Supply Shock, Monetary Policy, and Foreign Investment: The Costa Rican Case

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Abstract

In this article, I examine the impact of global supply disruptions on Latin American economies. I focus on the Costa Rican case to show that foreign investment attraction strategies, nearshoring, and monetary policy jointly explain the country's unusual displays of accelerated growth and deflation shortly after a supply shock. For such purposes, I combine an empirical analysis using aggregate macroeconomic data and a theoretical analysis to rationalize the macroeconomic behavior of a small and open economy with Costa Rica's characteristics. The results indicate that the higher presence of multinational companies, triggered by foreign investment, casts beneficial effects over aggregate productivity, therefore mitigating the effects of supply shocks.

Keywords

Supply Shocks; Investment; Nearshoring; Inflation; Monetary Policy; Costa Rica.

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1. Introduction

After the COVID-19 pandemic, Latin American economies suffered sudden increases in unemployment rates and negative output gaps, while inflation rates upscaled substantially. Such behavior put primary attention to global and local supply factors as the main determinants in the cyclical behavior of the economies after the pandemic. Increases in transportation costs and the surge of armed conflicts between key commodity producers (e.g. Russia and Ukraine) led to cost-push shocks in emerging economies. These may deteriorate an efficient resource allocation in the short term, and economies usually absorb such shocks with a rise in prices and a fall in output. Moreover, Latin American economies are particularly susceptible to amplified effects of supply disruptions due to their strong openness to trade and financial flows.

Despite the predictions of mainstream macroeconomic models (e.g. Galí & Monacelli, 2005), some Latin American economies have experienced accelerated output growth and low inflation shortly after supply disruptions. For instance, Costa Rica's real GDP grew by 5.1% annually in the third quarter of 2023, while annual CPI inflation reached a historically low of -3.3% in August 2023 (BCCR, 2024), and has remained negative by March of 2024. Moreover, Costa Rica pioneered the loosening stage of monetary policy in Latin America after reverting the inflationary pressures by 2023. As of April of 2024, Costa Rica's monetary policy rate is 4.75%, below the fed fund rate. What factors have led to these results? What role has monetary played in the recovery from these shocks?

In this paper, I focus on Costa Rica to argue that this apparent disconnection between theory and empirics can be reconciled once international investment patterns are considered. Costa Rica's investment attraction policies over the last decades have contributed to the country's rapid recovery by promoting growth in new, more productive sectors. Moreover, geopolitical upheavals between the US and China have triggered a phenomenon of *nearshoring* from US firms, which have been moving their production sites to geographically closer countries (Alfaro, 2024). Costa Rica has benefitted from this phenomenon through an acceleration of productivity growth induced by the increasing foreign investment flows which, alongside monetary policy, have counteracted the effects of supply disruptions over output and inflation. The purpose of this essay is to provide evidence supporting the above hypothesis, as well as a theoretical framework that sheds new light on the mechanisms by which the economy has internalized these changes.

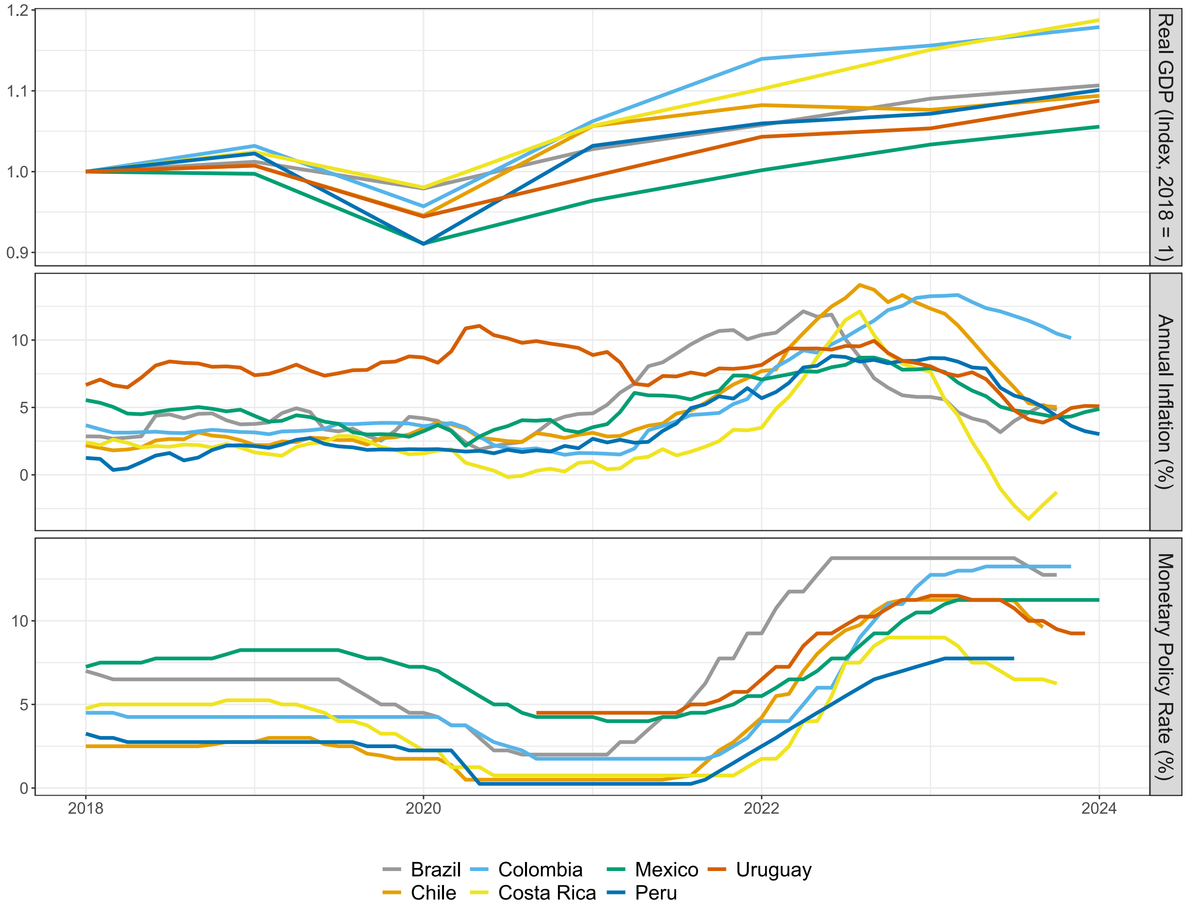
For such purposes, I provide a cross-country descriptive analysis of the impact and reversion of supply disruptions in Latin American economies, as well as monetary policy actions. For the Costa Rican case, I analyze the impact of the identified disruptions on potential output, as it provides a measure of the economy's aggregate supply. Then, I propose a dynamic decomposition framework that identifies the major factors explaining core inflation deviations from its target, to identify the relative importance of supply and demand factors. I use estimates on the real interest rate gap to determine the overall effect of monetary policy over core inflation. Next, I present data on foreign investment, export growth, and manufacturing, showing that investment flows attracted by country's free zone regime have increased throughout the past few years, including the post-pandemic years. Finally, I introduce an endogenous-growth general equilibrium model by adapting Fornaro and Wolf (2023) to a small and open economy in a static setting.

This paper is structured as follows. Section 2 studies the impact and reversion of the supply shocks between 2020 and 2023, as well as the monetary policy actions taken. Section 3 presents data on foreign investment and export growth, and explains possible mechanisms by which they can explain the behavior of the variables studied in section 1. Section 4 introduces a theoretical framework used to rationalize the findings from the previous section, and uses it to model the Costa Rican supply shock case and its recovery. Section 5 concludes.

2. Supply Disruptions in Latin America: Output, Prices, and Monetary Policy

What has been the impact of the global disruptions in the 2020-2023 period on output and inflation for Latin American economies? How have monetary authorities reacted to these disruptions? How have these economies recovered from the shocks? Figure 1 presents data on real GDP, annual CPI inflation, and monetary policy rates to address these questions.

Figure 1. Latin America. Real GDP, Inflation, and Monetary Policy Rates



Source: Author's elaboration using data from FLAR's SIE (2024) and IMF's World Economic Outlook (2023). GDP data for 2023-2024 is based on IMF forecasts. Uruguay's main monetary policy instrument during 2013-2020 was growth in the M1 money supply. Therefore, data on the policy rate is available starting from September 2020.

Standard New Keynesian models predict that, after a negative aggregate supply shock, output falls and prices increase. Conversely, after a negative aggregate demand shock, both output and prices decrease (Garin et al., 2021). Given the unique nature of the pandemic shock, Werning (2024) posits that it is more intuitive to think of demand-pull and cost-push shocks, as they characterize much better economic and monetary policy optimal responses. More precisely, the pandemic initially had a twofold impact. On one side, the implementation of sanitary measures such as lockdowns depressed aggregate demand, pulling inflation down. On the other one, the effects of sanitary measures over factor markets hindered efficient resource allocation, pushing inflation up. As depicted by Figure 1, inflation overall remained stable throughout this period. Throughout the 2021-2022 period, cost-push shocks induced strong inflationary pressures as the economies' demand side slackness started to close. Additionally, in 2022, the Russian-Ukrainian War broke out, and global oil prices rose as a result, further impacting the economies' supply side and generating additional inflationary pressures. As a result, all countries from the region experienced high levels of inflation, with varying levels of persistence.

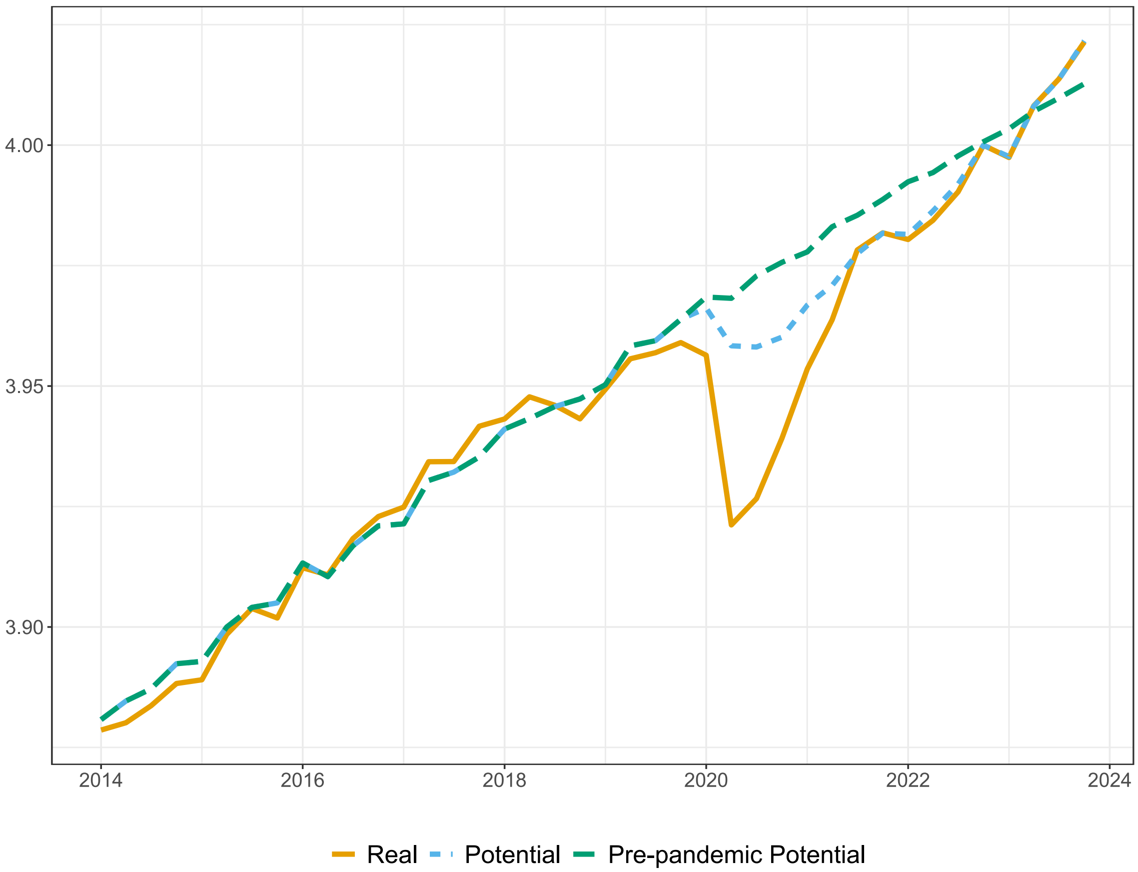
In response to the disruptions described above, monetary policy followed a similar path throughout all economies in the region. Expansionary monetary policy was applied as a response to the pandemic-driven recession, while contractionary monetary policy was implemented to curb inflationary pressures. However, as shown in Figure 1, monetary policy effectiveness in terms of inflation varied greatly across countries: some needed to increase their policy rate to a greater extent to successfully revert the inflationary path induced by cost-push shocks.

There are three significant observations to be made regarding the Costa Rican case. First, the country managed to achieve accelerated levels of output growth shortly after the described demand-pull and cost-push shocks. Second, Costa Rica has achieved the lowest inflation levels in the region, with the annual inflation rate dropping to negative values during 2023. Last, Costa Rica exhibited a sharp disinflationary process despite a relatively moderate effect on its policy rate.

2.1. Supply Disruptions, Output, and Inflation: The Costa Rican Case

To assess the impact of the studied disruptions on the Costa Rican economy's supply side, I follow Rodriguez (2022) by using potential output estimates as an approximation of the economy's production level under an efficient resource allocation, thereby capturing structural factors that influence aggregate supply. Figure 2 shows that Costa Rica experienced a profound negative output gap in 2020. Nonetheless, such a gap closed rapidly, and potential GDP even exceeded the pre-pandemic trend.

Figure 2. Costa Rica: Real and Potential Gross Domestic Product (billions of 2017 chained Costa Rican colones, log scale)

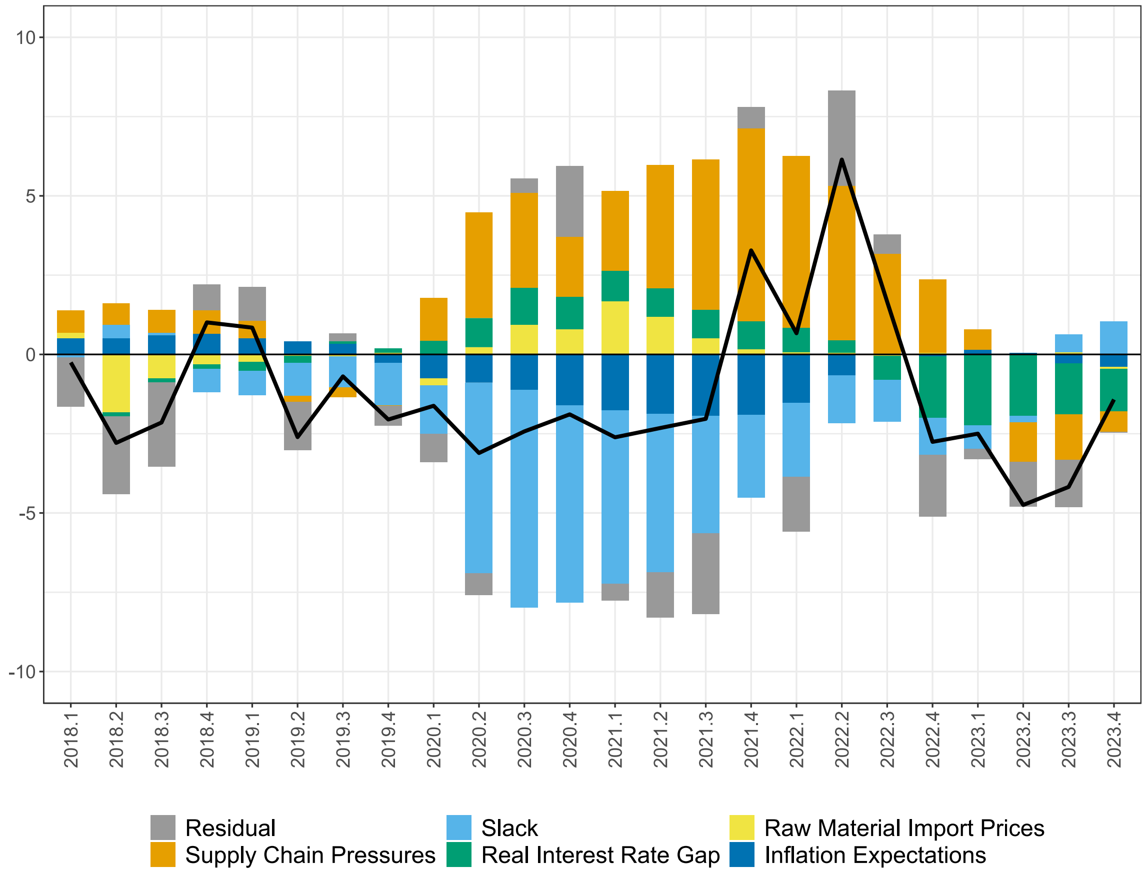


Source: Author's elaboration using data from Central Bank of Costa Rica (BCCR), (2024). The potential GDP series corresponds to official BCCR estimations for their January 2024 Monetary Policy Meetings. To extrapolate the pre-pandemic potential, I use potential GDP data (2014 Q1 to 2019 Q4) in an ARIMA model.

To analyze the main determinants that explained core inflation deviations from the inflation target, I propose a dynamic regression model based on Yellen (2015) and CEA (2023) to capture the relative contribution of clearly intuitive excess demand and cost-push shocks to price stability[1]. Figure 3 showcases the results.

[1] See Appendix 7.1 for a detailed explanation of the model.

Figure 3. Costa Rica: Key Determinants of Core Inflation (percentage point deviation from inflation target)



Source: Author's elaboration using data from BCCR, Federal Reserve Bank of New York (2024) and Garita and Sandoval (2023). Further analysis suggested that most of the remaining residual for 2018-2019 reflected shocks in external prices that negatively affected the CPI, which transmitted their effects to the core CPI.

As discussed in the previous subsection, the pandemic impacted both aggregate demand and supply. Nevertheless, two observations from Figures 2 and 3 suggest that the effects of negative demand-pull shocks were initially more relevant. First, the fall in real output was substantially sharper and more severe than in potential output, leading to a strongly negative output gap. Second, although there were clear supply shocks, increases in raw material import prices, and loosened monetary policy, core inflation remained below the target value. Therefore, the reversion of demand-pull disruptions is also a key determinant in the inflation path observed during the post-pandemic years.

As demand-pull disruptions reversed in 2021 and the output gap closed (see Figure 2), inflationary pressures triggered by cost-push disruptions started to become relatively more important, summarized in Figure 3. Geopolitical tensions such as the Russian-Ukrainian conflict further exacerbated these cost-push shocks, dropping output (as shown in Figure 2) and amplifying the ongoing inflationary process. Consequently, aggressive contractionary monetary policy was taken in response to the increasing inflation levels throughout 2021 and 2022. Monetary policy and cost-push shock reversion account for most of the disinflationary process from 2023.

However, both real and potential output experienced accelerated growth shortly after the disruptions, even managing to surpass pre-pandemic levels. This is particularly unusual given the fact that monetary policy was still following a contractionary path during this period. This suggests that there may have been structural factors that played an important role in Costa Rica's growth path and post-shock recovery, particularly by the end of 2022.

2.2. Monetary Policy After Supply Disruptions in Costa Rica

Like most Central Banks, the Central Bank of Costa Rica (BCCR) has a price stability objective. The monetary policy rate (MPR) is BCCR's main policy instrument, and the country has a managed float exchange rate regime. To evaluate the monetary policy stand throughout the cyclical recovery of Costa Rica's economy, I use the natural rate of interest estimated by Segura (2023), which is defined as the real short-term interest rate expected to prevail when an economy is at full strength and inflation is stable (Holston, et al., 2023). I estimate the real interest rate gap as the difference between the actual real interest rate and the natural interest rate. A positive (negative) real interest rate gap indicates the presence of a contractionary (expansionary) monetary policy.

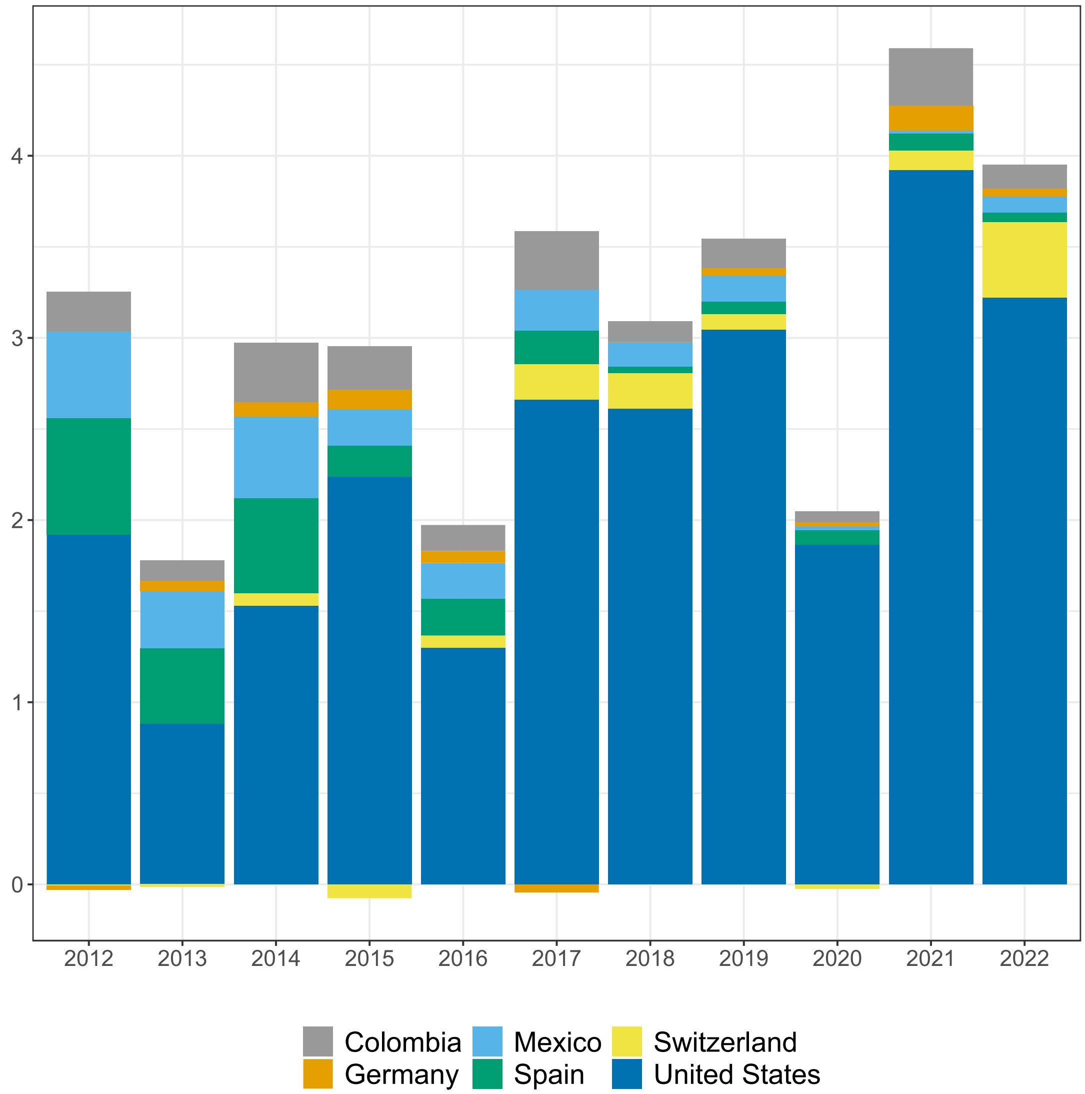
BCCR's immediate response to the pandemic shock was to lower the MPR, to mitigate the adverse effects of the pandemic-induced recession. By lowering the economy's real interest rate, the induced negative real interest rate gap pushed prices to a higher level (see Figure 3). Once the demand slackness closed, cost-push shocks and expansionary monetary policy triggered a spike in inflation. The BCCR reacted with an aggressive increase in the MPR, which successfully deflated the economy. Nonetheless, as shown in Figure 3, inflation went below its target value by an important magnitude, which potentially suggests that monetary policy was excessively contractionary during 2023.

3. Costa Rica: The Role of Investment Attraction Policies in the Recovery from Supply Disruptions

What can explain the accelerated post-shock growth and disinflation? I hypothesize that Costa Rica's foreign investment attraction strategy over the last decades has created opportunities for multinational corporations (MNCs) to settle in the country, beneficially impacting the economy. Müller et al. (2024) call the Costa Rican Economy a "jaguar", comparing it with Asian "tiger" economies from the 1960s, which developed via the accumulation of capital, manufacturing for exports, and the development of human capital.

Undoubtedly, Costa Rica's unique free trade zone policy, introduced in 1995, has played a major role in positioning it as an attractive country for MNCs. The policy offers a differentiated tax regime to all the qualifying companies that invest and operate within the country. Moreover, the US-China trade conflict and geopolitical pressures have introduced additional pressures to global supply chains, for which nearshoring has emerged as an alternative to mitigate the derived risks. This has played in Costa Rica's favor, "enhancing its position as an attractive hub for international trade" (Alfaro, 2024). As reflected in Figure 4, the contribution of foreign investment to GDP grew substantially between 2012 and 2022.

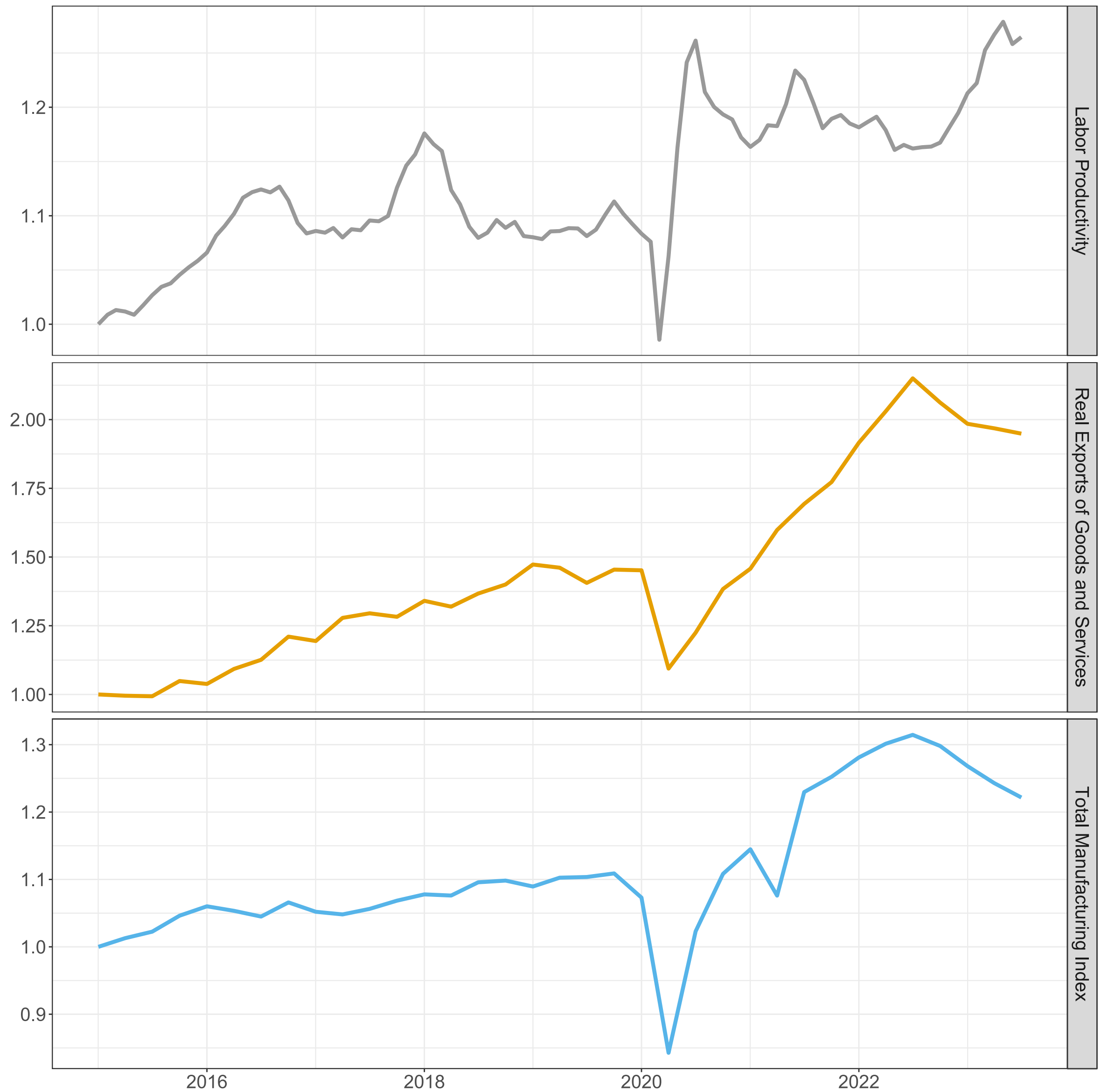
Figure 4. Costa Rica: Foreign Direct Investment Inflows (% of GDP)



Source: Author's elaboration using data from CEPAL (2023) and BCCR (2024).

This development strategy has led to the establishment of new industries (e.g. medical devices). Alfaro (2024) argues the presence of several factors behind the country's industrial expansion: a skilled labor force, political stability, and investment incentives. Figure 5 summarizes the behavior of labor productivity, exports, and manufacturing. Overall, the growing presence of MNCs has increased these variables.

Figure 5. Costa Rica: Labor Productivity, Real Exports and Total Manufacturing (index, 2015 = 1)



Source: Author's elaboration using data from BCCR and OECD (2024). Labor productivity is defined as the ratio between the Monthly Economic Activity Indicator over the occupied labor force.

The entry of multinational firms can beneficially impact aggregate productivity mainly by setting linkages with domestic firms. For instance, domestic producers can supply inputs to MNCs, which favors the integration of the domestic economy into global supply chains. Alfaro-Ureña, Manelici, and Vasquez (2022) use countrywide data tracking firm-to-firm transactions to analyze the effects of becoming a first-time supplier to an MNC. Their results show that, four years after the first sale, domestic firms experience a 4% to 9% growth in total factor productivity (TFP), as well as a higher workforce, and higher sales. Additionally, because of the first MNC sale, domestic firms acquire new and better buyers, which in turn, increases sales to other buyers by 20%.

At a macro level, the TFP increases in domestic firms comprise opposite effects compared to those triggered by negative supply disruptions. The potential output acceleration, given the fact that the labor force has decreased in 2023, suggests an increase in TFP. Therefore, this mechanism, alongside the reversion of supply shocks, provides a plausible explanation for Costa Rica's unusual displays of growth and deflation throughout late 2022 and 2023.

4. A General Equilibrium Framework Rationalizing the Costa Rican Case

To rationalize the previous empirical discussion and provide a theoretical background to my main hypothesis, I present an extension to Fornaro and Wolf's (2023) New Keynesian general equilibrium model. Particularly, I extend the model to a small open economy framework and consider an exogenous investment shock used to emulate the effects of foreign investment on the local economy. The model presents three key elements. First, the small-open economy feature makes it more suited for Latin American economies, as external variables are exogenous to the domestic economy, but can greatly influence its current scenario. Secondly, I endogenize productivity growth, as it depends on firms' investment decisions. Third, nominal wage rigidities allow for deviations of output and employment from their potential level.

The economy displays a discrete infinite time horizon, indexed by $t \in \{0,1,2,\dots\}$, and is inhabited by four agents. A representative household seeks utility maximization by choosing consumption and savings paths, where consumption (C_t) is an index composed of domestic (C_t^H) and imported (C_t^F) final goods. It inelastically supplies hours of labor subject to a labor endowment ($N_t \leq \bar{N}$), and labor yields no disutility. Households are owners of the firms and receive dividends at the end of each period. A representative firm operating in a fully competitive market produces domestic final goods (Y_t^H) using labor and intermediate goods (X_t) subject to the productivity of each factor. A monopolist uses units of domestic final goods to produce intermediate goods and has incentives to invest in its productivity (Γ_t) to increase future profits. Finally, a central bank sets the interest rate to dictate monetary policy.

For simplicity, this essay focuses on permanent disruptions over an initial steady-state equilibrium[2].I also assume foreign consumption (C^*) and prices (P^*) follow a constant path and normalize P^* to be equal to 1.

A steady-state equilibrium consists of a constant path of endogenous variables $\{c, g, \Pi, N, r\}$ that, given the exogenous variables $\{A, c^*, \iota^*\}$, satisfy the following equations[3]:

$$g = \beta(1 + r) \tag{IS}$$

$$g = \beta\big(\kappa(1 + \iota^*)\widehat{\Psi} AN + 1\big) \tag{GG}$$

$$\widehat{\Omega} AN = (1 - \theta)c + \theta c^* + \frac{g - 1}{\kappa(1 + \iota^*)} \tag{MK}$$

$$\Pi = \frac{\bar{g}}{g} \cdot \left(\frac{N}{\overline{\overline{N}}}\right)^{\xi} \tag{PC}$$

$$1 + r = (1 + \bar{r})\left(\frac{N}{\overline{\overline{N}}}\right)^{\phi} \tag{MP}$$

(IS) showcases the household's optimal consumption path evaluated at a steady state, where $g_{t+1} \equiv \frac{\Gamma_{t+1}}{\Gamma_t}$ denotes endogenous productivity growth, r is the real interest rate, and $\beta \in (0,1)$ is the household's subjective discount factor. (GG) rules for the economy's growth, as it showcases the investment optimality condition for the intermediate monopolist, where κ > 0 denotes investment productivity, $\iota^* \geq 0$ is

[2] Variables without a subscript denote time-invariant values.
[3] See Appendix 7.2 for a dynamic version of the model, as well as the micro-foundations and derivations of the steady state equilibrium conditions.

the exogenous foreign investment shock , $A > 0$ is an exogenous labor productivity shock (the "supply shock"), and $\widehat{\Psi}$ is a composite parameter. (MK) is the market clearing condition for the domestic final good, where $c_t \equiv \frac{C_t}{\Gamma_t}$, $c_t^* \equiv \frac{C_t^*}{\Gamma_t}$ denote domestic and foreign consumption normalized by productivity, respectively, and $\theta \in [0,1]$ is an openness parameter. Under equilibrium, the produced units of the domestic final good need to be distributed into domestic consumption, exports, and investment, denoted respectively by each summand on the right-hand side of the equation. (PC) is the Philips Curve that dictates the path of CPI inflation ($\Pi_t \equiv \frac{P_t}{P_{t-1}}$) given unemployment, where $\bar{g}$ is the initial full employment steady state growth and $\xi > 0$. CPI inflation also depends on imported inflation, but the fixed external prices assumption implies that it will be completely determined by domestic factors. Exchange rate evolution, in turn, will be equal to domestic inflation. The central bank follows (MP) to determine monetary policy, where $\bar{r}$ is the initial equilibrium real interest rate and $\phi > 0$. This monetary policy rule, as will be shown, allows deviations from full employment.

Combining (IS) and (MP) summarizes the demand side of the model.

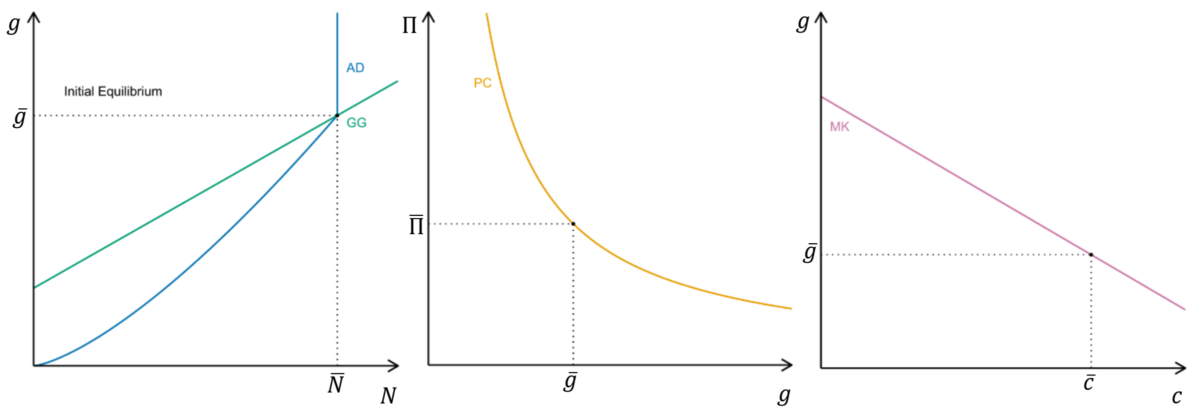
$$g = \beta(1+\bar{r})\left(\frac{N}{\overline{N}}\right)^{\phi} \tag{AD}$$

(AD) establishes a positive relationship between g and N. Intuitively, if productivity growth increases, there is an associated wealth effect, which increases the household's consumption and savings demand, pushing for a rise in employment. The central bank counteracts this effect by raising the interest rate, reestablishing equilibrium in the credit market. Nevertheless, once the economy reaches $\overline{N}$, the employment constraint becomes binding. (GG) also implies a positive relationship between g and N. An increase in employment is associated with an increase in future market sizes, increasing the returns on investment. As a result, firms increase investment, and productivity growth is accelerated. The following subsection characterizes the equilibrium and simulates the Costa Rican case.

4.1. The Costa Rican Disruption Path

Suppose an economy that starts in a full employment steady state[4]. For this essay, I will focus on supply disruptions, refraining from modeling the demand-side shocks associated with the pandemic. Figure 6 represents the initial equilibrium as the intersection of the AD and GG curves $(\bar{N}, \bar{g})$, which in turn, defines the values for $\bar{c}$ and $\bar{\Pi}$ (initially equal to 1).

Figure 6. Initial Equilibrium.



The pandemic-led cost-push shocks dropped exogenous productivity (A) unexpectedly. Graphically, this shifts curve GG downwards, slowing output growth due to lower investment returns derived from a smaller future market. Additionally, a negative wealth effect reduces aggregate demand. The monetary policy rule does not allow the interest rate to adjust to a value that restores full employment, resulting in a lower employment level. Lower employment reduces future market sizes again, which aggravates the initial impact of the supply shock, introducing scarring effects associated with contractionary monetary policy.[5]

The shock comprises two opposite effects of inflation. The increase in unemployment resulting from monetary policy puts downward pressure on prices, while depressed growth increases inflation. For empirical realism, I assume the second effect dominates, such that the overall effect is an increase in inflation. The combined effect of the supply shock and the rise in unemployment importantly

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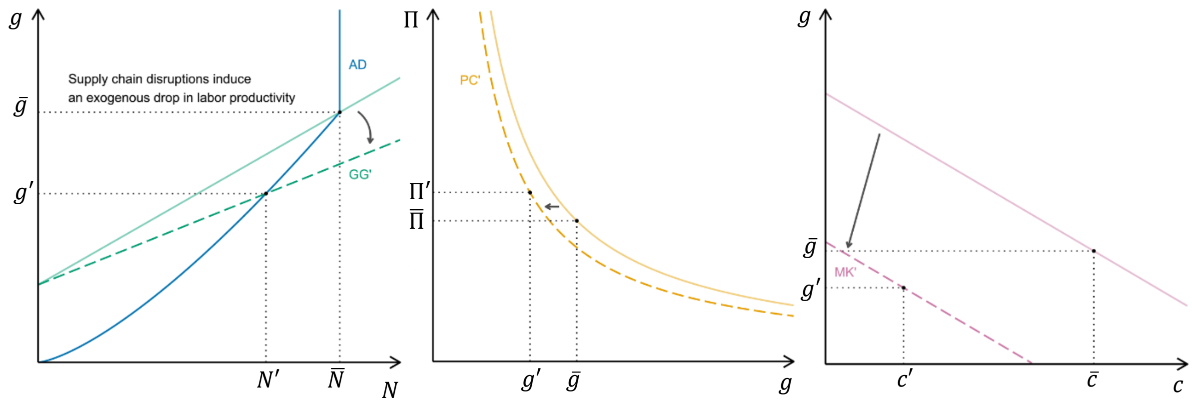
[4] Variables with upper bars denote values on the initial equilibrium, assuming $(\bar{A}, \bar{\iota}^*) = (1, 0)$.
[5] See Fornaro and Wolf (2023) for a detailed analysis on scarring effects.

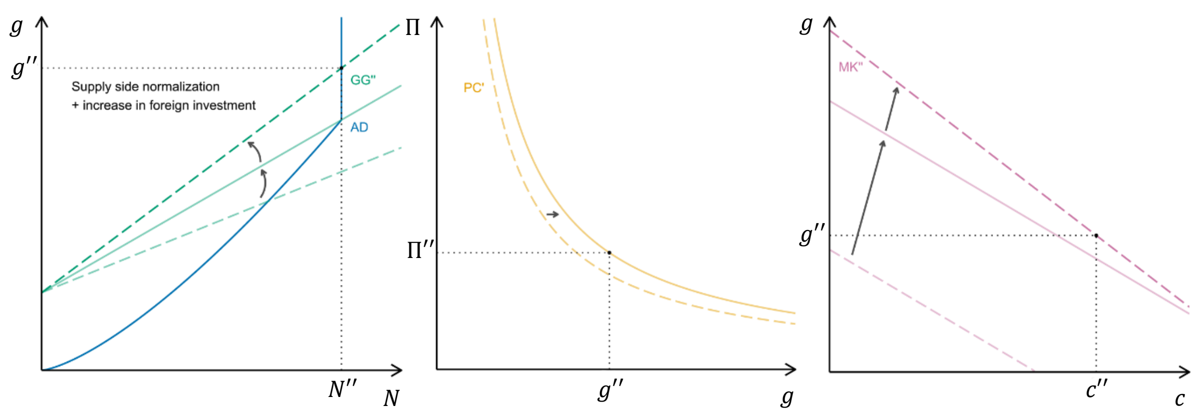
depresses output, which translates into lower consumption given the endogenous productivity. Figure 7 depicts the effects of such shock.

Figure 7. Macroeconomic Implications of Supply Shocks.



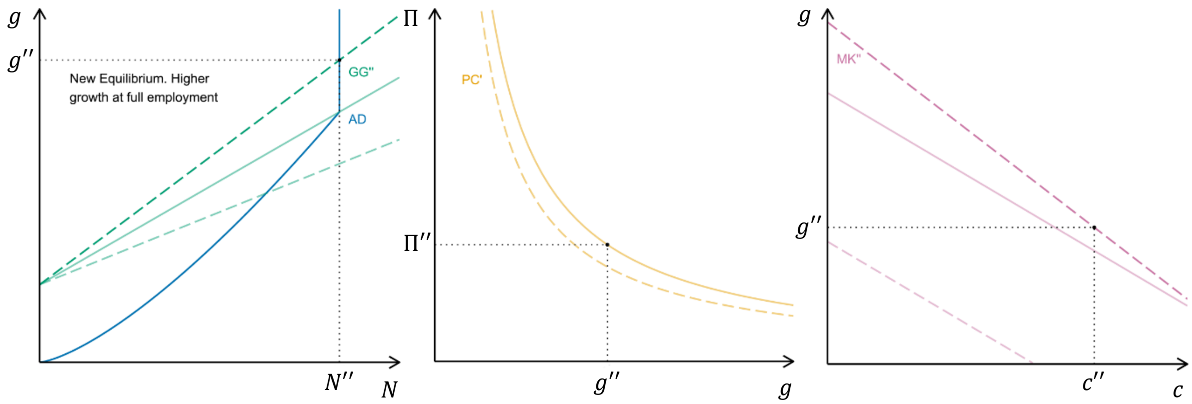
As the impact on the economy's supply side reverses, I assume an unexpected exogenous increase in foreign investment flows by a shift in ι^*. This shock emulates the nearshoring effects since, as discussed previously, they are plausibly exogenous to the Costa Rican economy. The investment shock, as shown in Figure 8, induces a positive shift in (GG), as investment now yields additional returns. It allows for higher growth once the economy has returned to full employment, which in turn, reduces inflation. The model displays a substitution effect that overall reduces c compared to its initial level, although this effect is quantitatively small. Since investment is now more profitable, firms sacrifice paying dividends to invest more.

Figure 8. Supply shock reversion and foreign investment shock.



The model fully accounts for Costa Rica's output and inflation path after the initial supply shock and the seemingly costless disinflation driven by the foreign investment shock. Figure 9 depicts the new equilibrium.

Figure 9. Final Equilibrium.



5. Conclusions and recommendations

In this essay I conclude that once the pandemic-led negative output gaps were closed, supply disruptions triggered inflationary pressures and depressed growth. In consequence, monetary authorities jointly showed contractionary monetary policy responses, despite the remaining slackness inherited from the pandemic. For the Costa Rican case, the analysis suggests that although the pandemic triggered a major fall in potential output, this deviation closed rapidly; and after the inflationary process triggered by global supply chain disruptions, monetary policy played a major role in the disinflationary process. Nonetheless, the importance of fundamental variables for small and open economies, such as foreign investment, is key to understand the cyclical recovery of inflation and output in Latin American economies, particularly the Costa Rican case.

My theoretical analysis shows that the adverse effects of supply shocks are potentially more moderated in small open economies such as Costa Rica in the presence of higher foreign investment flows. Additional to the initial supply shock effects, contractionary monetary policy adversely impacts investment, which has dynamic effects on the economy's growth by reducing future aggregate productivity. However, foreign investment increases domestic investment productivity, which mitigates the growth slowdown induced jointly by contractionary monetary policy and supply disruptions, and therefore reduces the associated effects on endogenous variables.

This paper highlights the importance of understanding key variables in small and open economies, such as foreign investment, to better understand their interaction with economic results. Future research should aim on better understanding how to design monetary policy in emerging markets, to allow for more efficient policy responses to shocks. In this line, extensions of the introduced framework may be useful to capture additional effects associated with these variables.

6. References

Alfaro, L. (2024). *Biomedical Exports and Costa Rica: The Great Reallocation of Global Supply Chains*. Retrieved from ReVista: https://revista.drclas.harvard.edu/biomedical-exports-and-costa-rica-the-great-reallocation-of-global-supply-chains/

Alfaro-Ureña, A., Manelici, I., & Vasquez, J. (2022). The Effects of Joining Multinational Supply Chains: New Evidence from Firm-to-Firm Linkages. *The Quarterly Journal of Economics, 137*(3). doi:10.1093/qje/qjac006

Banco Central de Costa Rica. (2024). *Informe de Política Monetaria - Enero 2024.* San José: Banco Central de Costa Rica.

CEA. (2023). *Disinflation Explanation: Supply, Demand, and their Interaction*. Retrieved from https://www.whitehouse.gov/cea/written-materials/2023/11/30/disinflation-explanation-supply-demand-and-their-interaction/

CEPAL. (2023). *La Inversión Extranjera Directa en América Latina y el Caribe 2023.* Santiago: CEPAL.

Fornaro, L., & Wolf, M. (2023). The scars of supply shocks: Implications for monetary policy. *Journal of Monetary Economics, 140*, S18-S36. doi:10.1016/j.jmoneco.2023.04.003

Galí, J., & Monacelli, T. (2005). Monetary Policy and Exchange Rate Volatility in a Small Open Economy. *Review of Economic Studies, 72*, 707-734.

Garin, J., Lester, R., & Sims, E. (2021). *Intermediate Macroeconomics.*

Garita, J., & Sandoval, C. (2023). *Indicadores de holgura en el mercado laboral costarricense.* BCCR. Documentos de Trabajo. N.º 02 | 2023.

Holston, K., Laubach, T., & Williams, J. (2023). *Measuring the Natural Rate of Interest after COVID-19.* Federal Reserve Bank of New York Staff Reports, no. 1063, June.

IMF. (2022). *World Economic Outlook, April 2022: War Sets Back the Global Recovery.* Washington, DC.

Müller, A., Diaz, P., Martin, L., & Brauer, J. (2004). *Costa Rica Viewpoint. Jaguar economy and the spillovers from export-led growth.* Bank of America Global Research.

PROCOMER. (n.d.). *Free Zone Regime Guide: Special Regimes.* San José: PROCOMER.

Rodríguez, A. (2022). Estimación del producto potencial para Costa Rica. 1995-2021. *Nota técnica N.º 003 | 2022* . Banco Central de Costa Rica.

Segura, C. (2023). *La tasa de interés real neutral en una economía abierta y pequeña: el caso de Costa Rica.* BCCR. Jornadas de Investigación Económica.

Smith, D., Price, j., Rockey, R., & Bohnaker, J. (2023). *U.S. Manufacturing Resurgence? Exploring the Challenges and Factors Driving Onshoring and Nearshoring*. Retrieved from Cushman & Wakefield: https://www.cushmanwakefield.com/en/united-states/insights/exploring-the-challenges-and-factors-driving-onshoring-and-nearshoring#:~:text=Nearshoring%20is%20the%20practice%20of,Costa%20Rica%2C%20Canada%20or%20Mexico.

Werning, I. (2024, April 17). Inflation: Old and New Perspectives. Inter-American Development Bank.

Yellen, J. L. (2015). "Inflation Dynamics and Monetary Policy" speech delivered at The Philip Gamble Memorial Lecture, University of Massachusetts . Amherst, Massachusetts.

7. Appendix

7.1. Multiple Regression Decomposition Model

To decompose the inflation deviations from its target value, I utilize a constrained OLS regression. The resulting estimation is the following:

$$
\begin{aligned}
inflation_t = {} & 0.3951021 \cdot inflation_{t-1} - 0.0461059 \cdot inflation_{t-2} + 0.6510038 \cdot infexp_t \\
& + 1.881026 \cdot slack_t - 0.1642671 \cdot gscpi_t + 0.9454601 \cdot imports_t \\
& + 1.65529 \cdot rirgap_t + \varepsilon_t
\end{aligned}
$$

Where $inflation$ is the quarterly annualized core CPI inflation deviation from 3 percentage points, $infexp$ are the deviations of 60-month CPI inflation expectations from the 3 p.p. target value, taken from BCCR's survey; $slack$ is the unemployment gap, which was built using estimates on the natural unemployment rate based on Garita and Sandoval (2023), $gscpi$ is the Federal Reserve Bank of New York's Global Supply Chain Pressures Index, $imports$ are relative raw material import prices inflation relative to CPI inflation, and $rirgap$ are BCCR's estimates on the real interest rate gap, and ε_t are the error terms. The model is constrained such that the coefficients on inflation lagged values and inflation expectations add up to 1. To estimate the model, data from 2010 to 2023 is used. To determine the specific contribution of each factor, each explanatory variable is set to 0 and the model is simulated. To capture the dynamic effects of each component, lags are taken from the simulated values, instead of the actual values. Finally, the difference between actual and simulated values corresponds to each factor's contribution.

7.2. A Small Open Economy Model with Nominal Wage Rigidities, Endogenous Technological Growth and Foreign Investment Shocks

The following appendix presents the full theoretical framework used to rationalize the findings from section 2. It extends Fornaro and Wolf (2023) by incorporating a two-country economy, and an exogenous investment shock, which is used to emulate the effects of the Free Zone Regime in Costa Rica. The time horizon is infinite, with each period being indexed by $t \in \{0,1,2,\dots\}$. The economy is inhabited by domestic and foreign households and firms, as well as a domestic central bank that sets monetary policy. Perfect foresight is assumed.

7.2.1. **Households**

In each country, the representative household is endowed with $\bar{N}$ units of labor and inelastically supplies $N_t \leq \bar{N}$ units on the market. It faces the following problem:

$$\max_{\{C_t, B_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \, log C_t \quad s.t. \; P_t C_t + \frac{B_{t+1}}{1+i_t} = W_t N_t + B_t + D_t,$$

where $\beta \in (0,1)$ is the subjective discount factor, B_{t+1} is the nominal payoff in period $t+1$ of a one-period bond held from period t, i_t is the nominal interest rate, W_t is the nominal wage, and D_t denotes the dividends from the ownership of firms. For simplification, I assume the household only has access to domestic bonds.

C_t is a composite consumption index and P_t is the CPI, defined respectively by[6]

$$C_t \equiv \frac{(C_t^H)^{1-\theta}(C_t^F)^{\theta}}{\theta^{\theta}(1-\theta)^{1-\theta}} \; ; \; P_t \equiv (P_t^H)^{1-\theta}(P_t^F)^{\theta},$$

where $\theta \in (0,1)$ is an index of openness. The household statically seeks to maximize its consumption index. Equalizing the marginal rate of substitution with the price ratio and solving for C_t^F yields the optimality condition $C_t^F = \frac{\theta}{1-\theta}\frac{P_t^H}{P_t^F} \cdot C_t^H$. Injecting it into the consumption index and solving for C_t^H, and then obtaining C_t^F from the

[6] Gali and Monacelli (2005), taking the substitutability parameter equal to 1.

optimality condition, yields the following optimal allocation between foreign and domestic goods.

$$C_t^H = (1-\theta)\frac{P_t}{P_t^H}C_t \;\; ; \; C_t^F = \theta\frac{P_t}{P_t^F}C_t.$$

The Bellman Equation associated to the household's problem is

$$V(B_t) = \max_{\{C_t, B_{t+1}\}} \beta^t \left[\log C_t + \lambda_{C,t}\left(W_t N_t + B_t + D_t - P_t C_t - \tfrac{B_{t+1}}{1+i_t}\right) + \ \beta V(B_{t+1})\right],$$

where $\lambda_{C,t}$ is the Lagrange multiplier of the budget constraint in period t. Applying the Benveniste-Scheinkman Theorem, the first order conditions and the envelope conditions are, respectively:

$$\frac{\partial V(B_t)}{\partial C_t} = \frac{\beta^t}{Ct} - \beta^t\lambda_t P_t = 0,$$

$$\frac{\partial V(B_t)}{\partial B_{t+1}} = \frac{-\beta^t\lambda_t}{1+i_t} + \beta V'(B_{t+1}) = 0,$$

$$V'(B_{t+1}) = \beta^t\lambda_{t+1}.$$

The transversality condition ($\lim_{T\to\infty} \beta^T\lambda_T B_{T+1} = 0$) prevents the household from engaging in Ponzi-schemes and reflects the fact that it is not optimal for the household to collect assets Combining the tree equations yields the Euler equation.

$$C_t = \frac{\Pi_{t+1}C_{t+1}}{\beta(1+i_t)},$$

(M.1)

where $\Pi_t \equiv \frac{P_t}{P_{t-1}}$ denotes CPI inflation. Let $1 + r_t \equiv \frac{1+i_t}{\Pi_{t+1}}$ be the real interest rate.

7.2.2. **Final Good Firms**

Domestic final goods (Y_t^H) are produced by firms under a fully competitive market using labor and an intermediate input X_t. Output is given by the following production function:

$$Y_t^H = (A_t N_t)^{1-\alpha}(\Gamma_t^{1-\alpha} X_t^{\alpha})$$

(M.2)

where $\alpha \in (0,1)$, Γ_t is the quality of the intermediate input. A_t is productivity shock that captures disruptions in labor productivity that are not related to firm's investment. Final good firms statically select the optimal combination of production factors (N_t, X_t) to maximize profits $P_t^H (A_t N_t)^{1-\alpha} \Gamma_t^{1-\alpha} X_t^{\alpha} - W_t N_t - P_{X,t} X_t$, which yields the following factor demands:

$$(1-\alpha) P_t^H A_t^{1-\alpha} N_t^{-\alpha} \Gamma_t^{1-\alpha} X_t^{\alpha} = W_t$$

(M.3)

$$\alpha P_t^H (A_t N_t)^{1-\alpha} \Gamma_t^{1-\alpha} X_t^{\alpha-1} = P_{X,t},$$

(M.4)

where $P_{X,t}$ is the nominal price of the intermediate input. Since final good firms operate in a fully competitive market, their profits are equal to 0.

7.2.3. **Intermediate Input Firm**

Intermediate input X_t is produced by a monopolist using a single unit of the domestic final good. It chooses $P_{X,t}$ to maximize profits $\left(P_{X,t} - P_t^H\right) X_t$ subject to the final good firms demand for X_t (M.7). Optimal price setting implies $P_{X,t} = \frac{1}{\alpha} P_t^H$, implying that the produced quantity is

$$X_t = \alpha^{\frac{2}{1-\alpha}} A_t N_t \Gamma_t.$$

(M.5)

Therefore, monopolist's profits at period t are $D_{X,t} = \widehat{\Psi} P_t A_t N_t \Gamma_t$, where $\widehat{\Psi} \equiv \left(\frac{1}{\alpha} - 1\right) \alpha^{\frac{2}{1-\alpha}}$. Notice that profits are increasing in Γ_t.

7.2.4. Investment and Productivity Growth

The intermediate sector monopolist can invest to improve its good's quality, which evolves by the following rule:

$$\Gamma_{t+1} = \Gamma_t + \kappa(1 + \iota_t^*) I_t, \tag{M.6}$$

where $\kappa > 0$ is the productivity of investment, I_t is the firm's investment in period t (in units of domestic final good), and ι_t^* is an exogenous investment shock, which will be used to emulate the results of the free zone regime in Costa Rica. Intuitively, foreign firms introduce new technology that was previously unavailable in the country, therefore boosting the increase in productivity. I_t is chosen to maximize the discounted stream of real profits minus investment costs

$$\sum_{t=0}^{\infty} \prod_{j=0}^{\infty} \frac{1}{1 + r_{j-1}} [\, \Psi A_t N_t \Gamma_t - I_t \,],$$

subject to (M.6) and given $\Gamma_0 > 0$.

Notice that, by the Euler equation $\prod_{j=0}^{t} \frac{1}{1+r_{j-1}} = \prod_{j=0}^{t} \frac{\beta C_{j-1}}{C_j} = \beta^t \frac{C_0}{C_t}$. Injecting (M.6), the firm's problem defines the following Bellman equation (assuming investment is always positive):

$$V(\Gamma_t) = \max_{\Gamma_{t+1}} \left\{ \beta^t \frac{C_0}{C_t} \left[\widehat{\Psi} A_t N_t \Gamma_t - \frac{1}{\kappa(1 + \iota_t^*)} (\Gamma_{t+1} - \Gamma_t) \right] + \beta V(\Gamma_{t+1}) \right\}.$$

Applying the Benveniste-Scheinkman Theorem, the first order condition and the envelope condition are, respectively:

$$\frac{\partial V(\Gamma_t)}{\partial \Gamma_{t+1}} = -\beta^t \frac{C_0}{C_t} \cdot \frac{1}{\kappa(1+\iota_t^*)} + \beta V'(\Gamma_{t+1}) = 0,$$

$$V'(\Gamma_{t+1}) = \beta^t \frac{C_0}{C_{t+1}} \left(\Psi A_{t+1} N_{t+1} + \frac{1}{\kappa(1+\iota_t^*)} \right).$$

Combining these equations yields the investment optimality condition:

$$\frac{1}{\kappa(1+\iota_t^*)} = \beta \frac{C_t}{C_{t+1}} \left[\widehat{\Psi} A_{t+1} N_{t+1} + \frac{1}{\kappa(1+\iota_t^*)} \right].$$

(M.7)

Intuitively, investment is chosen such that its marginal cost equals its discounted marginal benefit. Let $g_t \equiv \frac{\Gamma_t}{\Gamma_{t-1}}$ denote productivity growth in period t.

7.2.5. Rest of the World

Foreign variables are assumed to be exogenous. Since foreign households are assumed to have the same preferences as domestic ones, the foreign Euler equation and demand for home goods (C_t^{H*}) are given by[7]:

$$C_t^* = \frac{\Pi_{t+1}^* C_{t+1}^*}{\beta(1+i_t^*)}$$

(M.8)

$$C_t^{H*} = \theta \cdot \frac{P_t^*}{P_t^{H*}} \cdot C_t^*.$$

(M.9)

We assume that the law of one price holds:

$$P_t^F = \varepsilon_t P_t^*;\ P_t^H = \varepsilon_t P_t^{H*},$$

(M.10)

[7] Variables with "*" superscript denote variables for the rest of the world.

where ε_t denotes the nominal exchange rate in units of domestic currency per unit of foreign currency. Applying the law of one price to the definition of the CPI, a relationship between domestic, foreign, and CPI inflation can be established:

$$\Pi_t = (\Pi_t^H)^{1-\theta} \left[\left(\frac{\varepsilon_t}{\varepsilon_{t-1}} \right) \Pi_t^* \right]^{\theta}.$$

(M.11)

7.2.6. Nominal Rigidities

Nominal rigidities are introduced in the model by adding frictions in nominal wage adjustment, to create involuntary unemployment and to break monetary policy neutrality. Nominal wages evolve according to the following rule:

$$\frac{W_t}{W_{t-1}} = \bar{g} \left(\frac{N_t}{\bar{N}} \right)^{\xi},$$

(M.12)

where $\xi > 0$, and $\bar{g}$ is the full employment steady state productivity growth.

Combining the definition of the CPI, (M.3), (M.11), and (M.12) yields the Philips curve:

$$\Pi_t = \left[\frac{\bar{g}}{g_t} \cdot \frac{A_{t-1}}{A_t} \cdot \left(\frac{N_t}{\bar{N}} \right)^{\xi} \right]^{1-\theta} \left[\left(\frac{\varepsilon_t}{\varepsilon_{t-1}} \right) \Pi_t^* \right]^{\theta}$$

(PC)

7.2.7. **Monetary Policy**

Central Bank controls i_t to stabilize CPI inflation around its full employment steady state value $\bar{\Pi}$:

$$1 + i_t = (1 + \bar{r}) \left(\frac{\Pi_t}{\bar{\Pi}} \right)^{\phi} \Pi_{t+1},$$

(MP)

where $\phi > 0$ and $\bar{r}$ is the neutral interest rate.

7.2.8. Aggregation and Market Clearing

Market clearing for the domestic final good implies that, by combining the optimal consumption of domestic goods, (M.9), and (M.10),

$$Y_t^H - X_t \ = \ C_t^H + C_t^{H*} + I_t \ = \ (1-\theta)\left(\frac{\varepsilon_t P_t^*}{P_t^H}\right)^{\theta} C_t + \theta\left(\frac{\varepsilon_t P_t^*}{P_t^H}\right) C_t^* + I_t.$$

(M.13)

The left-hand side of the equation is the GDP of the home economy, which can also be written, by combining (M.2) and (M.5), as

$$\Rightarrow Y_t^H - X_t = \ \hat{\Omega} A_t N_t \Gamma_t,$$

(M.14)

where $\hat{\Omega} \equiv \alpha^{\frac{2\alpha}{1-\alpha}} - \ \alpha^{\frac{2}{1-\alpha}}$.

Labor market clearing condition is $N_t \leq \overline{N}$, and $\overline{N} - N_t$ is the unemployment rate.

7.2.9. Equilibrium

The equilibrium path of the model is defined as the set of sequences $\{g_{t+1}, c_t, P_t, N_t, i_t, \varepsilon_t\}_{t=0}^{\infty}$ given the exogenous sequences $\{A_t, I_t^*, c_t^*, P_t^*\}_{t=0}^{\infty}$ and the initial conditions $\{\Pi_{-1}, A_{-1}, I_{-1}^*, C_{-1}^*, \Pi_{-1}^*\}$ satisfying $0 \leq N_t \leq \overline{N},\ g_{t+1} > 1, c_t > 0$ for all $t \geq 0$, as well as the following:

$$c_t = \frac{g_{t+1} c_{t+1}}{\beta(1+r_t)}$$

(IS)

$$g_{t+1} = \beta \frac{c_t}{c_{t+1}} \left(\kappa(1+\iota_t^*)\hat{\Psi} A_{t+1} N_{t+1} + 1\right)$$

(GG)

$$\hat{\Omega} A_t N_t = (1-\theta)\left(\frac{\varepsilon_t P_t^*}{P_t^H}\right)^{\theta} c_t + \theta\left(\frac{\varepsilon_t P_t^*}{P_t^H}\right) c_t^* + \frac{g_{t+1} - 1}{\kappa(1+\iota_t^*)}$$

(MK)

$$\Pi_t = \left[\frac{\bar{g}}{g_t} \cdot \frac{A_{t-1}}{A_t} \cdot \left(\frac{N_t}{\overline{N}}\right)^{\xi}\right]^{1-\theta} [E_t \Pi_t^*]^{\theta}$$

(PC)

$$1 + r_t = (1 + \bar{r})\left(\frac{N_t}{\bar{N}}\right)^{\phi}$$

(MP)

$$\Pi_t^F = E_t \Pi_t^*;\ \Pi_t^H = E_t \Pi_t^{H*}$$

(LP)

(IS) represents the consumer's decisions regarding consumption and savings. It showcases the path of consumption normalized by productivity ($c_t \equiv \frac{C_t}{\Gamma_t}$) given inflation, the nominal interest rate, the household's subjective discount factor and productivity growth. (GG) showcases the optimality conditions for the intermediate sector monopolist's investment, therefore ruling for the economy's growth. Intuitively, growth is increasing in real future monopoly profits), as they incentive higher investment, investment productivity, the discount factor, and foreign investment). At the same time, growth depends inversely on normalized consumption growth, as resources destined for investment will be transferred to the households as dividends if consumption demand increases. (MK) is the market clearing condition for the domestic final good, normalized by productivity. It states that, under equilibrium, the produced units of final good need to be distributed into domestic consumption, exports, and investment, denoted respectively by each summand. (MP) dictates the monetary policy rule. The central bank will adjust the nominal interest rate to ensure full employment, where $\bar{r}$ is the neutral interest rate. Finally, (LP) is the traditional law of one price for the foreign and domestic goods respectively, where Π_t^{H*} is the price of domestic goods in the foreign economy (assumed to be constant). It states that goods must have the same price globally to prevent arbitrage. Therefore, it dictates the path of the nominal exchange rate.

A steady state is defined as constant values for $\{g_{t+1}, c_t, \Pi_t, N_t, i_t, E_t, A_t\}_{t=0}^{\infty}$ that satisfy the above equations. Moreover, the initial full employment steady state[8] is a steady state satisfying $N = \bar{N}$, where the exogenous productivity is normalized to $\bar{A} = 1$ and $\overline{\iota^*} = 0$.

[8] Variables in this state will be denoted with an upper bar.