriately parameterised, yield surprisingly realistic outcomes for the evolution of demand-side factors. Nonetheless, there are limitations to the importance of this accuracy.

First, to run the model, we need to take the evolution of autonomous demand components—exports, government expenditures, and autonomous consumption spending—as exogenous inputs. Notably, the current choice of autonomous demand components implies that around 40% of total aggregate demand is considered an exogenous input factor. Therefore, the model's ability to replicate real-world demand-side dynamics is effectively limited to describing the remaining 60% of aggregate demand, consisting of approximately 50% consumption demand and 10% investment demand.

Second, while we treat autonomous demand as exogenous to the evolution of aggregate income, many authors argue that most autonomous demand components are, in fact, dependent, directly or indirectly, on the evolution of aggregate income (i.e., real GDP). Hence, future research should engage with scholars who have explored the properties and limitations of autonomous demand definitions and include this as a central part of the empirical analysis.

Third, despite the simplicity of our model's structure, it heavily depends on behavioural assumptions to describe the investment and consumption patterns of firms and households. This reliance, particularly concerning household behaviour, is unrealistic. Our empirical analysis shows that the scenarios which best predict unemployment and output (i.e. real GDP) (Table 13) are those with extremely long-lived growth expectations. Specifically, these scenarios suggest that households base their expectations for next year's real GDP growth on over thirty years of past growth data. This method of forming growth expectations is highly unrealistic. Therefore, future research should critically examine the microfoundations underpinning both investment and consumption in this model.

Future research

Based on the methodology, findings, and limitations of this research, three key areas for future exploration emerge. These areas address the needs and scope that could guide subsequent efforts building on this work.

First, an expanded model could be developed from the current one. Researchers should ensure they spend adequate time considering case-specific information as a primary step in their analysis. For example, to enhance Fazzari, Ferri, and Variato (2020)'s model in capturing the Italian economy's evolution, it is crucial to recognise that Italy's economic struggles are closely linked to austerity measures. These measures were adopted by Italian policymakers to join the Euro area and subsequently restricted the country due to the Eurozone's fiscal rules.

Additionally, the concept of hysteresis requires further exploration. Our empirical analysis reveals that the current model does not accurately capture the dynamics of supply-side variables (such as labour productivity and labour supply growth), particularly post the stagnation of the early 1990s. This indicates that the hysteresis mechanisms in our model need revision. This revision should address both the hysteresis channels (i.e., which demand-side variables influence supply-side variables) and the timing of these mechanisms (e.g., the lag between unemployment dynamics and labour supply growth may be longer). Other factors, such as excluding significant variables like labour protection legislation indicators and financialisation proxies, might also contribute to this issue. Therefore, when developing a larger model, researchers must transparently identify the hysteresis mechanisms in their formulation and include the necessary variables to better understand supply-side dynamics.

Finally, the current model does not account for many critical considerations in public and policy debates. Two key areas should guide future modelling efforts: inequality and ecological constraints. Extensive research indicates that inequality significantly impacts long-term economic growth and should be a primary focus of any economic growth study (Galbraith 2016). Regarding ecological constraints, it is important to note that while our current model's potential output represents the maximum production achievable with all available labour resources at the current productivity level, it does not consider ecological boundaries. Thus, an ecologically-driven definition of potential output should be introduced.

Both these last research directions aim to expand the concept of sustainability traditionally associated with potential output. Typically, potential output is seen as the sustainable production limit, beyond which inflationary pressures arise. However, including distributional and ecological aspects, which are equally important facets of sustainability, is promising for future research.

Second, while maintaining the current model's basic structure, it would be valuable to conduct a comparative analysis using the same conceptual and empirical approaches on a different model. This analysis could focus on juxtaposing the current model with a simple growth model often cited in traditional economic growth theory, such as the Solow-Swan model. Although this task may appear straightforward initially, it involves complex steps. Specifically, significant conceptual effort is required to interpret and compare the theoretical assumptions underlying each model and to determine whether the model boundaries are comparable. While this work might not have immediate policy implications, it can provide a unique perspective on different approaches to understanding economic growth and the fundamental assumptions that underpin these interpretations.

Third, exploring the connection between economic modelling and policymaking offers significant potential for future research. Notably, this investigation could begin by recognising that economic models used by major policymaking institutions predominantly rely on a single theoretical framework. While variations typically arise from differences in methodology and the additional structures applied to this theoretical core, this framework is increasingly debated within academic circles and public discourse. Therefore, an intriguing starting point would be to examine how policymakers incorporate diverse and competing economic theories and how this diversity should be communicated to the public.

This line of research may require different investigative methods than those used in this study, such as interviews with modelling experts at major policymaking institutions. By understanding how models are employed in policymaking, the specific needs of policymakers regarding modelling efforts, and how the plurality of economic theories can be integrated into policymaking, an essential link can be forged between economic research and real-world policy.

VII. Conclusion

When analysing economic growth, there is a significant and growing body of evidence supporting the existence of hysteresis – the concept that demand-side economic dynamics can have long-lasting effects on an economy's potential output. This notion has gained particular attention over the past 15 years, especially following the dramatic events of the 2008-2009 global financial crisis.

Despite the increasing empirical evidence on this topic, which has profound implications for how major global institutions approach economic growth, little research has focused on developing simple dynamic models that incorporate hysteresis mechanisms. Notable exceptions include the work of Fazzari, Ferri, and Variato (2020), and Fazzari and Gonzales (2023), who used a straightforward demand-led model to explore the effects of hysteresis on the growth prospects of the US economy.

This thesis aimed at expanding and critically analysing the work of Fazzari, Ferri, and Variato (2020) in two key areas. First, it investigated whether their framework can adequately represent a different economic context, specifically the Italian economy between 1979 and 2018. Second, it introduced key methodological changes in quantifying model accuracy and conducting uncertainty analysis.

Through this approach, several compelling insights have emerged, which will be thoroughly outlined by addressing the research questions guiding this study.

Answering the research questions

The main research question of this thesis is:

How can a simple demand-led model, incorporating the concept of hysteresis, enhance our understanding of economic growth?

To address this broad question comprehensively, six specific sub-research questions have been developed. While the final sub-question, which deals with the model's limitations and potential directions for future research, will be discussed in the concluding section, we will now address the following questions:

i. **How have (potential) economic growth and hysteresis been conceptualised in macroeconomic literature?**

Economic growth is usually analysed by dividing economic forces into demand-side and supply-side categories. Demand-side forces include factors like consumer spending, government expenditures, and investment, which influence economic fluctuations in the short term. Supply-side forces, such as technological innovations, the availability of skilled labour, and capital stock, are thought to be essential for ensuring long-run growth and sustaining potential output.

Potential output represents the highest level of output an economy can achieve without triggering inflation, serving as the benchmark around which actual output tends to fluctuate. A longstanding academic debate persists regarding whether potential output is solely influenced by supply-side factors or also by demand-side elements through hysteresis mechanisms. Mainstream economists generally argue that potential output is determined by supply-side factors, while others contend that demand-side factors can have lasting impacts on potential output. This debate gained prominence following the 2008 financial crisis, as empirical evidence suggested that demand-driven economic downturns could have enduring negative effects on growth capacity.

Understanding this debate is vital not only in academic circles but also for real-world policymaking, particularly in the context of E(M)U countries. Estimating potential output and related unobservable variables is crucial for both fiscal and monetary policy planning.

From a fiscal perspective, the European Commission uses the output gap—the difference between actual output (real GDP) and potential output—to determine the structural budget balance. This balance reflects the government's budget position adjusted for the economic cycle. Since the early 2000s, calculating the output gap and structural budget balance has become institutionalised, with member states required to target a structural budget balance as a medium-term objective, facing sanctions for non-compliance. This institutional framework directly influences the urgency of fiscal consolidation measures for member states.

On the monetary side, the output gap's relationship with price movements has been a focal point of research since the early 1980s. Central banks monitor the output gap to guide the economy towards its natural level of activity, defined by potential output. Operating above potential output generates inflationary pressures, while operating below it can lead to deflation. Thus, maintaining proximity to potential output is crucial for price stability.

Hence, understanding the dynamics of potential output and hysteresis is not only an academic exercise but a fundamental aspect of effective fiscal and monetary policy, especially within the EMU.

ii. What are the key stylised facts to consider when studying the Italian economy?

To understand the development of the Italian economy between 1979 and 2018, it is essential to examine the evolution of key macroeconomic variables, particularly in comparison to Germany and France. Over these four decades, all three economies experienced a decline in economic dynamism, evident in reduced growth rates of real GDP per capita and labour productivity. However, the Italian economy stands out for its relative and absolute decline. Unlike Germany and France, Italy's economic engine seems to have lost its capacity to sustain long-term growth. This is reflected not only in its persistently low and stagnant GDP and labour productivity growth rates but also in its structurally high unemployment, which peaked at over 12% following the 2008 global financial crisis.

Additionally, Italy has a high incidence of involuntary part-time employment, reaching over 60% of total part-time employment in 2018, compared to about 40% in France and less than 10% in Germany. Furthermore, real compensation per employee in Italy is lower now than it was thirty years ago.

A critical aspect of Italy's economic decline is the profound restructuring of its political and economic structure over the past 30 years, driven by the goal of meeting the conditions for acceptance into the European Monetary Union. During the 1970s and 1980s, known as the Italian Years of Lead, Italy faced severe inflationary pressures and a growing debt-to-GDP ratio. In response, the Italian government implemented structural reforms aimed at reducing structural unemployment, controlling price instability, and enhancing international competitiveness in exports. These reforms, which have shaped Italian policy for the last three decades, included stringent fiscal consolidation measures (such as significant cuts to government expenditures that severely impacted the welfare system), privatisation and liberalisation of goods and service markets, and strong wage moderation and labour market flexibilization policies.

While these measures achieved price stability, they failed to create positive and reinforcing growth mechanisms. As a result, Italy's economic trajectory has been marked by stagnation and decline, highlighting the challenges and limitations of the reform strategies employed. This understanding is crucial for framing the broader narrative of Italy's economic performance and its position within the European Union.

iii. What are the key features of the Fazzari, Ferri, and Variato (2020) growth model?

Fazzari, Ferri, and Variato (2020)'s model provides a straightforward yet insightful framework for studying economic growth. This model is demand-led, meaning that demand-side dynamics, particularly the evolution of autonomous demand components like government spending and exports, shape the system's evolution both in the short run and the long run. In this context, potential output is conceptualised as the upper boundary for economic dynamics, essentially serving as a ceiling that actual economic output cannot surpass.

A crucial aspect of this model is that the potential output ceiling evolves in response to demand-side dynamics. Hysteresis mechanisms are central to this process, linking the evolution of potential output to changes in the unemployment rate and the accumulation of productive capital stock through investments. This implies that supply-side dynamics are significantly influenced by demand-side factors, challenging traditional views that separate these two aspects.

The model also introduces micro-foundations to explain both household consumption and firm investment dynamics. These micro foundations are based on adaptive expectations of future output growth, where agents form their expectations based on past economic performance, and on the concept of convergence towards a long-run capital-output ratio chosen by firms.

Despite its conceptual simplicity, the mathematical formulation of the model introduces non-linear mechanisms. This complexity requires empirical simulations across a range of uncertain model parameters to fully understand the system's dynamic evolution and the stability of its steady-state solutions.

iv. How do changes in the model's input factors across their feasible empirical ranges affect model accuracy and dynamic stability?

Running dynamic simulations of the Fazzari, Ferri, and Variato (2020) model across multiple scenarios reveals several critical insights about model accuracy and dynamic stability. These simulations, which involve varying combinations of uncertain input factors, highlight a few key points.

Firstly, the model exhibits a notable trade-off between accurately describing unemployment dynamics and the dynamics of other key macroeconomic variables. Scenarios that best match real-world unemployment trends often yield unrealistic behaviours for other variables such as consumption, investment, and labour productivity. For example, some of these scenarios predict Italy's real GDP reaching over three trillion euros in 2018, which is almost the size of Germany's economy in the same year. Conversely, scenarios that accurately describe real economic output tend to produce unrealistic unemployment rates, including conditions of full employment.

Secondly, according to our optimisation exercise our model identifies the (average) propensity to save (s), and the long-run target capital output ratio (v^*) as crucial parameters for achieving accurate simulations based on both output and unemployment dynamics. For the simulations to be accurate, the propensity to save should fall between 0.44 and 0.53, and the long-run target capital output ratio falls between 1.4 and 1.6. These parameters significantly influence the overall performance of the model in aligning with real-world data.

Thirdly, despite focusing on scenarios that are accurate from an output perspective, our empirical analysis provides rough estimates for the magnitude of hysteresis mechanisms. Specifically, a 1% decrease in unemployment is associated with an approximate 0.5% increase in labour productivity growth and a 0.2% increase in labour supply growth. Additionally, a 1% increase in the capital replacement rate—defined as the sum of the capital stock growth rate and the depreciation rate—correlates with a 0.5% increase in labour productivity growth.

Regarding dynamic stability, the empirical simulations indicate that the stability of steady-state solutions is influenced primarily by certain demand-side parameters. These include the adjustment speed for expected growth (α), and the adjustment speed for the capital-output ratio (λ). Importantly, all scenarios that are most accurate for the Italian economy fall outside the so-called unstable scenarios space. This means these scenarios will gravitate around the path set by the evolution of autonomous demand growth, ensuring stable economic dynamics.
The critical factor ensuring these scenarios remain outside the unstable range is the value of the adjustment speed for expected growth (α). In all accurate scenarios, α is set at 0.95, whereas the range for unstable equilibria lies between 0.75 and 0.81. However, caution is warranted as a value of $\alpha = 0.95$ implies unrealistically long memories of past growth when forming future growth expectations for firms and households, considering growth rates from more than a decade prior.

v. What are the potential policy implications of this research?

Although this research focuses on a simple model, its critical review of the literature, along with its conceptual and methodological approach, provides at least three significant implications for future policy.

First, given the growing body of literature supporting the existence of hysteresis, it is crucial for policymaking institutions to explicitly acknowledge hysteresis mechanisms and incorporate them into the core macroeconomic models used for fiscal policy decisions. This insight is particularly important within the legal and institutional frameworks of E(M)U countries, which currently base national government spending sustainability on a notion of potential output independent of demand-side forces. Policymakers should engage more deeply with the hysteresis debate, identify the relevant hysteresis mechanisms in their contexts, evaluate the necessary assumptions for these mechanisms to function, and integrate them into existing models. This approach can enhance current models by incorporating alternative perspectives that link demand-side and supply-side forces.

Second, a similar approach should be applied to the practices of monetary policymaking institutions. The recent experiences of price instability following the COVID-19 pandemic and the Russian invasion of Ukraine, combined with increasing theoretical and empirical evidence against a clear connection between output dynamics and price movements, present an opportunity to reconsider the role of potential output. Integrating hysteresis into monetary policy discussions would challenge the current view that potential output, determined solely by supply-side factors, acts as an inflationary barrier. This perspective suggests that monetary tightening, such as raising interest rates, has long-term effects by hindering the evolution of potential output.

Third, our analysis highlights the diversity of theoretical interpretations within the economics discipline. While this diversity may not yield straightforward recommendations, it underscores the need for policymakers to openly embrace a plurality of conceptual and methodological perspectives.

Regular discussions about the criteria for evaluating model suitability and exploring how different models, grounded in various theoretical assumptions, interpret the same data can enhance the credibility and effectiveness of policy decisions.

In summary, recognising hysteresis mechanisms, re-evaluating the role of potential output in monetary policy, and embracing a plurality of economic perspectives are essential steps for improving policy formulation and implementation.

vi. What are the key limitations of the proposed analysis, and how should future studies be developed?

The key limitations of the proposed analysis encompass both technical-methodological and conceptual aspects. Technically, the study's accuracy relies on critical assumptions due to the lack of initial data, such as the initial capital-output ratio and expected output growth rate, which might not accurately reflect actual conditions. Future research should include these assumptions in a broader uncertainty analysis to evaluate their impact on model performance. The empirical strategy, though intuitive, may lack the mathematical rigour required for robustness, necessitating expert involvement to refine methods and enhance credibility. Advanced econometric techniques should be employed to derive robust empirical values for model parameters, improving accuracy and reliability.

Additionally, the qualitative method used to determine accurate scenarios might limit robustness. Integrating more sophisticated techniques, such as behaviour-based scenario discovery methods, could provide a nuanced understanding of conditions leading to stable model outputs. The model’s simplicity in evaluating real-world dynamics using yearly data might be overly optimistic. Assessing accuracy based on moving averages of key macroeconomic variables would acknowledge the model’s limitations and focus on longer-term dynamics.

Conceptually, the model fails to optimally represent supply-side dynamics, particularly the stagnation of labour productivity and the evolution of labour supply. Its dependence on exogenous inputs for autonomous demand components limits its ability to replicate real-world demand-side dynamics. Future research should explore the properties and limitations of autonomous demand definitions and critically examine the behavioural assumptions underpinning investment and consumption patterns.

Future research can focus on three key areas. First, expanding the current model by including case-specific factors is essential. For instance, Italy's economic challenges, linked to austerity measures and Eurozone fiscal rules, could be further explored. Additionally, the concept of hysteresis needs further investigation to better understand supply-side dynamics. Including variables like labour protection legislation and financialization proxies could improve accuracy. Moreover, integrating factors such as inequality and ecological constraints is crucial, as they significantly affect long-term sustainable economic growth.

Second, performing a comparative analysis using the same conceptual and empirical approaches on a different model, such as the Solow-Swan model, would yield valuable insights. This would help highlight various approaches to understanding economic growth and reveal the fundamental assumptions underlying these interpretations.

Third, exploring the relationship between economic modelling and policymaking holds significant potential. Investigating how policymakers integrate diverse and competing economic theories could bridge the gap between economic research and practical policy. This could involve interviewing modelling experts at major policymaking institutions to understand their specific needs and how a variety of economic theories can be incorporated into policymaking.

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Appendix A

In macroeconomic discourse, scholars often delineate between supply-side and demand-side factors. However, these distinctions can be abstract, especially for those not deeply immersed in economic theory. This appendix aims to clarify these concepts in a way that is accessible to non-economists, highlighting their importance in both short-run and long-run economic contexts.

Central to the supply side are variables that directly affect an economy's production capacity. These include demographic trends, which determine labour availability, and technological advancements that boost production efficiency. Legal and institutional factors, such as labour market regulations, also play a crucial role in the supply side. They can either facilitate or hinder economic growth.

Conversely, demand-side factors constitute aggregate demand – the total expenditure on an economy's goods and services by households, businesses, governments, and foreign buyers. According to the National Accounting System, aggregate demand (AD) is represented by the equation:

$$AD \equiv C + G + I + E$$

Here, C stands for private consumption, I for private investment, G for government consumption and investment, and E for exports. Aggregate demand matches the supply of domestically produced and imported goods and services, expressed as:

$$AD \equiv GDP + M = Y + M$$

AD ≡ GDP + M = Y + M. In this equation, GDP (or Y) represents the Gross Domestic Product, and M denotes imports, leading to the key macroeconomic identity:

$$Y = C + G + I + E - M$$

Three considerations are crucial here. First, mainstream economics, often guided by Say's Law, suggests that in the long-run, supply naturally creates its own demand. This notion tends to diminish the role of aggregate demand. However, this view is not universally held. Post-Keynesian thought – distinct from New-Keynesian – posits that economies are demand-led in both the short and long run, influencing the supply-side factors of long-run growth (Lavoie, 2022, p. 37).

Second, understanding how economies function over different time scales relies on comprehending the distinction between the short-run and the long-run. In macroeconomics, this distinction involves the flexibility and adjustment of production inputs, known as factors of production, which include capital, labour, and technology. Capital, comprising physical assets like machinery and buildings, is typically fixed in the short-run and cannot be quickly adjusted to market changes. Labor, representing human workforce effort, is more adaptable in the short-run, allowing businesses to adjust employment levels in response to economic shifts. Technology, which encompasses production methods and processes, evolves predominantly in the long-run.

These considerations imply that in the short-run, fixed inputs like capital lead to price and wage rigidity and immediate impacts from economic policies. In the long-run, all inputs, including capital, are variable, facilitating full adjustment to economic conditions and focusing on sustainable growth and equilibrium.

Finally, the division between short and long-run dynamics should not be viewed as representing specific real-world time periods. As Gallo (2022, 2023) suggests, the definition of these periods is model-dependent and varies across sectors due to different levels of input flexibility. Moreover, heterodox economic theories indicate that long-run trends are inherently linked to short-run dynamics. As Kalecki, cited in Lavoie (2022, p. 38), aptly noted, “the long-run trend is but a slowly changing component of a chain of short-period situations; it has no independent entity.

Appendix B: Stylised facts

	1979-1988			1989-1998			1999-2008			2009-2018		
Variable	**Italy**	**Germany**	**France**	**Italy**	**Germany**	**France**	**Italy**	**Germany**	**France**	**Italy**	**Germany**	**France**
Real GDP growth	2.57	-	-	1.62	1.36	1.82	1.23	1.52	2.09	-0.3	1.29	0.95
Potential GDP growth	2.3	-	2.2	1.8	1.93	2.26	0.97	1.35	1.84	-0.11	1.28	0.93
Labour productivity growth	2.72	1.98	1.73	1.63	1.95	1.66	0.83	1.61	1.41	-0.41	1.02	0.48
Unemployment rate	9.22	5.5	8.71	10.92	7.53	11.11	8.54	9.11	8.84	10.54	5.2	9.32
NAWRU	7.83	5.52	6.82	9.25	7.32	8.36	9.29	8.52	9.03	9.48	5	8.9
Employment rate	56.81	-	61.33	56.56	68.57	61.73	62.17	71.68	65.39	62.64	79.53	66.29
Participation rate	61.71	-	66.66	62.73	73.94	68.17	67.49	77.92	71.23	69.5	83.31	73.12
Part-time employment	5.15	12.65	11.02	6.11	15.59	14.28	10.95	22.47	16.93	17.21	27.2	18.31
Involuntary part-time employment	35.67	6.72	-	36.66	8.81	37.4	36.9	17.08	28.79	58.45	14.71	38.27
Public debt-to-GDP ratio	0.7	0.37	0.27	1.06	0.49	0.48	1.03	0.63	0.63	1.29	0.74	0.92
Annual inflation rate	12.04	3.04	8.1	4.57	2.68	2.17	2.42	1.69	1.77	1.27	1.31	1.02

Glossary

Phillips curve is a concept that illustrates a potential inverse relationship between the rate of inflation and the unemployment rate in an economy. It suggests that lower unemployment rates might be associated with higher inflation, and higher unemployment rates might be associated with lower inflation. The relationship depicted by this curve has been subject to debate, particularly during periods such as the 1970s, when both high inflation and high unemployment occurred simultaneously.

Hysteresis in economics refers to the phenomenon where temporary disturbances, such as a recession, can have long-lasting effects on economic variables like unemployment and potential output. The impact of these (demand-side) shocks can persist even after the initial causes have been resolved, leading to prolonged periods of high unemployment or reduced economic growth. This concept highlights the importance of addressing economic downturns effectively to prevent enduring negative effects.

Steady-state equilibrium is a condition where a specific economic variable, such as the growth rate of output, remains constant over time. This implies that the variable is growing at a constant rate without accelerating or decelerating. It is a state where the forces affecting the variable are balanced, allowing it to maintain a stable growth path.

Balanced equilibrium refers to a state in which two or more variables evolve at the same pace over time. This condition indicates that the variables are growing in a synchronized manner, maintaining a consistent relationship with each other. Balanced equilibrium is often used to describe scenarios where different parts of the economy grow at a harmonious rate, ensuring stable and sustainable development.

Dynamic stability refers to an economy's ability to return to a (steady-state) equilibrium after experiencing disturbances or shocks. It involves the process and time it takes for the economy to adjust and revert to equilibrium, emphasizing the resilience and adaptability of the economy in responding to changes.

Static stability, in contrast, describes an economy that remains in equilibrium as long as there are no external disturbances. It does not account for the adjustment process over time if the economy is disturbed. In static stability, any deviation from equilibrium would lead to an immediate return to the original state without considering the dynamics of the adjustment process.

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