# Vehicle currency pricing and its positive welfare consequences under optimal monetary policy[☆]

Masanori Kashiwagi [*]

Department of Economics, National Taiwan University, 21 Hsu-Chow Road, Taipei 10055, Taiwan

## ARTICLE INFO

## ABSTRACT

Using a two-country general equilibrium model, this paper analytically derives the possibility of positive welfare consequences of vehicle currency use in invoicing international trades. Such vehicle currency use is prominent in the data. The literature points out welfare loss under optimal monetary policy due to vehicle currency pricing relative to the flexible price equilibrium outcome, modeling only tradable goods. By introducing nontradable goods and their sector-specific productivity shocks, this paper provides a closed-form condition under which one country's welfare is higher under optimal monetary policy if its exports are invoiced with the other country's currency than if invoiced with its own currency, given that the other country's exports are invoiced with the producer's currency. That is, this paper derives a condition under which vehicle currency pricing is preferred by the nonvehicle currency country to producer currency pricing.

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## 1. Introduction

In international trade, the U.S. dollar is prominently used for invoicing, not only for trades involving the United States but also for those not involving the United States. This observation is important for a model of open economy macroeconomics with nominal rigidities, since invoicing currency has implications for exchange rate pass-through and, accordingly, optimal monetary policy and welfare. The welfare implications of such vehicle currency use are studied by Goldberg and Tille (2009), who consider a model in which all goods are tradable. The authors point out that vehicle currency use leads to welfare loss relative to the flexible price outcome. On the other hand, this paper shows that vehicle currency use has a positive aspect in terms of welfare when nontradable goods are introduced in a two-country general

equilibrium model. Specifically, the welfare of a nonvehicle currency country under optimal monetary policy can be higher if a vehicle currency is used than if trades are invoiced in the producer's currency.

The New Open Economy Macroeconomics literature[1] widely considers two types of pricing frameworks. Obstfeld and Rogoff (1995) assume that firms price their products in the currency of the country where they are located. This pricing structure is called producer currency pricing (PCP). If prices are set in the producer's currency, the law of one price holds; that is, prices in different markets are linked to the nominal exchange rates. On the other hand, Devereux and Engel (2003), Canzoneri et al. (2005), Obstfeld (2008), Duarte and Obstfeld (2008), and Engel (2011) study the case in which products are priced in the currency of the consumers; that is, goods are priced in the domestic currency for domestic sales, while they are priced in the importer's currency for international sales. This pricing framework is called local currency pricing (LCP).[2]

As empirical evidence, Goldberg and Tille (2008, 2009) point out that a substantial fraction of international trade is invoiced in

[1] For a comprehensive survey, see Lane (2001), Bowman and Doyle (2003), Corsetti et al. (2010).
[2] Under LCP, firms can conduct pricing to market. See Betts and Devereux (1996, 2000), among others.

U.S. dollars. For example, more than 90 percent of U.S. exports and imports were invoiced in U.S. dollars in 2003 and more than 80 percent of Korean exports and imports were invoiced in U.S. dollars in 2001. It is therefore compelling to consider the case in which one country's currency is used for all international transactions.

Such a pricing framework, defined as vehicle currency pricing (VCP) in this paper,[3] is considered by, for example, Corsetti and Pesenti (2002, 2007), Devereux et al. (2007), and Goldberg and Tille (2009). In these four studies, all goods are tradable, but as this paper shows, introducing nontradable goods and their sector-specific productivity shocks provides different welfare implications under optimal monetary policy from those obtained in a model with only tradable goods. In particular, whereas Goldberg and Tille (2009) present a negative impact on welfare, this paper shows that VCP can be welfare enhancing for the nonvehicle currency country once nontradable goods are introduced. This is the main contribution of the present paper. Note that Goldberg and Tille's (2009) analysis computes welfare loss relative to the flexible price equilibrium while this paper essentially compares the welfare of the nonvehicle currency country under VCP with that under PCP. Once nontradable goods are introduced, optimal monetary policy under PCP no longer replicates the flexible price equilibrium, whereas it does if all goods are tradable. Consequently, it is possible that VCP dominates PCP in terms of the nonvehicle currency country's welfare.

This paper analytically explores optimal monetary policy and its implications for welfare in a two-country general equilibrium model with nontradable goods, considering various assumptions about the export invoicing currency. Exports are assumed to be priced in either the domestic currency or the other country's currency. Accordingly, there are four possible pricing frameworks and, after deriving optimal policies under each framework, I investigate the welfare consequences. Specifically, by fixing the invoicing currency for one country's exports, I compare the other country's welfare under the two possible invoicing currencies, which is this paper's main analysis. The two countries in the model are called Home and Foreign. The following is proved in this paper. First, given that the Home (Foreign) country's exports are priced in the Foreign (Home) country's currency, the Foreign (Home) country's welfare is independent of the invoicing currency for the Foreign (Home) country's exports. Second, if the Home (Foreign) country's exports are priced in the Home (Foreign) country's currency, the Foreign (Home) country's welfare can be both lower and higher under PCP than under VCP with the Home (Foreign) currency, depending on the volatility of the sector-specific productivity shocks. In addition, this paper provides a closed-form condition that determines such an inequality. Effectively, this paper derives an analytical condition under which the nonvehicle currency country prefers VCP to PCP.

The possibility of both inequalities is due to the introduction of nontradable goods and their sector-specific productivity shocks. Intuitively, if exports are priced in the producer's currency and all goods are tradable, exchange rate changes lead to ideal terms of trade adjustments and the flexible price equilibrium allocation is attained. Shocks in the nontradable goods sector distort the terms of trade and such a possibility emerges.

In the literature, the introduction of nontradable goods has been proven to provide different implications for exchange rate fluctuations from those obtained by models with only tradable goods. By modeling nontradable goods, Obstfeld (2008) and Duarte and Obstfeld (2008) show that the nominal exchange rate fluctuates under the optimal monetary policy, even in the case of LCP, since each country needs to react to shocks asymmetrically due to the existence of nontradable goods. This finding contrasts with that of Devereux and Engel (2003), who examine optimal monetary policy in an open economy and the resulting exchange rate behavior under PCP and LCP assuming that all goods are tradable. These authors show that the nominal exchange rate is constant when each country carries out the optimal monetary policy under LCP.[4] By taking a similar approach, I explore the exchange rate variability under the optimal monetary policy for each pricing framework. Through the analysis I confirm the previous results for PCP and LCP and show that the exchange rate fluctuates under VCP whether nontradable goods are introduced or not. In addition, the degree of exchange rate fluctuations under VCP, computed as the conditional variance of the log of the nominal exchange rate, is lower than that under PCP and higher than that under LCP.

The spirit of this paper is related to that of Corsetti and Pesenti (2005), who generalize the degree of export price indexation to the exchange rate by allowing pass-through elasticity to take a value between zero and one. Hence PCP, LCP, and VCP can be considered as particular situations of a class of their parameterization. PCP and LCP correspond to cases in which there is full pass-through and zero pass-through in each country, respectively. Under VCP, there is full pass-through in one country and zero pass-through in the other. For analytical tractability, I focus on these special cases. In addition, Devereux et al. (2007) conduct welfare analysis for these cases in a model with only tradable goods.[5]

I consider a two-country model with monopolistically competitive firms and sticky prices similar to the model of Corsetti and Pesenti (2005). I extend the model by introducing a nontradable goods sector and sector-specific productivity shocks. There are disturbances in velocity as well. Monetary authorities react to these productivity and velocity shocks in the two countries through money supply rules, following Devereux and Engel (2003). Optimal monetary policy rules maximize the domestic welfare.

For simplicity and analytical tractability, I assume that export invoicing currencies (and thereby the degrees of exchange rate pass-through) are exogenous, following, for example, Corsetti and Pesenti (2005) and Goldberg and Tille (2009). Studies that endogenize decisions on invoicing currency include Devereux and Engel (2001), Devereux et al. (2004), and Devereux et al. (2007). Although such endogeneity is an interesting avenue of research, it is beyond the scope of this paper. Note that these three works do not consider nontradable goods.[6]

This paper is organized as follows. Section 2 describes a two-country general equilibrium model. Section 3 solves for the authorities' optimal policy rules in each pricing scheme and compares welfare. Section 4 concludes the paper.

## 2. Model

The model is similar to the two-country model studied by Corsetti and Pesenti (2005). I extend their model by introducing a

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[3] Trade between the United States and Japan is probably best characterized by VCP. According to invoicing currency data for 1992–2001 provided by the Japanese Ministry of Finance, about 80–85 percent of Japanese exports and imports with the United States were invoiced in U.S. dollars. The data (in Japanese) are available at http://www.mof.go.jp/about_mof/councils/yen_internationalization/report/koku130627e.htm.

[4] Note also that Devereux and Engel (2003) prove that the flexible price equilibrium allocations are replicated in the PCP setting.

[5] Devereux et al. (2007) consider a general CRRA utility function for consumption and conduct numerical analyses. In this paper, I assume a log utility for consumption and maintain the model's analytical tractability.

[6] Bacchetta and van Wincoop (2005) study invoicing decisions by firms in a model with tradable and nontradable goods. In their model, money supply is exogenous and monetary policy decision is not considered.