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Optimal long-run inflation rate in an open economy

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ABSTRACT

I analyze the long-run optimal inflation rate in the sticky price model with trend inflation and a two-country, two-good Ricardian trade structure. As in the closed-economy model, price stickiness effectively reduces an industry's productivity under trend inflation. Contrary to the standard closed-economy models in which the optimal inflation rate is approximately zero, the model implies that the optimal rate is positive under certain conditions. Welfare gains come from manipulations of the terms of trade, and are hence associated with the loss of the trade partner. If the partner counter-acts, the allocation can be worse than what would occur under autarky.

1. Introduction

Motivated by the recent convention that many central banks set positive target inflation rates, monetary studies analyze the consequence of trend inflation on economic welfare using various versions of sticky price models with trend inflation (e.g., King and Wolman, 1999; Ascari, 2004; Schmitt-Grohé and Uribe, 2007, 2011; Ascari and Ropele, 2007; Coibion et al., 2012; Damjanovic and Nolan, 2010; Ascari and Sbordone, 2014; Carreras et al., 2016; Kurozumi and Van Zandweghe, 2016). With few exceptions, these studies conclude that a zero-inflation rate maximizes welfare in the long run.[2] However, they focus on single-good, closed-economy settings, and the long-run consequences of trend inflation in an open economy are yet to be analyzed.[3]

I examine the long-run optimal inflation rate in a two-economy setting with a focus on the role played by the terms of trade. The terms of trade, that is the price of the exported goods relative to the price of the imported goods, are one of the key determinants of a country's welfare in an open-economy setting. Moreover, the terms of trade are empirically correlated with the inflation rate. Fig. 1 shows the relationship between the inflation rate and the terms of trade for four developed countries: Canada (CAN), Japan

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[2] In the short run, the initial price dispersion induces a slightly negative rate as optimal (Yun, 1996; Damjanovic and Nolan, 2010), whereas a possibility of hitting the zero-lower bound of the nominal interest rate implies that a slight positive rate is optimal (Schmitt-Grohé and Uribe, 2011; Coibion et al., 2012). There are at least two papers showing non-zero optimal trend inflation in the closed-economy setting. Carreras et al. (2016) show that the standard New Keynesian model with a regime-switching specification of risk premium shocks implies a high optimal trend inflation rate. Kurozumi and Van Zandweghe (2016) introduce the kinked demand curve in the Calvo-model with trend inflation and show that the long-run output is positively associated with the inflation rate.

[3] The multi-country, multi-good extension literature also focuses on short-run implications (e.g., Obstfeld and Rogoff, 1996; Benigno and Benigno, 2003; Benigno, 2004; Corsetti and Pesenti, 2005; Corsetti et al., 2011; Bergin and Corsetti, 2016).

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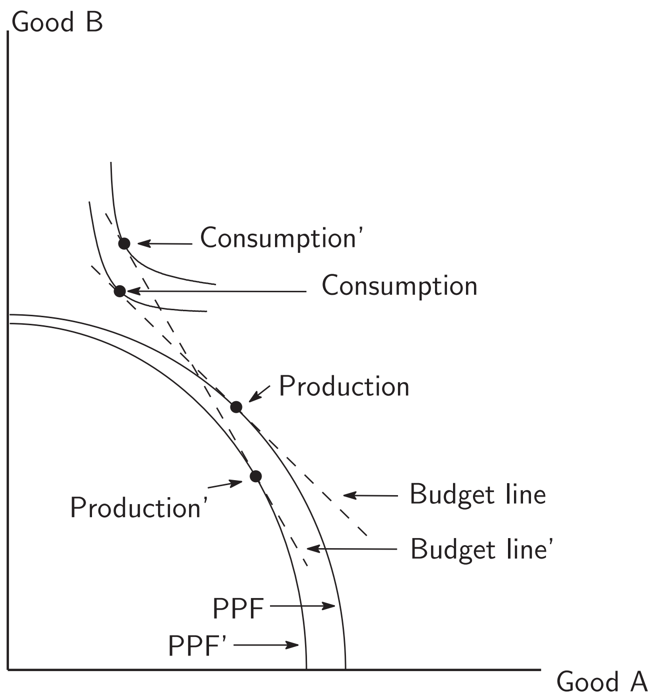

Fig. 8. The effect of non-zero inflation in the Ricardo-Viner model.

Proposition 2′. *Consider a Ricardo-Viner model where the home country exports good A and the foreign country exports good B. Suppose Assumption 2 holds. A change in Π affects the terms of trade. A sufficient condition that an increase in the terms of trade by Π's deviation from one is*

$$\left|\frac{\partial s_A^\gamma}{\partial \Pi}\frac{\Pi}{s_A^\gamma}\right| \geq \left|\frac{\partial s_B^\gamma}{\partial \Pi}\frac{\Pi}{s_B^\gamma}\right| \tag{39}$$

Proof. See the Appendix. □

In other words, the condition requires that the exporting sector is at least more price sticky than the importing sector. As in the Ricardian case, immiserizing growth is possible in this model. Fig. 8 illustrates the situation. Compared with Fig. 4, the main difference is that the production possibility frontiers are now bow-shaped curves rather than straight lines.

Contrary to the CRS case, the conditions for immiserizing growth take a complicated form, and the condition is not readily interpretable. However, using some endogenous variables, an extended version of Proposition 3 still holds.

Proposition 3′. *Consider a Ricardo-Viner model where the home country exports good A and the foreign country exports good B. Suppose Assumption 2 holds. The change in welfare caused by a change in Π is expressed as*

$$\frac{du}{d\Pi}\frac{\Pi}{u} \propto \frac{dw}{d\Pi}\frac{\Pi}{w} = \underbrace{\underbrace{\frac{-p_B(y_B - c_B)}{c}}_{\text{import ratio}}\frac{dp}{d\Pi}\frac{\Pi}{p}}_{\text{terms-of-trade effect}} - \underbrace{\sum_{i=A,B}\frac{l_i}{l}\frac{\partial s_i^\gamma}{\partial \Pi}\frac{\Pi}{s_i^\gamma}}_{\text{direct costs}} \tag{40}$$

In the autarky or small-open economy models, the welfare change is captured by the second term ("direct costs") in the above expression.

Proof. See the Appendix. □

The expression now includes both exporting and importing sectors; the change in welfare is captured by the trade-GDP ratio, the inflation elasticity of the terms of trade, labor shares of import and export sectors, and inflation elasticity of the price distortion. Note that $y_B - c_B < 0$ because B is an imported good, the first term follows the sign of $dp/d\Pi$. Under the condition that $dp/d\Pi > 0$ (as Proposition 2′), the first term attenuates the loss from the second term.

Table 2
Inflation rate elasticity of welfare.

	CAN	GBR	JPN	USA
ω	0.60	0.74	0.79	0.68
Inflation rate	2.3%	1.9%	−0.6%	3.1%
Terms-of-trade elasticity	−0.20	−0.97	1.91	0.39
Trade share	0.36	0.26	0.10	0.11
Direct cost	−0.12	−0.30	−0.12	−0.30
Terms-of-trade effect	−0.07	−0.25	0.19	0.04
Overall	−0.19	−0.55	0.07	−0.26

The values are the author's calculation using (40) except for ω. The parameter value ω is from Klenow and Malin (2011). I impose $s_A = s_B$ for simplicity. The import ratio and $(dp/d\Pi)(\Pi/p)$ are from the data. The direct cost term, $(\partial s_i^{\gamma}/\partial \Pi)/(\Pi/s_i^{\gamma})$, is calculated based on (25). The parameter values other than ω are $\eta = 10$ and $\gamma = 0.95$.

4.1. Quantitative impact

A back-of-the-envelope calculation using (40) for CAN, JPN, GBR, and USA gauges the quantitative sense of the expression, and the calculation shows a small but non-negligible impact of the terms-of-trade effect. There are two methods to show the quantitative impacts. The first method is to set all parameter values and calculate all model variables. For this, I need to feed parameter values of the hypothetical foreign country, including the price rigidity and inflation rate. Given the gap between the stylized two-country, two-good model and actual multi-country, multi-good real data, I do not employ this strategy. Instead, I use an alternative method: some summary statistics from the empirical estimates and a minimal set of parameter values to derive key quantitative implications. The cost of using this second strategy is that I cannot calculate the optimal inflation rate for the country.

Here, I show a summary of the methods and report the results. The Appendix explains the details of the data and calculations. I start with the term "direct costs". I consider the symmetric case ($s_A = s_B$). This assumption may not be empirically accurate, but it is hard to obtain various parameters of multiple countries for exporting and importing sectors separately.[27] Under this assumption, the "direct costs" term in (40) simply becomes the inflation elasticity of the price distortion, and the value depends on the price rigidity and other model parameters. The first row in Table 2 reports the values of ω, the probability that the firms cannot change the price. These values are from Klenow and Malin (2011).[28]

The average monthly inflation rate is the inflation rate of the CPI during the sample period for the calculations of ω. The second row in Table 2 reports the annual average values. Substituting these values, together with $\eta = 10$ (10% markup rate) and $\gamma = 0.95$ (small magnitude of DRS) to (25), gives the value for the "direct costs" term reported in the sixth row of Table 2. For the US, a one-percent increase in the inflation rate directly reduces welfare by 0.30%. The direct costs are in the range of a similar magnitude across countries.

The "terms-of-trade effect" term has two components: the trade share and the terms-of-trade elasticity. The trade share is the average of the import and export shares to GDP during the sample period.[29] The third row in Table 2 reports the values. I estimate the terms-of-trade elasticity using consumer, export, and import price indices. The data is from the OECD data, and the sample period is the post-Bretton-Woods period.[30] A regression fitting the log of the terms of trade on the log of the inflation rate gives the elasticity. The fourth row in Table 2 reports the results. The elasticity is 0.39 for the US.[31] With the trade share of 0.11, the terms-of-trade effect term is approximately $0.04 (\approx 0.11 \times 0.39)$. A one-percent increase in the inflation rate indirectly raises welfare by 0.04% by improving the terms of trade. The fifth row in Table 2 reports the value. Thus, the overall inflation elasticity of welfare ($= \frac{dw}{d\Pi}\frac{\Pi}{w}$) is $-0.26 (\approx -0.30 + 0.04)$, as shown in the bottom row in Table 2. That is, a one-percent increase in the inflation rate reduces welfare by 0.26%. The contribution of the terms-of-trade effect is small, but the terms of trade have a non-negligible ($15\% (\approx 0.04/0.26)$ overall) positive impact on the elasticity of welfare.

These values vary across countries. For Canada and the UK, the terms-of-trade elasticity is a negative value; hence, the overall loss is larger than the direct cost. According to Proposition 2′, the negative elasticity means that the assumption of symmetry across sectors ($s_A = s_B$) is not true for these two countries. Hence, the direct costs are also not calculated accurately. On the contrary, for Japan, a sizeable terms-of-trade elasticity dominates the direct cost such that the deviations from zero inflation improve welfare.

27 Ishise (2020) calculate the input price rigidity for different sectors for the US.

28 The original sources are Amirault et al. (2006) for Canada, Higo and Saita (2007) for Japan, Bunn and Ellis (2009) for the UK, and Goldberg and Hellerstein (2011) for the US. I use updated versions of the original sources for Japan and the US.

29 The values of exports, imports, and GDP are from OECD data.

30 The following estimation uses an extended sample period to have a reasonable sample size.

31 This elasticity is an OLS estimate. The methodology may have several issues with time series econometrics. For a reference, I also employ the dynamic OLS fitting log of the terms of trade on the log of the inflation rate, the first difference of the log of the inflation rate, and one and two periods leads and lags of the first difference of the log of the inflation rate. In this case, the estimated elasticity for the US is 0.68. See the Appendix for additional details.

5. Concluding remarks

This paper introduces the classical Ricardian and Ricardo-Viner international trade models into a stylized model of nominal rigidity with trend inflation. In the long-run steady state, the model implies that the magnitude of price rigidity and the inflation rate affect the terms of trade and that the optimal inflation rate can be non-zero. The welfare loss of non-zero inflation is smaller in a two-country model than in a closed or small-open model if the terms of trade lead to gains. The main driver of welfare gain is the manipulation of the terms of trade. The terms-of-trade effect may have a sizeable quantitative impact depending on the country.

I focus only on the steady state. However, a dynamic consideration may lead to a different value. By extending the existing quantitative studies of the optimal inflation rate by, for example, Schmitt-Grohé and Uribe (2011), Coibion et al. (2012), and Carreras et al. (2016) who examine dynamic closed-economy settings, future studies considering a dynamic open-economy extensions can make interesting findings.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.euroecorev.2022.104223.

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