Transfer Effect in National Price Levels

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Abstract

A model of national price levels is developed to lay bare implicit assumptions behind the conventional view on the effect of productivity differentials and net foreign assets. The effect of productivity on national price levels is determined by the interaction of several countervailing channels, implying that the net effect can go in either direction for reasonable parameter values. By comparison, net foreign assets have a more robust effect on national price levels than productivity differentials. Basic theoretical implications are confirmed by the price level data of OECD countries.

Keywords: price levels; productivity; net foreign assets.

JEL codes: C82, F31, and F41

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1 Introduction

The positive association between national price levels and income, aptly named the Penn effect by Samuelson (1994), motivated the celebrated papers by Balassa (1964) and Samuelson (1964). The Harrod-Balassa-Samuelson effect formulated by them has been the cornerstone of the long line of research on the link between productivity and the real exchange rate. However, the Penn effect is not as strong among advanced economies as it is in the sample comprising countries at varying stages of development (Rogoff, 1996). The weakness has been confirmed in the empirical papers that explored the strength of the Balassa-Samuelson effect. For advanced economies, productivity differentials have not always had statistically significant associations with the real exchange rates (see Lee and Tang (2003) for a summary of the literature).

While much effort has been put into studying the Harrod-Balassa-Samuelson effect and the Penn effect despite their statistical weakness for advanced economies, little effort—none directly for national price levels—has been expended on exploring the role of net foreign assets in national price levels of advanced economies. The traditional transfer effect dictates that one looks at the link between net foreign assets and national price levels. Indeed, several papers have noted that the external balance have statistically significant and positive association with the real exchange rates: Faruqee (1995), Gagnon (1996), and Lane and Milesi-Ferretti (2002).

Building on these findings with exchange rates, this paper explores the transfer effect in national price levels.[1] By virtue of data availability, this paper studies the prices of traded and nontraded goods, constructed from disaggregate purchasing power parity (PPP) data of Eurostat. Individual purchasing power parity data for nearly 150 categories are combined into traded, nontraded, and aggregate purchasing power parities. These price data were obtained from actual benchmark surveys and enable us to go beyond the aggregate time-

[1] The national price level compares prices across space, while the real exchange rate compares prices over time. For more discussion on the conceptual difference between the real exchange rate and the national price level, see Kravis and Lipsey (1983). For its role in international comparisons of the Penn World Table, see Summers and Heston (1991) as well as articles posted on http://pwt.econ.upenn.edu/.

series association affirmed in the three exchange rate papers mentioned previously.

Considering the weak evidence of the Penn effect among advanced economies, the paper first presents a model of national price levels that compares the likely strength of the productivity effect and the transfer effect. The model allows the terms of trade to be determined endogenously subject to a home bias in consumption preference, in contrast to the traditional model with exogenous terms of trade. The theoretical ambiguity of the effect of productivity on the real exchange rate and national price levels has been studied by Fitzgerald (2003) and Bergin et. al (2004). We show further that for plausible degrees of home bias and substitutability, higher productivity can actually lead to a decline in national price levels. In contrast, higher values of net foreign assets are shown to raise national price levels, with only the magnitude of the effect varying with parameter values. Thus, theoretically, net foreign assets would be expected to have a more robust effect on national price levels than productivity differentials.

The paper then confirms several implications of theory in the price level data. It is found that nontraded prices show a greater dispersion than traded prices. While exhibiting a nice bell shape, the distribution of traded prices is centered around a mean different from unity (zero in log terms), affirming the presence of national price levels—the mean will be unity under the absolute purchasing power parity. Consistent with theoretical priors, net foreign assets have a more robust and positive association with national price levels than productivity proxies, and the effect is particularly strong in nontraded prices. Among advanced economies, the transfer effect appears to be stronger than the Penn effect, both theoretically and empirically.

One downside of the detailed and high-quality data is the narrow scope of countries, but this is not necessarily a serious handicap for studying the transfer effect through net foreign assets. Beyond this sample, most countries have maintained tight capital controls until lately, thereby limiting the working of the transfer effect through net foreign assets. The Eurostat sample is likely to be the best testing ground to study the transfer effect in national price levels. At the same time, the ongoing integration of international financial markets may bring out the transfer effect for a wider set of countries in the future. Even among advanced economies, the yawning imbalance in the external positions of major economies may strengthen the importance of the transfer effect. In this vein, we apply the estimates to a highly suggestive assessment of the exchange rate and the external position of the United States.

The rest of the paper is organized as follows. Section 2 works out a two-country model in which the endogenous terms of trade and the relative price of nontradables form two pillars of the theory of national price levels. Section 3 examines price data from Eurostat in the light of broad theoretical implications of Section 2 and offers background discussion, including the suggestive exercise with the U.S. exchange rate. Section 4 concludes.

2 Model

2.1 Prices Inclusive of Nontradables

There are two countries, home (H) and foreign (F, also denoted by $*$). A representative consumer at home country consumes tradables (C_T) and nontradables (C_N).

$$C = \frac{C_T^{\beta} C_N^{1-\beta}}{\beta^{\beta}(1-\beta)^{1-\beta}} \qquad 0 < \beta \leq 1 \tag{1}$$

The final consumption of tradables (C_T) is made possible by combining home-produced tradables (C_H), foreign-produced tradables (C_F), and intermediate nontradables ($\widetilde{C_N}$) in the following manner.

$$\widetilde{C_T} = \left[\gamma^{\frac{1}{\theta}} C_H^{1-\frac{1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}} C_F^{1-\frac{1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \qquad 0 < \theta < \infty \text{ and } 0 < \gamma \leq 1, \tag{2}$$

$$C_T = \frac{\widetilde{C_T}^{\alpha} \widetilde{C_N}^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}} \qquad 0 < \alpha \leq 1. \tag{3}$$

Home and foreign-produced tradables are combined with the elasticity of substitution θ to form a traded composite $\widetilde{C_T}$, which is then combined with nontradables ($\widetilde{C_N}$) with unit elasticity to generate the final consumption basket of tradables (C_T).[2] With nontradables sector involved in making traded goods available for final consumption, the final consumption price of tradables (C_T) will be affected by prices of nontraded goods; the international price of final consumption basket will not be equal, even if home and foreign traded goods were fully substitutable.[3]

Producers in this economy are small and the market is perfectly competitive for each category of goods. In particular, each of two traded goods is produced by numerous small firms that behave as price takers, leaving no room for strategic pricing decision by producers. As the result, unlike Corsetti and Dedola (2002) who analyze the effect of Leontief-type nontradables input on the pricing decision of monopolistically competitive firms, nontradables input is reflected fully in prices. Both tradables and nontradables are produced with labor alone, and the productivity of nontradables sector is normalized to 1.[4]

$$Y_H = A_H L_H \qquad Y_N = L_N \tag{4}$$

The same structure is assumed for preference and technology of the foreign country. The only difference with respect to preference lies with the share of foreign-produced tradables in consumption basket:

$$\widetilde{C_T^*} = \left[(1-\gamma^*)^{\frac{1}{\theta}}(C_H^*)^{1-\frac{1}{\theta}} + (\gamma^*)^{\frac{1}{\theta}}(C_F^*)^{1-\frac{1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \qquad 0 \leq \gamma^* \leq 1. \tag{5}$$

Foreign consumption of home-produced tradables is denoted by C_H^*, while foreign consump-

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[2]If home and foreign-produced tradables were perfectly substitutable, the elasticity θ between them would converge to ∞, and the relative price between them would remain constant at 1 as equation (2) becomes linear in two traded goods: $\widetilde{C_T} = C_H + C_F$.

[3]Kravis and Lipsey (1983) attribute the first observation of this phenomenon to Harrod.

[4]Alternatively, productivity of foreign nontradables sector alone can be normalized to 1. In that case, when A_N denotes nontradables productivity in home, A_H can be redefined as the relative productivity and equation (4) can be written as $Y_H = A_H A_N L_H$ and $Y_N = A_N L_N$, respectively. The effect of this alternative formulation will be commented in a few places later, and discussed in detail in the appendix.

tion of foreign-produced tradables is denoted by C_F^* (with its share in consumption basket being γ^*). With respect to technology, foreign-produced tradables sector has labor productivity A_F^*, and nontradables labor productivity is assumed to be identical to that of home nontradable sector: $Y_F^* = A_F^* L_F^* \qquad Y_N^* = L_N^*$

The CES specification of preference leads us to simple expressions for price aggregates. Intermediate tradables price is denoted by $\widetilde{P_T}$, the price of final traded consumption is denoted by P_T, the price of nontradables is denoted by P_N, and the price of the overall consumption basket is denoted by P.

$$\widetilde{P_T} = \left[\gamma P_H^{1-\theta} + (1-\gamma) P_F^{1-\theta}\right]^{\frac{1}{1-\theta}} \tag{6}$$

$$P_T = \widetilde{P_T}^{\alpha} P_N^{1-\alpha} \tag{7}$$

$$P = P_T^{\beta} P_N^{1-\beta} = \widetilde{P_T}^{\alpha\beta} P_N^{1-\alpha\beta} \tag{8}$$

Foreign prices are similarly defined, with the only difference being the composition of home and foreign goods in intermediate tradables price: $\widetilde{P_T^*} = \left[(1-\gamma^*) P_H^{1-\theta} + \gamma^* P_F^{1-\theta}\right]^{\frac{1}{1-\theta}}$ For various stages of aggregation, the price levels can be written in terms of price levels of traded intermediates and nontradables.

$$\frac{P_T}{P_T^*} = \left(\frac{\widetilde{P_T}}{\widetilde{P_T^*}}\right)^{\alpha} \left(\frac{P_N}{P_N^*}\right)^{1-\alpha} \tag{9}$$

$$\frac{P}{P^*} = \left(\frac{\widetilde{P_T}}{\widetilde{P_T^*}}\right)^{\alpha\beta} \left(\frac{P_N}{P_N^*}\right)^{1-\alpha\beta} \tag{10}$$

From the production side, we can see that

$$P_N = A_H P_H \ \text{ and } \ P_N^* = A_F P_F. \tag{11}$$

The labor market linkage that forms the basis of the traditional Harrod-Balassa-Samuelson effect is embedded in these two equations. Equations (6)–(10) and (11) show that all prices can be determined once we determine P_H and P_F, prices of home and foreign produced traded goods.

2.2 Equilibrium

The prices of two tradables can be determined from the goods-market equilibrium condition.

$$Y_H = C_H + C_H^* \tag{12}$$

This equilibrium condition is expressed in terms of prices by going through two stages. In the first stage, the equilibrium condition is written into value terms, to link them to resource constraints of the economy that are best summarized in value terms. Using the standard properties of CES utility, we get an equilibrium condition in value terms.

$$P_H Y_H = \gamma \left(\frac{P_H}{\widetilde{P_T}} \right)^{1-\theta} \widetilde{P_T} \widetilde{C_T} + (1 - \gamma^*) \left(\frac{P_H}{\widetilde{P_T^*}} \right)^{1-\theta} \widetilde{P_T^*} \widetilde{C_T^*} \tag{13}$$

In the second stage, resource constraints of the economy are incorporated into this equilibrium condition, converting it into an equation written in terms of prices only. When home economy's net foreign asset is denoted by FA and the world interest rate is denoted by r,[5] the resources at its disposal are: $P_N Y_N + P_H Y_H + rFA$. Since the aggregate value of production can be written in terms of traded prices and productivity as $P_N Y_N + P_H Y_H = A_H P_H (1 - L_H) + P_H A_H L_H = A_H P_H$, the total usable income of this economy is $A_H P_H + rFA$. Using the Cobb-Douglas specifications between tradables and nontradables (equations (1) and (3)), the budget constraint on traded consumption—the value of traded consumption—can be expressed in terms of prices only. Since a fixed frac-

[5]This is viewed as the steady state level of net foreign assets, determined outside the current model. Aside from the issue of a theoretical model that pins down a steady-state level of net foreign assets, there is ample evidence for the nonzero long-term average level of net foreign assets. See Lane and Milesi-Ferretti (2001) and Faruqee and Lee (2003).

tion of the total usable income is allocated to traded consumption,

$$\widetilde{P_T}\widetilde{C_T} = \alpha\beta(A_H P_H + rFA). \tag{14}$$

By the same reasoning, $\widetilde{P_T^*}\widetilde{C_T^*} = \alpha\beta(A_F P_F - rFA)$.

The value of home traded production (the left-hand side of equation (13)) can also be written in terms of prices. First, since $C_N + \widetilde{C_N} = Y_N$, expenditure on tradables can be related to the revenue of the traded sector and income from net foreign assets:

$$\widetilde{P_T}\widetilde{C_T} = P_H\widetilde{C_H} + P_F\widetilde{C_F} = P_H Y_H + rFA. \tag{15}$$

Now combining equations (14) and (15), the value of tradables production can be expressed in terms of prices only:

$$P_H Y_H = \alpha\beta A_H P_H + (1-\alpha\beta)rFA \tag{16}$$

Substituting equations (14) and (16) into equation (13) and using $FA + FA^* = 0$, we can write the equilibrium condition of equation (13) as

$$\alpha\beta A_H P_H + (1-\alpha\beta)rFA = \gamma\left(\frac{P_H}{\widetilde{P_T}}\right)^{1-\theta}\alpha\beta(A_H P_H + rFA) + (1-\gamma^*)\left(\frac{P_H}{\widetilde{P_T^*}}\right)^{1-\theta}\alpha\beta(A_F^* P_F - rFA). \tag{17}$$

This is an equilibrium condition that has incorporated consumption and production choices of the economy, subject to the supply of labor and the net foreign asset positions. A comparable equation can be derived from the equilibrium condition for foreign-produced tradables, and P_H and P_F can be solved from these two equations.

2.3 Analyzing Equilibrium

In the special case of zero net foreign assets ($FA = FA^* = 0$), the equations become homogeneous in prices, and in the absence of home bias ($\gamma = \gamma^* = 1/2$), the equilibrium can be solved algebraically. (see the appendix for details). In general cases with home bias ($\gamma, \gamma^* > 1/2$), however, the equilibrium cannot be solved algebraically. To explore the effect of relative productivity and net foreign assets on national price levels in general cases, we resort to log-linearization around the symmetric steady state with $P_H = P_F$. The symmetric equilibrium follows from equation (37) if symmetry assumed in both preference and technology, namely $\gamma = \gamma^* = \bar{\gamma}$ and $A_H = A_F^* = \bar{A}_0$. Note that if $\gamma = \gamma^* = \bar{\gamma} > \frac{1}{2}$, both countries exhibit the same degrees of home biases for domestically produced tradables.

We now log-linearize equilibrium condition (17) around the symmetric equilibrium under zero net foreign assets.[6] Where $\hat{}$ denotes the rate of change and Δ denotes the differential (which is necessary as the net foreign assets are varied around zero), laborious calculation yields the following equation.

$$[2\bar{\gamma}(1-\theta)-1](\widehat{P_H}-\widehat{P_F}) = \widehat{A_H} - \widehat{A_F^*} - \frac{1-\alpha\beta+\alpha\beta(2\bar{\gamma}-1)}{\alpha\beta(1-\bar{\gamma})}\frac{\Delta(rFA)}{\bar{A}_0} \tag{18}$$

The equilibrium terms of trade becomes:

$$\widehat{P_H}-\widehat{P_F} = -\frac{\widehat{A_H}-\widehat{A_F^*}}{2\bar{\gamma}(\theta-1)+1} + \frac{1-\alpha\beta+\alpha\beta(2\bar{\gamma}-1)}{\alpha\beta(1-\bar{\gamma})[2\bar{\gamma}(\theta-1)+1]}\frac{\Delta(rFA)}{\bar{A}_0} \tag{19}$$

It is assumed that $2\bar{\gamma}(\theta-1)+1>0$ for a fruitful economic analysis.[7]

All international prices follow from this equation using the following relationship.

$$\widehat{P_N}-\widehat{P_N^*} = (\widehat{P_H}-\widehat{P_F}) + (\widehat{A_H}-\widehat{A_F^*}) \tag{20}$$

$$\widehat{P_T}-\widehat{P_T^*} = \alpha(2\bar{\gamma}-1)(\widehat{P_H}-\widehat{P_F}) + (1-\alpha)(\widehat{P_N}-\widehat{P_N^*}) \tag{21}$$

$$\widehat{P}-\widehat{P^*} = \beta(\widehat{P_T}-\widehat{P_T^*}) + (1-\beta)(\widehat{P_N}-\widehat{P_N^*}) \tag{22}$$

[6]It should be noted that the log-linearization here is used as a device to compare two different steady states. The differential can be motivated either in terms of change over time (growth rate), or differences across space (cross-country comparison). The empirical exercise of this paper fits the latter interpretation better.

[7]This condition, which implies that higher productivity (positive supply shock) reduces the price, is always satisfied when $\theta \geq \frac{1}{2}$.

Substituting equation (19) into these equations, three international prices can be written in terms of productivity differential and net foreign assets.

$$\widehat{P_N} - \widehat{P_N^*} = \frac{2\bar{\gamma}(\theta-1)}{2\bar{\gamma}(\theta-1)+1}(\widehat{A_H} - \widehat{A_F^*}) + \frac{1-\alpha\beta+\alpha\beta(2\bar{\gamma}-1)}{\alpha\beta(1-\bar{\gamma})[2\bar{\gamma}(\theta-1)+1]}\frac{\Delta(rFA)}{\bar{A}_0} \tag{23}$$

$$\begin{aligned}\widehat{P_T} - \widehat{P_T^*} &= \frac{(1-\alpha)2\bar{\gamma}(\theta-1)-\alpha(2\bar{\gamma}-1)}{2\bar{\gamma}(\theta-1)+1}(\widehat{A_H} - \widehat{A_F^*}) \\ &+ \quad \frac{[1-\alpha+\alpha(2\bar{\gamma}-1)][1-\alpha\beta+\alpha\beta(2\bar{\gamma}-1)]}{\alpha\beta(1-\bar{\gamma})[2\bar{\gamma}(\theta-1)+1]}\frac{\Delta(rFA)}{\bar{A}_0}\end{aligned} \tag{24}$$

$$\widehat{P} - \widehat{P^*} = \frac{(1-\alpha\beta)2\bar{\gamma}(\theta-1)-\alpha\beta(2\bar{\gamma}-1)}{2\bar{\gamma}(\theta-1)+1}(\widehat{A_H} - \widehat{A_F^*}) + \frac{[1-\alpha\beta+\alpha\beta(2\bar{\gamma}-1)]^2}{\alpha\beta(1-\bar{\gamma})[2\bar{\gamma}(\theta-1)+1]}\frac{\Delta(rFA)}{\bar{A}_0} \tag{25}$$

These formulas lend themselves to straightforward economic interpretation in two extreme cases. In one case with no home bias ($\bar{\gamma} = 1/2$) and with only tradables in the final tradables consumption ($\alpha = 1$), the role of the elasticity of substitution (θ) stands out. In the other case without nontradables in either final tradables consumption ($\alpha = 1$) or overall consumption basket ($\beta = 1$), the role of home bias ($\bar{\gamma}$) emerges clearly.

2.3.1 Two Special Cases

Elasticity of Substitution To start with the first case that excludes home bias and contains only tradables in the final tradables consumption, equations (19), (23) and (25) simplify to :

$$\widehat{P_H} - \widehat{P_F} = -\frac{1}{\theta}(\widehat{A_H} - \widehat{A_F^*}) + \frac{2(1-\beta)}{\beta\theta}\frac{\Delta(rFA)}{\bar{A}_0} \tag{26}$$

$$\widehat{P_N} - \widehat{P_N^*} = \frac{(\theta-1)}{\theta}(\widehat{A_H} - \widehat{A_F^*}) + \frac{2(1-\beta)}{\beta\theta}\frac{\Delta(rFA)}{\bar{A}_0} \tag{27}$$

$$\widehat{P} - \widehat{P^*} = \frac{(1-\beta)(\theta-1)}{\theta}(\widehat{A_H} - \widehat{A_F^*}) + \frac{2(1-\beta)^2}{\beta\theta}\frac{\Delta(rFA)}{\bar{A}_0} \tag{28}$$

In equation (26), the relative increase in the productivity of home tradable sector lowers the relative price of home tradables (depressing the terms of trade).[8] The magnitude of price adjustment decreases with the elasticity of substitution. The more substitutable home and foreign produced tradables are, the smaller price adjustment is needed to restore equilibrium following the increase in relative productivity.

The net effect of higher productivity on price levels, however, is positive when home and foreign tradables are substitutable enough. The reason for this can be seen from equations (20)—(22). Since equation (21) implies that traded price levels (P_T and P_T^*) move in tandem when there is no home bias ($\bar{\gamma} = 1/2$), national price levels in equation (22) depend only on nontraded price levels. According to equation (20), nontraded price levels depend on the terms of trade effect ($\widehat{P_H} - \widehat{P_F}$) and the Balassa-Samuelson effect ($\widehat{A_H} - \widehat{A_F^*}$). In the traditional model with no terms of trade effect, the first term is zero and nontraded price levels depend only on the Balassa-Samuelson effect that is always positive. In this model, the larger the elasticity, the smaller is the terms of trade effect, and the more likely is it for the Balassa-Samuelson effect to dominate the terms of trade effect. The exact threshold in the absence of home bias is the elasticity of substitution equal to 1, as in equations (27) and (28). When the demand for home tradables is elastic ($\theta > 1$), relative productivity increase raises aggregate and nontraded price levels, as the decline in the terms of trade is not so large as to dominate the positive effect on the price of home nontradables. When the demand for home tradables is inelastic ($\theta < 1$), the opposite holds: the decline in the terms of trade dominates the positive effect on the price of home nontradables.

The increase in net foreign assets, however, always improves the terms of trade and raises the national price levels. Higher values of net foreign assets imply higher values of net wealth and income that can be spent on both tradables and nontradables. With no home bias, the increased spending on tradables falls on both home and foreign produced tradables proportionately, thereby having no direct effect on the terms of trade. The increased spending on

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[8]If economy-wide productivity term were added as $\widehat{A_N}$ (common to H and N sectors), equation (26) will have an additional $-\frac{1}{\theta}\widehat{A_N}$ term, which will show up as $-\frac{1}{\theta}\widehat{A_N}$ and $-\frac{1-\beta}{\theta}\widehat{A_N}$ in equations (27) and (28), respectively. See appendix for details.

nontradables, however, falls only on home nontradables with no effect on foreign nontrdables, thereby increasing home prices and the terms of trade with it. The larger is the share of nontradables in the consumption basket (smaller β), the stronger is this price effect. The magnitude of this effect is also affected by the elasticity of substitution (θ) because of the labor market linkage. Higher demand for nontradables increases demand for labor in the nontradables sector, which can be accommodated by pulling labor out of the home tradable sector (L_H). The more substitutable are the traded goods (H and F), the less effect will this labor reallocation have on nontraded prices P_N. When home and foreign traded goods are perfectly substitutable ($\theta = \infty$), changes in net foreign assets can be accommodated with no price adjustment.

Home Bias in Tradables In the case with tradables only ($\alpha = \beta = 1$), equations (19) and (25) simplify to :

$$\widehat{P_H} - \widehat{P_F} = -\frac{\widehat{A_H} - \widehat{A_F^*}}{2\bar{\gamma}(\theta-1)+1} + \frac{2\bar{\gamma}-1}{(1-\bar{\gamma})[2\bar{\gamma}(\theta-1)+1]}\frac{\Delta(rFA)}{\bar{A}_0} \tag{29}$$

$$\widehat{P} - \widehat{P^*} = \frac{-(2\bar{\gamma}-1)}{2\bar{\gamma}(\theta-1)+1}(\widehat{A_H} - \widehat{A_F^*}) + \frac{(2\bar{\gamma}-1)^2}{(1-\bar{\gamma})[2\bar{\gamma}(\theta-1)+1]}\frac{\Delta(rFA)}{\bar{A}_0} \tag{30}$$

Higher productivity in home tradables always lowers its international price, as seen in equation (29). If home goods account for a larger portion of the home basket ($\bar{\gamma} > 1/2$), the lower price of home tradables is carried over to the lower price level at home, as in equation (30). In contrast, higher values of net foreign assets always raise national price levels. Higher income from higher net foreign assets increases the expenditure by home residents, a larger proportion of which falls on home-produced goods, thereby raising demand for home labor and their price with it. The magnitude of these effect falls with elasticity, as smaller price adjustment is needed under higher elasticity.

2.3.2 General Implications

To move beyond extreme parameter values, several general properties emerge from equations (23)—(25). To start with productivity effect, home bias raises the threshold beyond which productivity growth raises national price levels.

Implication 1 *Higher home bias shrinks the range of elasticity for which national prices rise with productivity. More specifically, when*

$$\frac{\partial \log (P/P^*)}{\partial \log (A_H/A_F^*)} > 0 \quad \Leftrightarrow \quad \theta > \bar{\theta} \equiv 1 + \frac{\alpha\beta(2\bar{\gamma} - 1)}{(1 - \alpha\beta)2\bar{\gamma}}, \tag{31}$$

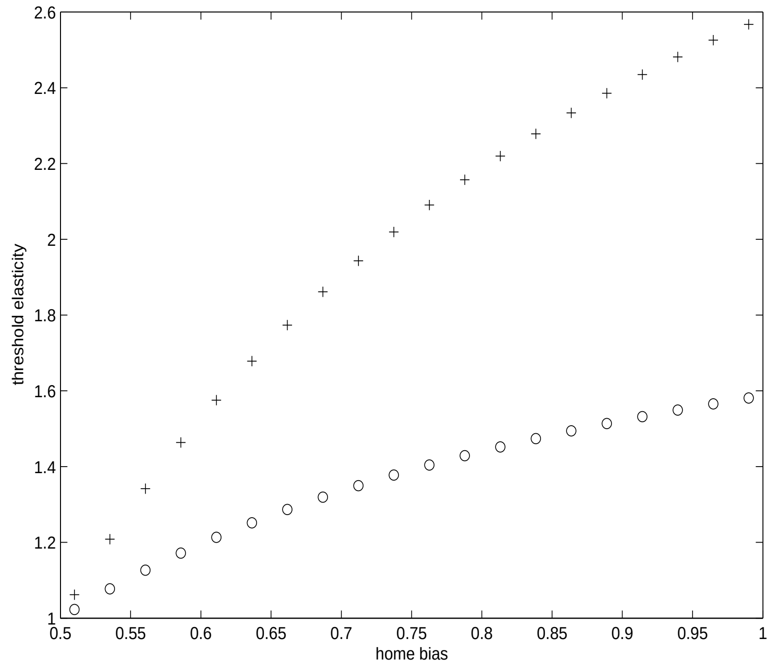
the threshold elasticity $\bar{\theta}$ *increases in* $\bar{\gamma}$ *and* $\alpha\beta$.

The threshold $\bar{\theta}$ is determined at a level that balances two opposing tendencies: terms of trade effect by which high productivity depresses price levels and the Balassa-Samuelson effect by which higher tradables productivity raises price levels. The role of the terms of trade effect grows with $\bar{\gamma}$ as home products—whose prices fall—take a larger share of tradables. Increase in $\alpha\beta$ also enhances the role of terms of trade effect, as traded goods account for a larger share of basket of goods. Figure 1 illustrates the change in the elasticity threshold for the relationship between price levels and the relative productivity, for two values of $\alpha\beta$. The circles track the threshold for $\alpha = 0.9$ and $\beta = 0.6$. The +'s track the threshold for $\alpha = 0.95$ and $\beta = 0.8$. For elasticities exceeding the threshold, higher productivity raises national price levels. The threshold elasticities increase with home bias and $\alpha\beta$. If the elasticity is close to 1, productivity increase may lower national price levels for a relatively small degree of home bias.

Implication 2 *A higher level of net foreign assets almost always raises national price levels.*

It can be easily verified that higher values of net foreign assets raise price levels, except when two traded goods are perfectly substitutable ($\theta = \infty$), or when $\alpha\beta = 1$ *and* $\bar{\gamma} = 1/2$ hold simultaneously. These conditions help to reinterpret the classical transfer problem. In

Figure 1: Thresholds



the latter case, there exists no home-country bias in expenditure, be it through nontraded goods ($\alpha\beta$) or through home bias in tradables consumption. This is the familiar case under which unilateral transfers are viewed not to affect national price levels (Ohlin view). Otherwise, unilateral transfers are regarded to raise the price level of the recipient country (Keynes view). The discussion in this section shows that there is another condition for the Keynes view to hold, namely that traded goods are not perfectly substitutable. If traded goods are perfectly substitutable, higher wealth can be spent on either home or foreign traded goods with little price effect, which is consistent with the Ohlin view.[9] However, parameter values for which Ohlin view prevails are highly limited. Except in extreme cases, higher wealth falls more on home-specific goods, thereby raising national price levels, resonating with the Keynes view.

Implication 3 *When positive, the effects of productivity and net foreign assets on relative prices are stronger on P_N than on P_T, with the effect on P being the average of those on P_N*

[9] Although expenditure on nontradables rises with the increase in net foreign assets, the increased demand is fully satisfied by labor reallocated from home tradables sector, which has no effect on the terms of trade.

and P_T.

To be more exact, this proportion can be restated in elasticity format, although exact elasticity formula cannot be defined for net foreign assets that is centered around zero.

$$\frac{\partial \log (P_N/P_N^*)}{\partial X} \geq \frac{\partial \log (P/P^*)}{\partial X} \geq \frac{\partial \log (P_T/P_T^*)}{\partial X} \quad \text{for} \quad X = \log (A_H/A_F^*), \frac{(rFA)}{\bar{A}_0}. \qquad (32)$$

This inequality reflects both the composition effect and the fact that the ultimate source of national price levels is country-specific factors, namely labor and nontraded goods in this model. Traded prices are a combination of home and foreign traded goods, while the latter price is not influenced by the demand for home labor. Thus, productivity or net foreign assets will have a stronger effect on nontraded prices than on traded prices. Since aggregate national prices are a combination of traded and nontraded prices, the effect of productivity or net foreign assets will be in the intermediate range between two prices.

3 Meeting with Data

3.1 Data Description

To confront three implications of the model with data, we need prices of traded and nontraded goods separately. Purchasing power parities collected under the auspices of the ICP are probably the best data that captures prices for internationally comparable products. In particular, the parity data from the Eurostat has the most extensive coverage, and thus the highest ratio of actual data to interpolation.

The sectoral prices were constructed from the retail prices of about 150 categories in years 1985, 1990, 1993, 1996, 1999. In these years, actual price surveys were conducted for thousands of items, and were then grouped into about 150 categories. By aggregating these categories into tradables and nontradables along the guidelines set out by Kravis et al. (1982), I constructed purchasing power parities for the aggregate, tradables, and nontradables.[10] These purchasing power parities were then converted into the U.S. dollar terms, to obtain national price levels measured in a common currency.

Productivity measures are obtained from two sources. Per-capita income levels are obtained from PWT 6.1, and relative labor productivity between traded and nontraded sectors are calculated from the OECD Main Economic Indicators database.[11] Net foreign assets are obtained from the data of Lane and Milesi-Ferretti (2001).

3.2 Basic Statistics

Table 1 reports summary statistics of national price levels for OECD countries, denominated in U.S. dollars. If absolute purchasing power parity were to hold, national price levels would be a redundant concept with their values staying close to 1 (at least on average). In practice, the average price levels for each country are markedly different from 1 and from one another, indicating that national price levels are an empirically relevant concept.

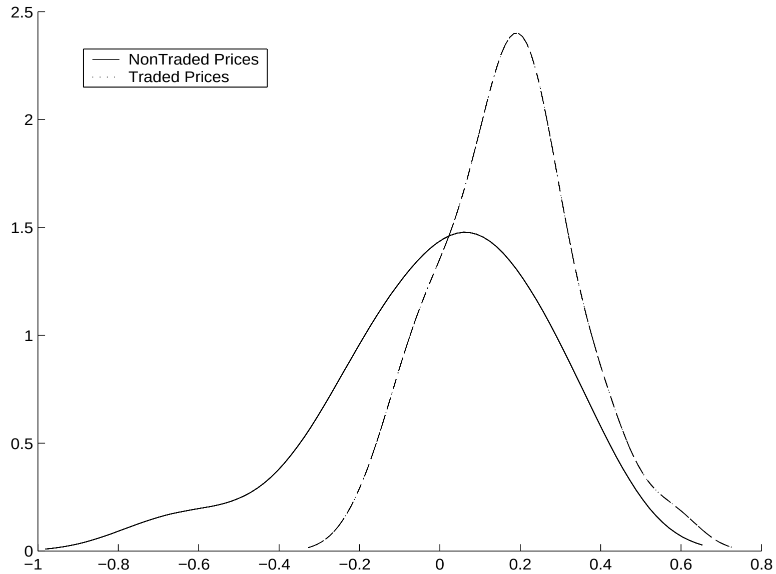
This casual reading of data is confirmed by a more formal statistical investigation reported in Table 2. The hypothesis that the average of log price levels equals zero—thus equal to one in levels—was tested for the aggregate, traded and nontraded price levels. The null hypothesis is rejected for traded prices, flying squarely in the face of the absolute purchasing power parity hypothesis . The null hypothesis is rejected for the nontraded prices, but with the opposite sign. Thus by coincidence, the null hypothesis is not rejected for the aggregate prices, as the averages of traded and nontraded prices cancel out each other. Aside from this coincidence, the premise of the absolute purchasing power parity hypothesis is undermined by the result that the average of traded prices is statistically different from zero.

If the absolute purchasing power parity hypothesis is rejected for both traded and nontraded prices, are they qualitatively identical? The answer is no, as can be inferred from

[10] See the appendix for further details of aggregating prices by the Geary method.

[11] Both variables measure labor productivity, not the total factor productivity. While this can be regarded as a limitation of the data, several papers have shown that the labor productivity provides stronger evidence in favor of the traditional Balassa-Samuelson effect on the real exchange rate; see Lee and Tang (2003) and references therein. The use of labor productivity increases the odds of finding evidence supportive of the Balassa-Samuelson effect.

Figure 2: Kernel Densities



the characteristics of their empirical distributions. Traded prices are found to exhibit a stronger tendency towards convergence than nontraded prices. First in Table 2, the variance is larger for nontraded prices, implying that there is greater diversity of prices among nontraded goods. Statistical tests of the hypothesis that variance equals 0.03—a value chosen arbitrarily for comparison—is rejected only for traded goods, thereby adding substance to the impression that variance is smaller for traded prices.

Moreover, traded prices are distributed closer to the normal distribution—around the nonzero mean—than nontraded prices are distributed around the zero mean. This contrast can be seen clearly from kernel densities plotted in Figure 2, where the distribution of nontraded prices has a thick tail on the left. According to Jacque-Bera tests (reported in the last column of Table 2), normality is statistically rejected for nontraded prices, while not being rejected for traded prices.

Such difference in distributions of traded and nontraded goods strongly suggests that traded prices converge faster to a mean than nontraded prices, but that the mean to which traded prices converge differs from zero. A faster convergence of traded prices will be the natural outcome of the force of arbitrage operating more strongly on traded prices than on nontraded prices. The target of convergence, however, is not equal to zero, implying the presence of national price levels.

3.3 Productivity and Net Foreign Assets

The next question is what factors explain cross-country differences in national price levels. Section 2 suggests that productivity and net foreign assets can be two identifiable factors that determine national price levels. To investigate their role empirically, cross-section and panel specifications were estimated on the sample based on four survey years (1985, 1990, 1993, 1996) for which net foreign asset data were available.[12]

Considering that spatial comparison is the backbone of the price level data, Figure 3 plots time-averages of price levels of each country against the average ratios of net foreign assets to GDP and average relative incomes. The upper panel suggests that nontraded prices and net foreign assets exhibit a strong positive association, while traded prices and net foreign assets hardly show a clear positive association. In the lower panel that plots nontraded and traded prices against relative incomes, neither price exhibits a clear positive association with relative incomes, though slightly more likely for nontraded prices. These figures appear consistent with the theoretical implication that net foreign assets and productivity exert a stronger effect on nontraded prices than on traded prices.

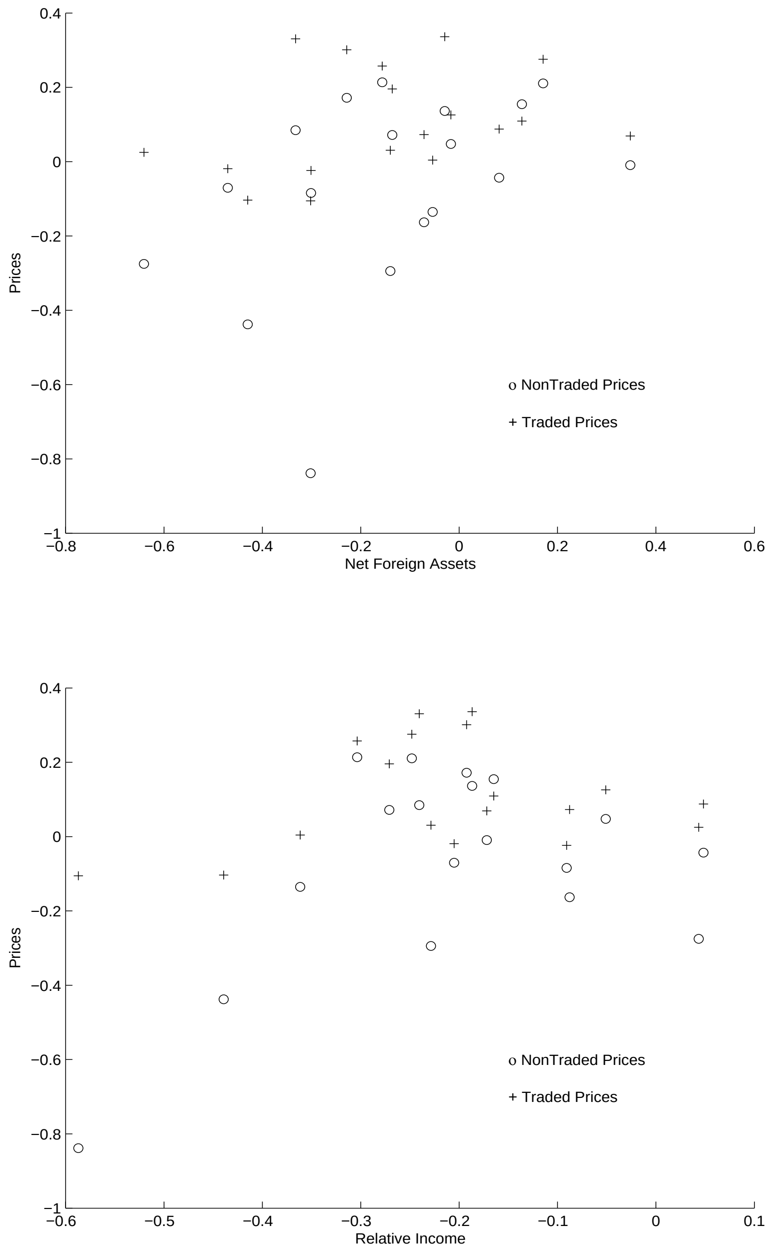
A more systematic statistical investigation is undertaken, on the basis of the following panel specification.

$$P_{it} = \beta_{0i} + \beta_1 Y_{it} + \beta_2 FA_{2it} + \beta_3 T_{it} + \epsilon_{it} \tag{33}$$

The dependent variable is logs of aggregate, traded, and nontraded price levels. For each price variable, two measures of productivity were used. One productivity measure is the log of the ratio of per-capita income of each country to that of the United States, both calculated from PWT. The other productivity measure is the log differential of relative productivity calculated on the basis of the OECD Main Economic Indicators, namely the log of country

[12] The estimation that included openness and government expenditure, two variables often used in the analysis of national price levels, did not produce statistically significant coefficient estimates.

Figure 3: Spatial Comparison



A's relative productivity between traded and nontraded sectors minus the log of the U.S. relative productivity between traded and nontraded sectors. The net foreign assets variable is the ratio of net foreign assets to GDP for each country.[13]

As the starting point, Table 3 reports the regression based on time averages of all variables, thereby providing a statistical transition from Figure 3 to panel estimations. The average price levels of each country were regressed on the averages of productivity measures and ratios of net foreign assets to GDP. Net foreign assets are found to have statistically significant effect on the prices of nontrables, while having no statistically significant effect on the prices of tradables.[14] The relative productivity differential has no statistically significant effect on any price level, while the relative income has a statistically significant effect only on the price level of nontradables. Quantitatively, a ten percentage-point increase in the ratio of net foreign assets to GDP raises the aggregate price level by about 3 percentage points.

The panel regressions were run in six versions for each pair of net foreign assets and productivity variables. The first grouping depends on whether time dummy (T_{it}) was used. To the extent that there is common-trend or cyclical comovement, regression with time dummy would be appropriate. First, equation (33) was estimated assuming common constant term (β_{0i} identical over i's), fixed effect (β_{0i} country specific), and random effects (β_{0i} pulled from a common distribution). Next, the same three specifications were estimated without time dummy included ($\beta_3 = 0$).

The results of regression for aggregate price levels are reported in Table 4, with the upper panel showing estimates based on relative per-capita income and the lower panel showing estimates based on relative productivity differential. Net foreign assets have robust positive

[13]Net foreign assets are, by construction, against the rest of the world, and already incorporates the position relative to the United States. Measuring net foreign assets as the difference from the U.S. values will magnify the role of the net balance sheet position against the U.S., while ameliorating the role of net balance sheet position against third countries. When net foreign assets measured as the difference from the U.S. values are used in the regression, coefficient estimates on net foreign assets often, though not always, rise in numerical value and statistical significance. These results are available from the author upon request.

[14]When cross-section regression was estimated separately for each sample year, the coefficients on productivity were not statistically significant while the coefficient on net foreign assets was statistically significant for some of the sample years.

effect that is statistically significant, across all specifications. Productivity, however, has no statistically significant effect when time dummy is included. In estimates obtained without time dummy, the coefficients on productivity exceed 1 by a wide margin, contrary to the prediction of theory (Note that elasticities are smaller than one when positive, according to the model in the previous section). Comparing two determinants, net foreign assets have more robust positive effect on aggregate price levels than either measure of productivity, consistent with Implications 1 and 2.

The results for price levels of traded and nontraded sectors are reported in Table 5 and Table 6, respectively. The results for nontradables are almost identical to the results for aggregate prices. The coefficients on net foreign assets are again statistically significant across all specifications, while the coefficients on productivity are not statistically significant once time dummies are included. The results for tradables show a clear contrast. Most coefficients are not statistically significant. Even net foreign assets are found to have a statistically significant effect only in one specification.

The contrast in statistical significance among three tables constitutes evidence supportive of Implication 3. To compare three tables, coefficients on nontraded prices are most often statistically significant, followed by coefficients on aggregate prices, while coefficients on traded prices are rarely statistically significant. Coefficients on nontraded prices also assume largest numerical values in most cases. This pattern implies that productivity differential and net foreign assets have the strongest effect on non-traded prices, and affecting traded prices only indirectly and thus least strongly.

3.4 Discussion

While coefficient estimates support the three implications of the model, the examination of estimation results points to the limitation of these prime macro variables as the explanatory variable of cross-country differences in national price levels. In each table, country-specific coefficients—be they through fixed-effect specification or random-effect specification—account for bulk of cross-country variation in national price levels. With or without time effects, the

R^2 (check F-statistics) increase by a large margin when country specific constant terms are allowed.

This attests to the importance of other determinants of national price levels, although not readily identifiable. Several conventional variables were already examined in the background analysis of this paper, but produced no strong results. The drivers of these country-specific effects remain an open question, but two papers are worth noting. Bergstrand (1991) made the case for the importance of demand side factors, which would translate into differences in preferences in the likes of the model used in this paper. Possibly, further progress in the empirical study of preference (in trade literature) may shed light on one determinant of national price levels. Broda (2003) argued that the exchange rate regime choice can translate into the difference in national price levels, in the face of sluggish price adjustment. He also found a strong evidence in favor of such effects for developing countries. While he found little supportive evidence for advanced economies, the exchange rate regime can be an important factor in the broader sample comprising developing countries.

Subject to some limitation in accounting for national price levels, between productivity differential and net foreign assets, net foreign assets appear to deserve more emphasis that it used to receive. Since the systematic investigation of net foreign assets has started with the extensive data put together by Lane and Milesi-Ferretti (2000), the evidence on the international dispersion of net foreign assets has been accumulating. Lane and Milesi-Ferretti (2000) themselves first observed a persistent cross-country dispersion in net foreign asset positions of nearly 100 countries. Subsequently, Kraay and Ventura (2000) found that net foreign asset positions were highly persistent among advanced economies. Combining this evidence of long-run dispersion with this paper's result that net foreign assets have robust effect on price levels, net foreign assets are one robust determinant of national price levels that warrants further investigation.

The real exchange rate and net foreign assets of the United States may offer a case in point. Obstfeld and Rogoff (2005) have argued that the deteriorating external balance of the U.S. cannot continue indefinitely, and tried to quantify the magnitude of the exchange rate adjustment that would be necessary to restore external balance. The estimates of this paper allow us to ask a related question.

If the U.S. external position were to stabilize at the observed level of net external assets (liabilities), what could be the consistent real exchange rate? Figure 4 presents the result of the following hypothetical scenario. Assume that the real exchange rate of the U.S. has lately been out of equilibrium and has not been reflecting the effect of deteriorating external positions. One way to estimate its effect is to use the estimated coefficients of this paper. The estimated effect of net foreign assets can be obtained by multiplying the coefficient estimate and the level of net foreign assets, and we use three values (0.2, 0.5, and 0.7) that encompass most estimates we obtained. We thus present the observed the real exchange rate, and three series constructed by adding the estimated contribution of net foreign assets.

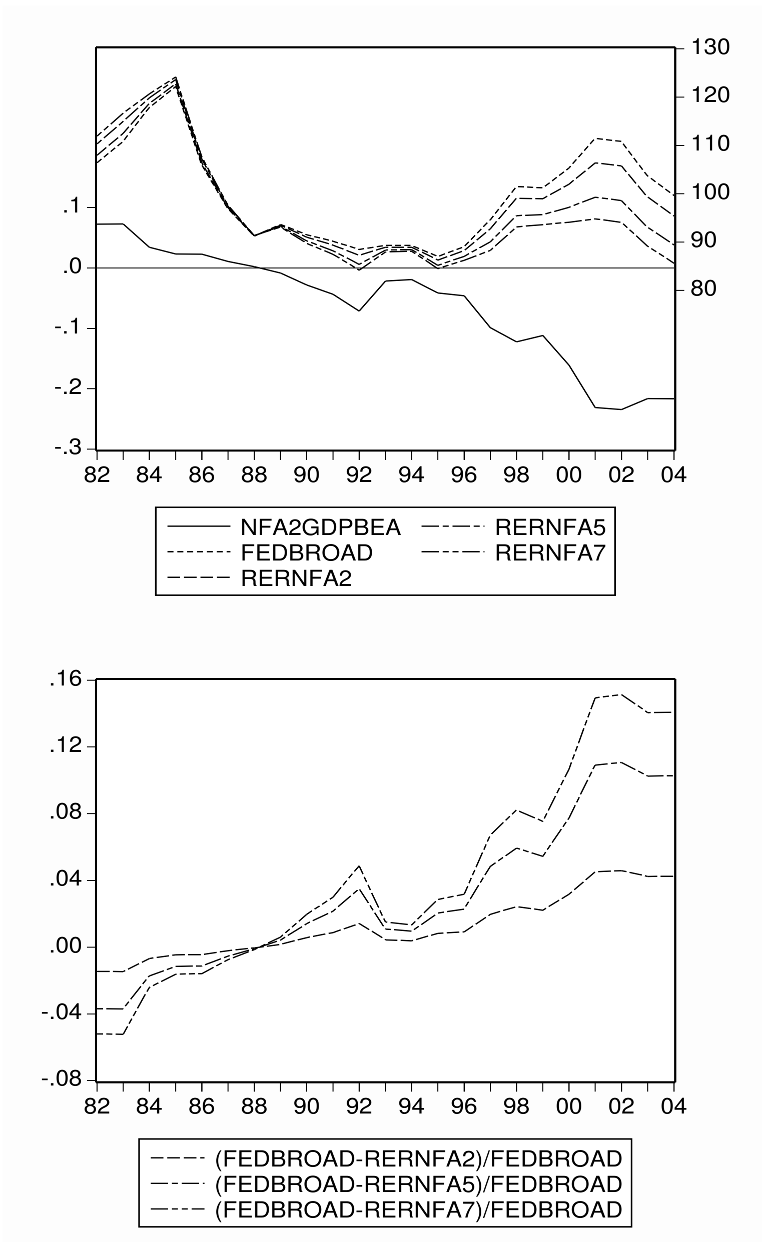
The upper panel shows the actual and constructed real exchange rates (based on the Federal Reserve Board index), and the net foreign assets in percent of GDP (obtained from the U.S. International Investment Position of the BEA). The lower panel shows the percentage difference between the actual and constructed real exchange rates; they show the estimated contribution of net foreign assets in percent of the actual real exchange rates. The estimated exchange rate imbalance ranges from 4 to 15 percent in 2004.

Of course, this exercise is undertaken for illustrative and speculative purposes, and there are several obvious disparities.[15] The estimations were done for the national price levels rather than for the effective real exchange rates; with non-continuous data rather than with continuous time series; and with the assumption that the effect of net foreign assets are reflected in national price levels.

This third assumption is particularly important, flying in the face of our assumption that net foreign assets have not been fully reflected in the real exchange rate of the United States. However, since the estimation used no data after 1997, it is consistent with the view that net external imbalance has not been a first-order issue for the U.S. before the late 1990s.

[15]More balanced and quantitative attempts to assess the likely development of the U.S. exchange rate can be found in Chinn and Lee (2005) and the references therein.

Figure 4: U.S. Exchange Rate and Net Foreign Assets



Moreover, the estimation used the U.S. as a numeraire currency, and most of variation was from other countries. If this third assumption is to be dropped, then the lower panel would indicate the likely amount of exchange rate depreciation that has been built into the observed exchange rate of the U.S.

4 Conclusion

It was shown theoretically that under most parameter restrictions, higher values of net foreign assets raise national price levels, while higher values of productivity have a less decisive effect. Even under quite plausible parameter values, national price levels can fall as productivity rises. In addition, productivity and net foreign assets are predicted to have stronger effects on nontraded prices than on traded prices. These theoretical predictions consolidate comparable predictions that were made for the effect of productivity and net foreign assets on the real exchange rate.

The examination of price level data for OECD countries confirms these predictions, strengthening the framework for systematic explanation of national price levels. In particular, the basic premise of this paper is confirmed by the greater dispersion of nontraded prices and the more robust effect of net foreign assets on nontraded prices. One direction for future research on national price levels would be to explore further the effect of net foreign assets in a broader sample of countries, since net foreign assets appear to be a no less robust determinant of national price levels than productivity, which has been the primary focus of literature on national price levels. It is also quite likely that this channel will apply more and more to other countries as they rapidly integrate themselves into the global financial market.

Appendixes

A More on the PPP Data

Under the auspices of the International Comparison Program, purchasing power parities (PPPs) are constructed as a comparator of retail prices across space. To ensure comparability across space, prices are gathered for products broken down to a great detail (thousands of categories). The raw data are then gradually aggregated into smaller numbers of categories. The data used for this paper were the one aggregated to 130-180 categories, with some variation among different survey years. For each year, individual categories were grouped into tradables and nontradables, according to the guideline laid out in Appendix Table 2.1 of Kravis et al. (1982).

The most difficult part of the construction of prices for traded and non-traded goods is the aggregation of individual price parities. While the usual aggregation would average individual prices(p_{ij} for price of category i in country j) by applying individual quantity weights (q_{ij}), this approach provides no information on the international comparability of prices. To derive the internationally comparable measure of the aggregate purchasing power parity (PPP_j), the value of aggregate expenditure needs to be compared with the international value of expenditure. To calculate the international value of expenditure, it is necessary to have the international price (Π_i) of each category of category. But the international price is best defined as the average of country-specific prices, converted into common unit by the aggregate purchasing power parity. This leads to the dilemma that the calculation of PPP_j's require Π_i's and vice versa. The solution to this dilemma (credited with Geary) is to obtain the international prices and aggregate purchasing power parities simultaneously.[16]

$$PPP_j = \frac{\sum_{i=1}^{m} p_{ij} q_{ij}}{\sum_{i=1}^{m} \Pi_i q_{ij}} \qquad j = 1, \cdots, n. \tag{34}$$

[16] Refer to Kravis (1984) or Kravis, Heston, and Summers (1982).

$$\Pi_i = \sum_{j=1}^{n} \frac{p_{ij}}{PPP_j} \left[\frac{q_{ij}}{\sum_{j=1}^{n} q_{ij}} \right] \qquad i = 1, \cdots, m. \tag{35}$$

In this paper, the aggregation was implemented according to this methodology.

B Symmetric Steady State

In the special case of zero net foreign assets ($FA = FA^* = 0$), the equations become homogeneous in prices. To see this, first note that

$$\frac{P_H}{\widetilde{P_T}} = \left[\gamma + (1-\gamma) \left(\frac{P_H}{P_F} \right)^{\theta-1} \right]^{\frac{1}{\theta-1}} \quad \textit{and} \quad \frac{P_H}{\widetilde{P_T^*}} = \left[(1-\gamma^*) + \gamma^* \left(\frac{P_H}{P_F} \right)^{\theta-1} \right]^{\frac{1}{\theta-1}}. \tag{36}$$

Substituting these into equilibrium condition (17) and imposing $FA = 0$, we get the following expression which fully determines $\frac{P_H}{P_F}$.

$$\frac{A_H}{A_F^*} \frac{P_H}{P_F} = \gamma \left[\gamma + (1-\gamma) \left(\frac{P_H}{P_F} \right)^{\theta-1} \right]^{\frac{1-\theta}{\theta-1}} + (1-\gamma^*) \left[(1-\gamma^*) + \gamma^* \left(\frac{P_H}{P_F} \right)^{\theta-1} \right]^{\frac{1-\theta}{\theta-1}} \tag{37}$$

The relative price between two tradables—the terms of trade, $\frac{P_H}{P_F}$—depends on the relative productivity $\frac{A_H}{A_F^*}$ and several primitive parameters, including the elasticity of substitution (θ) and home bias in preference (γ and γ^*). In the absence of home bias ($\gamma = \gamma^* = 1/2$), the model reduces to a two-country version of Fitzgerald (2003) and the relative price can be solved algebraically.

In general cases with home bias ($\gamma, \gamma^* > 1/2$), however, the model cannot be solved algebraically. A well-defined symmetric equilibrium offers a convenient base for log-linearization. A symmetric steady state with $P_H = P_F$ can be obtained from equation (37) if symmetry is assumed in both preference and technology, namely $\gamma = \gamma^* = \bar{\gamma}$ and $A_H = A_F^* = \bar{A}_0$.

C Productivity in the Nontraded Sector

If domestic nontraded productivity is allowed to change (relative to foreign nontradables productivity), equation (2.2) is rewritten as:

$$P_N Y_N + P_H Y_H = A_H P_H A_N (1 - L_H) + P_H A_H A_N L_H = A_H A_N P_H, \tag{38}$$

and equation (14) is written as:

$$\widetilde{P_T}\widetilde{C_T} = \alpha\beta(A_H A_N P_H + rFA). \tag{39}$$

As the result, equations (16) and (17) become:

$$P_H Y_H = \alpha\beta A_H A_N P_H + (1 - \alpha\beta) rFA \tag{40}$$

and

$$\alpha\beta A_H A_N P_H + (1-\alpha\beta) rFA = \gamma \left(\frac{P_H}{\widetilde{P_T}}\right)^{1-\theta} \alpha\beta(A_H A_N P_H + rFA) + (1-\gamma^*) \left(\frac{P_H}{\widetilde{P_T^*}}\right)^{1-\theta} \alpha\beta(A_F^* P_F - rFA). \tag{41}$$

To log-linearize around the symmetric equilibrium with identical productivity for all sectors and zero net foreign assets, the equilibrium terms of trade (equation (19) changes to

$$\widehat{P_H} - \widehat{P_F} = -\frac{\widehat{A_H} + \widehat{A_N} - \widehat{A_F^*}}{2\bar{\gamma}(\theta - 1) + 1} + \frac{1 - \alpha\beta + \alpha\beta(2\bar{\gamma} - 1)}{\alpha\beta(1 - \bar{\gamma})[2\bar{\gamma}(\theta - 1) + 1]} \frac{\Delta(rFA)}{\bar{A}_0}. \tag{42}$$

As the result, the international prices of nontraded goods carry the negative terms of trade effect of home nontraded productivity improvement. Relative to equation (23), we have

$$\widehat{P_N} - \widehat{P_N^*} = -\frac{\widehat{A_N}}{2\bar{\gamma}(\theta - 1) + 1} + \frac{2\bar{\gamma}(\theta - 1)}{2\bar{\gamma}(\theta - 1) + 1}(\widehat{A_H} - \widehat{A_F^*}) + \frac{1 - \alpha\beta + \alpha\beta(2\bar{\gamma} - 1)}{\alpha\beta(1 - \bar{\gamma})[2\bar{\gamma}(\theta - 1) + 1]} \frac{\Delta(rFA)}{\bar{A}_0} \tag{43}$$

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Table 1: Price Levels in U.S. dollars

	Aggregate		Traded		Nontraded	
	mean	std dev	mean	s.d.	mean	s.d.
Australia	0.93	(0.08)	1.10	(0.14)	0.85	(0.09)
Austria	1.14	(0.19)	1.40	(0.27)	1.01	(0.17)
Belgium	1.01	(0.16)	1.19	(0.22)	0.91	(0.14)
Canada	0.92	(0.11)	1.06	(0.13)	0.84	(0.10)
Switzerland	1.47	(0.15)	1.53	(0.17)	1.43	(0.16)
Denmark	1.25	(0.20)	1.49	(0.27)	1.12	(0.17)
Finland	1.19	(0.26)	1.52	(0.31)	1.03	(0.24)
France	1.10	(0.17)	1.29	(0.24)	0.99	(0.14)
Germany	1.13	(0.19)	1.21	(0.24)	1.09	(0.17)
Greece	0.77	(0.12)	1.14	(0.33)	0.62	(0.08)
Ireland	0.99	(0.13)	1.31	(0.20)	0.81	(0.13)
Italy	0.94	(0.17)	1.20	(0.24)	0.80	(0.14)
Japan	1.31	(0.23)	1.48	(0.25)	1.22	(0.22)
Netherlands	1.02	(0.16)	1.18	(0.22)	0.93	(0.14)
Norway	1.24	(0.20)	1.54	(0.27)	1.08	(0.18)
New Zealand	0.84	(0.13)	1.13	(0.16)	0.71	(0.12)
Portugal	0.62	(0.14)	1.06	(0.22)	0.44	(0.11)
Spain	0.87	(0.19)	1.24	(0.28)	0.73	(0.16)
Sweden	1.25	(0.22)	1.40	(0.23)	1.16	(0.21)
United Kingdom	0.95	(0.13)	1.15	(0.19)	0.85	(0.10)
United States	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)

For each country, the sample is for 1985, 1990, 1993, 1996, and 1999.
For Switzerland, no observation was available for 1985.

Table 2: Summary Statistics of Price Levels

	Sample Statistics			Hypothesis Tests			Normality
	Mean	S.D.	Median	Mean=0[a]	Var=0.03[b]	Med=0[c]	Jacque-Bera test[d]
Aggregate	-0.004	0.25	0.01	-0.13 (0.89)	186.85 (0.00)	0.29 (0.78)	14.40 (0.00)
Traded	0.10	0.21	0.13	4.58 (0.00)	134.54 (0.00)	4.18 (0.00)	1.24 (0.54)
Nontraded	-0.07	0.30	-0.07	-2.13 (0.04)	271.33 (0.00)	1.55 (0.12)	41.95 (0.00)

The data are observations for 1985, 1990, 1993, 1996, and 1999.

[a] $t-$statistic and the associated probability in parenthesis
[b] Variance ratio and associated probability in parenthesis
[c] Wilcoxon singed rank and associated probability in parenthesis
[d] Jacque-Bera test statistic and associated probability in parenthesis

The sample is for the 18 countries that were used in Tables 3 and 4.

Table 3: Cross-Section Regressions

	Aggregate Prices	Traded Prices	Nontraded Prices
Relative Income	0.46	0.15	0.68
	(0.28)	(0.22)	(0.35)*
Net Foreign Assets	0.32	0.17	0.42
	(0.18)*	(0.14)	(0.23)*
R^2	0.30	0.12	0.35
Relative Productivity Differential	0.16	0.05	0.24
	(0.15)	(0.11)	(0.19)
Net Foreign Assets	0.35	0.17	0.45
	(0.19)*	(0.14)	(0.24)*
R^2	0.24	0.10	0.27

Average over sample years 1985, 1990, 1993, and 1996, for which net foreign assets data were also available. Statistical significance at 10 and 5 percent is denoted by * and **, respectively.

Table 4: Aggregate Price Levels

	With time-specific effect			Without time-specific effect		
	Common	Fixed	Random	Common	Fixed	Random
Relative Income	0.02	-0.10	-0.03	0.20	1.87	0.66
	(0.17)	(0.44)	(0.25)	(0.21)	(0.47)**	(0.30)**
Net Foreign Assets	0.22	0.52	0.38	0.26	0.59	0.34
	(0.10)**	(0.18)**	(0.13)**	(0.13)*	(0.30)*	(0.18)*
R^2	0.46	0.90	0.86	0.08	0.67	0.47
Relative Productivity Differential	0.02	0.13	0.05	0.04	0.86	0.10
	(0.08)	(0.27)	(0.13)	(0.10)	(0.48)*	(0.15)
Net Foreign Assets	0.23	0.52	0.38	0.27	0.71	0.38
	(0.10)**	(0.18)**	(0.13)**	(0.13)**	(0.34)**	(0.18)**
R^2	0.46	0.90	0.87	0.07	0.58	0.41

For sample years 1985, 1990, 1993, and 1996, for which net foreign assets data were also available. Statistical significance at 10 and 5 percent is denoted by * and **, respectively.

Table 5: Traded Price Levels

	With time-specific effect			Without time-specific effect		
	Common	Fixed	Random	Common	Fixed	Random
Relative Income	-0.13	-0.22	-0.17	0.06	1.98	0.40
	(0.15)	(0.44)	(0.23)	(0.21)	(0.48)**	(0.27)
Net Foreign Assets	0.13	0.29	0.20	0.16	0.36	0.19
	(0.09)	(0.18)	(0.12)*	(0.13)	(0.31)	(0.17)
R^2	0.52	0.89	0.86	0.03	0.61	0.32
Relative Productivity Differential	-0.07	-0.28	-0.10	-0.05	0.64	-0.03
	(0.07)	(0.27)	(0.11)	(0.09)	(0.50)	(0.12)
Net Foreign Assets	0.11	0.29	0.19	0.16	0.49	0.20
	(0.09)	(0.18)	(0.12)	(0.13)	(0.36)	(0.15)
R^2	0.52	0.89	0.86	0.03	0.47	0.25

For sample years 1985, 1990, 1993, and 1996, for which net foreign assets data were also available. Statistical significance at 10 and 5 percent is denoted by * and **, respectively.

Table 6: Non-Traded Price Levels

	With time-specific effect			Without time-specific effect		
	Common	Fixed	Random	Common	Fixed	Random
Relative Income	0.11	-0.00	0.06	0.28	1.84	0.87
	(0.20)	(0.49)	(0.29)	(0.23)	(0.48)**	(0.33)**
Net Foreign Assets	0.27	0.65	0.47	0.30	0.74	0.45
	(0.12)**	(0.20)**	(0.15)**	(0.14)**	(0.31)**	(0.20)**
R^2	0.39	0.90	0.86	0.10	0.72	0.57
Relative Productivity	0.07	0.39	0.15	0.09	1.03	0.22
Differential	(0.09)	(0.30)	(0.15)	(0.11)	(0.47)**	(0.18)
Net Foreign Assets	0.28	0.66	0.49	0.33	0.85	0.51
	(0.12)**	(0.20)**	(0.15)**	(0.14)**	(0.34)**	(0.21)**
R^2	0.39	0.90	0.86	0.09	0.66	0.53

For sample years 1985, 1990, 1993, and 1996, for which net foreign assets data were also available. Statistical significance at 10 and 5 percent is denoted by * and **, respectively.