International Journal of Research - GRANTHAALAYAH
January 2026 14(1)
www.granthaalayah.com

Original Article

NOMINAL IMMISERIZING GROWTH: TECHNOLOGICAL PROGRESS, DEFLATION, AND FOREIGN CURRENCY ACCUMULATION

Yasunori Fujita [1*]
[1] Keio University, Japan

ABSTRACT

This paper develops a simple domestic macroeconomic model to examine how technological progress can generate immiserizing growth in nominal terms. While productivity improvements typically raise real output, the model shows that technological progress may sharply reduce prices when the price elasticity of demand is sufficiently low. As a result, the GDP deflator declines and nominal GDP falls over time despite continuous growth in real output. The analysis further demonstrates that declining nominal income leads to an expansion of foreign currency transactions, as domestic expenditure on goods decreases. By explicitly focusing on nominal GDP and price dynamics rather than real output alone, this paper provides a new interpretation of immiserizing growth and highlights an overlooked channel linking technological progress, deflation, and foreign currency accumulation.

Keywords: Immiserizing Growth, Domestic Macroeconomy, Technological Progress, Nominal GDP, Foreign Currency

INTRODUCTION

Technological progress is typically regarded as a fundamental source of economic growth and improved living standards. In standard growth models, productivity improvements raise real output and consumption, thereby enhancing social welfare. However, a long-standing tradition in international economics has emphasized that economic growth need not be unambiguously beneficial when it induces adverse price movements. The seminal contribution by Bhagwati et al. (1958) shows that growth can reduce welfare if it leads to a sufficiently large deterioration in relative prices, a phenomenon known as immiserizing growth.

Closely related to this insight is the observation that changes in relative prices generate a wedge between production-based measures of output and income-based indicators. In open economies, real GDP does not necessarily capture changes in purchasing power when export and import prices move. Kohli et al. (2004) demonstrates that real domestic income may diverge substantially from real GDP due to terms-of-trade effects, while Kehoe and Ruhl (2008) and Reinsdorf et al. (2010) emphasize central role of deflators in shaping both real and nominal income dynamics. These studies suggest that price movements are not merely a secondary feature of growth but can fundamentally alter the interpretation of macroeconomic performance.

A further strand of research focuses specifically on the accumulation of foreign exchange reserves and official foreign assets. Aizenman and Lee (2007) distinguish precautionary motives from mercantilist motives, while policy-oriented studies by the International Monetary Fund. (2011) and the European Central Bank. (2006) highlight the macroeconomic costs of sustained reserve accumulation, particularly under sterilized intervention. More recently, Adler et al. (2019) document systematic patterns of foreign

*Corresponding Author:
Email address: Yasunori Fujita (yfujita@econ.keio.ac.jp)

Received: 09 November 2026; **Accepted:** 29 December 2026; **Published** 22 January 2026
DOI: 10.29121/granthaalayah.v14.i1.2026.6594
Page Number: 44-48
Journal Title: International Journal of Research -GRANTHAALAYAH
Journal Abbreviation: Int. J. Res. Granthaalayah
Online ISSN: 2350-0530, **Print ISSN:** 2394-3629
Publisher: Granthaalayah Publications and Printers, India
Conflict of Interests: The authors declare that they have no competing interests.
Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Authors' Contributions: Each author made an equal contribution to the conception and design of the study. All authors have reviewed and approved the final version of the manuscript for publication.
Transparency: The authors affirm that this manuscript presents an honest, accurate, and transparent account of the study. All essential aspects have been included, and any deviations from the original study plan have been clearly explained. The writing process strictly adhered to established ethical standards.

exchange intervention and show how such policies affect inflation and monetary conditions. These contributions indicate that rising foreign currency holdings may coexist with disinflationary or deflationary pressures. At the same time, modern macroeconomic research has increasingly linked technological progress and globalization to persistently low inflation. Studies such as Gopinath et al. (2015) and Forbes et al. (2019) argue that global competition and technological innovation weaken pricing power and flatten Phillips curves, generating sustained downward pressure on prices.

Despite these advances, most existing studies focus primarily on real variables—such as real GDP, productivity, or welfare—and treat nominal aggregates as secondary. In particular, mechanism through which technological progress lowers the GDP deflator, thereby reducing nominal GDP even as real output expands, has received relatively little attention in formal dynamic models. Moreover, interaction between deflationary price dynamics and accumulation of foreign assets has not been fully explored in a parsimonious theoretical framework.

This paper contributes to the literature by extending Fujita et al. (2025) and developing a simple domestic macroeconomic model that explicitly incorporates foreign currency transactions. The model abstracts from goods trade and instead focuses on interaction between technological progress, price formation, nominal income, and foreign currency purchases. We show that when the price elasticity of demand is sufficiently low, technological progress leads to a sharp decline in prices, causing nominal GDP to fall over time even as real output grows. At the same time, trading volume of foreign currency increases as nominal income is reallocated away from domestic goods expenditure. This mechanism provides a new interpretation of immiserizing growth in nominal terms.

The remainder of the paper is organized as follows. Section 2 presents the basic model. Section 3 analyzes the conditions under which technological progress generates immiserizing growth and increased foreign currency transactions. Section 4 concludes.

BASIC MODEL

Let us consider a domestic macroeconomic economy in which goods and foreign currency are traded using money. Let Y(t), F(t), and M(t) denote the transaction volume of goods, foreign currency purchases in domestic currency terms, and money supply in period t, respectively.

We assume that foreign currency is only purchased and not sold during the periods under consideration. This assumption captures a situation in which households and firms accumulate foreign assets as a store of value under persistent domestic price declines. In addition, output produced in period t-1 constitutes income in period t. Let P(t) denote the price of goods in period t. Then, total income in period t, which is equal to the money supply M(t), is given by

$$M(t) = P(t-1)Y(t-1). \qquad (1)$$

This formulation relies on the principle of three-sided equivalence, according to which production GDP equals distribution GDP.

We further assume that total income in period t, M(t), is fully spent on goods and foreign currency purchases within the same period. Since expenditure on goods in period tis P(t)Y(t) and expenditure on foreign currency in domestic currency terms is F(t), budget constraint in period t is expressed as

$$M(t) = P(t)Y(t) + F(t). \qquad (2)$$

Demand for goods in period t is assumed to increase with disposable income net of foreign currency purchases, M(t)-F(t), and to decrease with the price level P(t). Accordingly, demand function for goods, Y^D (t), is specified as

$$Y^D(t) = \frac{A + c(M(t) - F(t))}{P(t)^{\varepsilon}}, \qquad (3)$$

where A is a positive constant, ε is a positive constant that expresses price elasticity of demand, and c is a marginal propensity to consume that satisfies 0<c<1.

On the supply side, output grows at a constant rate g due to technological progress. Letting Y_0 denote initial output, supply of goods in period t, Y^S (t), is given by

$$Y^S(t) = (1+g)^{t-1}Y_0. \qquad (4)$$

We assume full employment and market clearing in every period, so that goods demand equals goods supply, Y^D (t)=Y^S (t)=Y(t). Therefore, the equilibrium condition is written as

$$(1+g)^{t-1}Y_0 = \frac{A + c\big(M(t) - F(t)\big)}{P(t)^{\varepsilon}}. \qquad (5)$$

TECHNOLOGICAL PROGRESS, IMMISERIZING GROWTH AND TRADING VOLUME OF FOREIGN CURRENCY

We are now ready to derive the condition under which the economy in this paper exhibits immiserizing growth.

First, substituting equation (2) into equation (5) and rearranging terms yield

$$(P(t)(1+g))^{t-1}Y_0 = \frac{A}{P(t)^{\varepsilon-1}-c}. \qquad (6)$$

Since the left-hand side of equation (6) represents nominal GDP in period t, it follows that nominal GDP is negatively related to P(t)^(ε-1)-c. Specifically, if P(t)^(ε-1)-c increases over time, nominal GDP decreases, whereas if P(t)^(ε-1)-c decreases over time, nominal GDP increases.

Equation (6) can also be rewritten to determine the price level P(t) as

$$P(t)(P(t)^{\varepsilon-1}-c) = \frac{A}{(1+g)^{t-1}Y_0}. \qquad (7)$$

When ε<1, Figure 1(i) illustrates that equation (7) admits two solutions for P(t), denoted by points A and B. Let the right-hand side of equation (7) be denoted by R. Taking the total differential of equation (7), we obtain

$$(\varepsilon P(t)^{\varepsilon-1}-c)\,dP = dR. \qquad (8)$$

At point A, the condition εP(t)^(ε-1)-c>0 holds. Hence, a small increase in the price raises the left-hand side of equation (8), implying that P(t) must decrease to restore equality. This confirms that point A is a stable equilibrium.

In contrast, at point B, the condition εP(t)^(ε-1)-c<0 holds. In this case, a small increase in the price lowers the left-hand side of equation (8), implying that P(t) must increase further to satisfy the equation. Therefore, point B is an unstable equilibrium.

In what follows, we focus on the stable equilibrium at point A and adopt it as the equilibrium price level.

Figure 1

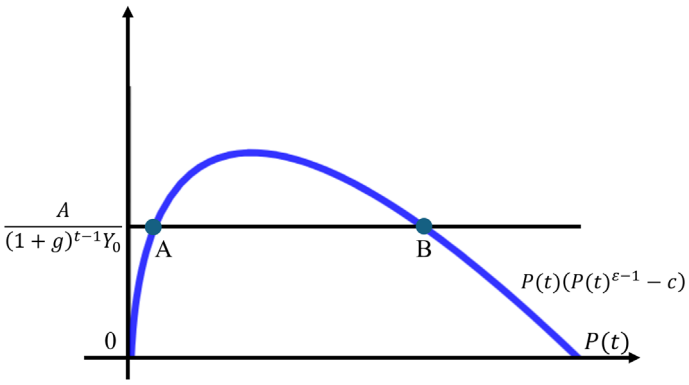

Figure 1 (a) Determination of the Equilibrium Price P(t)when ε<1

In contrast, when ε>1, Figure 1(ii) shows that P(t) is uniquely determined at point A and exhibits stable behavior.

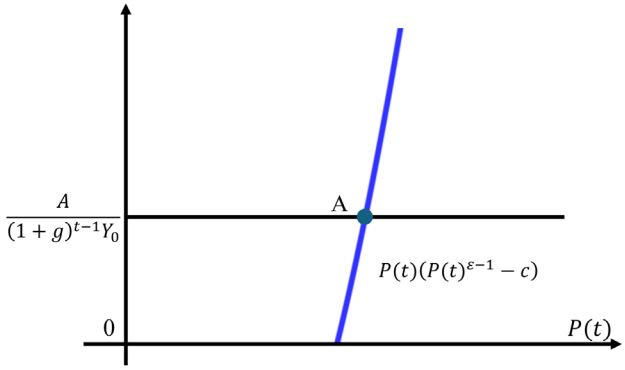

Figure 1 (b) Determination of the Equilibrium Price P(t)when ε>1

Since $\frac{A}{(1+g)^{t-1}Y_0}$ decreases over time, from Figures 1(i) and 1(ii), we obtain the following Lemma 1.

Lemma 1.

Suppose that the supply of goods grows over time due to technological progress.

Regardless of whether ε<1or ε>1, the equilibrium price P(t) decreases monotonically over time.

Graph of (6), on the other hand, is depicted as an increasing curve as in Figure 2(i) if ε<1.

Figure 2

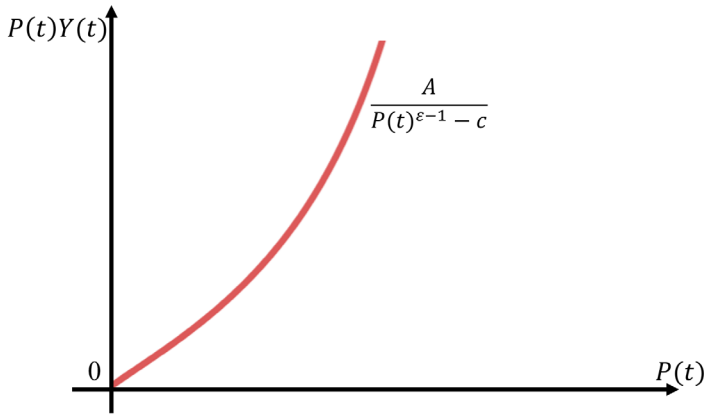

Figure 2 (a) Dynamics of Nominal GDP P(t)Y(t)when ε<1.

As prices decline in response to technological progress, nominal GDP decreases over time, illustrating Lemma 2(i).

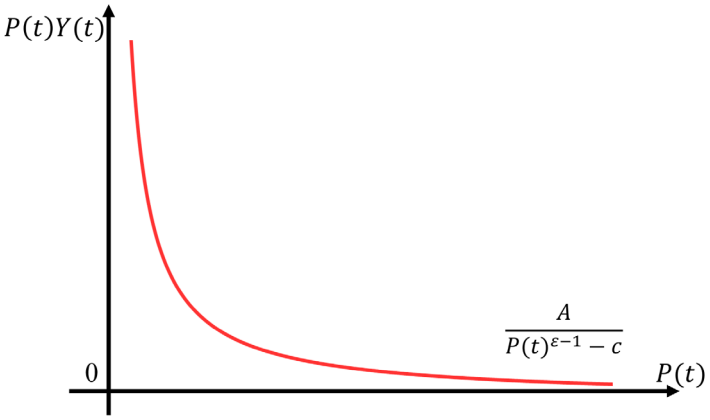

Figure 2 (b) Dynamics of Nominal GDP P(t)Y(t)when ε>1

As prices decline in response to technological progress, nominal GDP increases over time, illustrating Lemma 2(ii).

Figures 2(i) and 2(ii), in conjunction with Lemma 1, lead to the following result, stated as Lemma 2.

Lemma 2.

(i)If ε<1, technological progress induces a monotonic decline in nominal GDP, P(t)Y(t), despite continuous growth in real output.

(ii)If ε>1, technological progress induces a monotonic increase in nominal GDP, P(t)Y(t).

M(t)is given at the beginning of period t,. Hence, from equation (2), a decrease in P(t)Y(t)leads to an increase in F(t). Combining this result with Lemma 1 and Lemma 2(i), we obtain the following Proposition.

Proposition.

When the price elasticity of demand is sufficiently low ($\varepsilon<1$), technological progress generates immiserizing growth in nominal terms: nominal GDP declines over time, while the trading volume of foreign currency increases.

CONCLUDING REMARKS

This paper has shown that technological progress can generate immiserizing growth in nominal terms by sharply reducing prices and, consequently, nominal GDP. Unlike the traditional literature, which focuses on welfare or real income, our analysis highlights the central role of the GDP deflator in shaping macroeconomic outcomes.

The results also suggest a novel interpretation of rising foreign currency transactions in low-inflation or deflationary environments: foreign asset accumulation may reflect not only precautionary motives but also a mechanical consequence of declining nominal income. This perspective may help to reconcile persistent external surpluses with weak nominal growth observed in several advanced economies.

Extending the model to incorporate unemployment, endogenous growth, and two-way foreign asset trading remains an important avenue for future research.

ACKNOWLEDGMENTS

None.

REFERENCES

Adler, G., Lisack, N., and Mano, R. (2019). Large-Scale Foreign Exchange Intervention: Evidence from a New Dataset (IMF Working Paper No. 19/40). International Monetary Fund.

Aizenman, J., and Lee, J. (2007). International Reserves: Precautionary Versus Mercantilist Views, Theory and Evidence. Open Economies Review, 18(2), 191-214. https://doi.org/10.1007/s11079-007-9030-z

Bhagwati, J. (1958). Immiserizing Growth: A Geometrical Note. Review of Economic Studies, 25(3), 201-205. https://doi.org/10.2307/2295990

European Central Bank. (2006). The Accumulation of Foreign Reserves (ECB Occasional Paper Series No. 43).

Forbes, K. (2019). Inflation Dynamics: Dead, Dormant, or Determined Abroad? Brookings Papers on Economic Activity, Spring, 257-338. https://doi.org/10.1353/eca.2019.0015

Fujita, Y. (2025). Reconsidering the Immiserizing Growth in a Simple Domestic Macroeconomic Model with Financial Assets. Archives of Business Research, 13(3), 237-241. https://doi.org/10.14738/abr.133.18343

Gopinath, G. (2015). The International Price System. In Jackson Hole Economic Policy Symposium Proceedings. Federal Reserve Bank of Kansas City. https://doi.org/10.3386/w21646

International Monetary Fund. (2011). Reserve Accumulation and International Monetary Stability (IMF Policy Paper).

Kehoe, T. J., and Ruhl, K. J. (2008). Are Shocks to the Terms of Trade Shocks to Productivity? Review of Economic Dynamics, 11(4), 804-819. https://doi.org/10.1016/j.red.2008.04.001

Kohli, U. (2004). Real GDP, Real Domestic Income, and Terms-of-Trade Changes. Journal of International Economics, 62(1), 83-106. https://doi.org/10.1016/j.jinteco.2003.07.002

Reinsdorf, M. (2010). Terms of Trade Effects: Theory and Measurement. Review of Income and Wealth, 56(S1), S177-S205. https://doi.org/10.1111/j.1475-4991.2010.00384.x