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# UNDERSTANDING KOREA'S LONG-RUN REAL EXCHANGE RATE BEHAVIOR

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**ABSTRACT**

Korea’s real exchange rate has displayed a mild downward trend since the 1980s, with fluctuations of ±20 percent around that trend. This pattern is surprising because the classic Harrod-Balassa-Samuelson framework suggests that countries experiencing rapid growth in the productivity of their tradable industries should experience real currency appreciation over time. We decompose the sources of change behind the Korean won’s real exchange rate into internal price drivers (the relative price of nontradable goods) and external price drivers (the international relative price of tradable consumption goods, which is heavily dependent on the nominal exchange rate). We find that, on average, the variability in Korea’s real exchange rate, even over long periods, is overwhelmingly due to external price factors. Given the persistent medium-term effects of nominal exchange rate changes on the real exchange rate, the Korean policy of intervening in foreign exchange markets to smooth exchange rate fluctuations appears prudent. However, we also find that over the entire period 1985-2023, internal price factors are the main explanator of the won’s real depreciation. This finding poses a puzzle for standard accounts of the linkage between productivity growth and real exchange rates.

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# Understanding Korea's Long-Run Real Exchange Rate Behavior

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## I. Introduction

It is often said that the exchange rate is the most important price in any economy that is highly integrated with foreign markets. More precisely, the real exchange rate—the nominal exchange rate adjusted for national money price levels—is key for external balance and resource allocation in such an economy.

The case of Korea is particularly interesting. Since the 1960s, the country has transformed itself from one of the poorest countries in the world, exporting less than 1 percent of GDP, to a high-income, high-tech producer with exports of about 40-50 percent of GDP. Having experienced such rapid growth and structural change over a relatively short period of time makes Korea an important test case of whether its real exchange rate behavior conforms to our basic understanding of the long-term determinants of the rate.

A country's real exchange rate is partly affected by its nominal exchange rate regime and the stance of its monetary policy relative to monetary policies abroad. Korea's management of its nominal exchange rate has long had important implications for its real exchange rate. In particular, fixing the nominal exchange rate in the 1950s and 1960s, without following monetary policies consistent with that commitment, led to real exchange rate misalignments that adversely affected trade. The move toward a more flexible but still controlled nominal exchange rate regime in the mid-1960s enabled rapid growth in exports and a movement toward external balance.

The devastating financial crisis in 1997-98 inspired a far-reaching shift in Korea's monetary, financial, and exchange rate policy framework. The main elements in the new framework were:

- (i) a floating nominal exchange rate rather than a heavily managed one;
- (ii) targeting of foreign exchange reserves at a constant share of GDP, a share long maintained at or slightly above 25 percent;
- (iii) two-sided foreign exchange intervention to counter exchange-rate volatility while maintaining the target reserve level;
- (iv) introduction of an inflation-targeting framework for monetary policy;
- (v) thoroughgoing banking and financial-sector regulatory reform; and
- (vi) further opening of the capital account, consistent with greater currency flexibility and the need to draw on foreign direct and portfolio equity investment, but with allowance for macroprudential interventions.

Dooley, Dornbusch, and Park (2002) endorsed this framework as the pathway for Korea to transition from upper-middle-income to high-income status.[1]

More than 20 years and two major international crises later, essentially the same framework remains in effect. A key element in the successful operation of the current

[1] For discussions of Korean reforms, see Kim (2006), Kim and Park (2006), Obstfeld (2014), Lee (2016), and the references therein.

framework is for the Bank of Korea and the Ministry of Strategy and Finance to have a shared view of the appropriate level of the won's real exchange rate in light of long-run economic fundamentals.[2] This knowledge can help the authorities avoid being pushed into missteps both in monetary and financial stability policy.[3] Official intervention in the foreign exchange market when exchange rate volatility is deemed excessive is frequent and sometimes large, but it tends to be two-sided over time. For this framework to be sustainable, however, the Korean authorities must not attempt to resist market-determined trends through intervention.

Although Korea has achieved success under this regime, with continued albeit slowing growth and structural change, Korean policymakers continue to be attentive to movements in the won's real exchange rate. In fact, the past four decades have seen a gentle real depreciation trend for the won. This is surprising: According to standard macroeconomic theories, continued rapid productivity growth in tradable industries would be expected to lead to a secular appreciation of the real won exchange rate. Hence, Korea provides a fascinating case study in which one can assess current theories of real exchange rate movements in one of the most interesting and dynamic economies in the world.

Our goal is to assess changes in Korea's real exchange rate in light of the several factors that economic theory identifies as medium- to long-term determinants of the rate. We draw on the Harrod-Balassa-Samuelson (HBS) framework (Obstfeld and Rogoff 1996) to focus attention on the relative price of nontradable goods and services across countries, including the productivity developments behind that relative price. The role of internal prices in exchange rate determination and balance of payments analysis is a relatively recent insight, pioneered by Australian economists in the 1930s and after (Metaxas and Weber 2016). An older tradition focuses on external prices—that is, international competitiveness for tradable goods. Therefore, we also focus on the international relative price of tradables. As we shall see, both factors play roles empirically, although it is the international relative price of tradables that drives most variability in the won's real exchange rate.

Of course, different normative approaches to the equilibrium real exchange rate are useful but must be applied with caution—and a healthy dose of skepticism.[4] In this paper, we conduct a positive inquiry into the long-run won exchange rate with an eye toward elucidating key drivers. In principle, this approach can help avoid errors from overly rigid theories and

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[2] On Korean authorities' responsibility for intervention, see Ryoo, Kwon, and Lee (2013).

[3] For example, in late September 2022, amid monetary tightening by the US Federal Reserve, the nominal Korean won (KRW)/US dollar (USD) exchange rate breached the level of KRW 1,400 per dollar previously seen only during the Asian Crisis and the global financial crisis, sparking press commentary that Korea was experiencing a comparable financial crisis requiring dramatic policy intervention. As Reuters tellingly reported, "Every 100-won mark is considered psychologically important in South Korea." See Choonsik Yoo, "S. Korean Won Tumbles after Fed Hike Despite Official Warnings," Reuters, September 22, 2022, https://www.reuters.com/markets/currencies/skorea-vows-measures-stem-wons-decline-2022-09-21/. The commentary ignored the fact that the won's effective real exchange was not far below average levels of 2010-12, which were not crisis years for the Korean economy and saw the nominal KRW/USD rate at around 1,100. Recent strength of the dollar against other currencies, including the won, has revived intervention talk. See Cheng Leng and William Sandlund, "U.S., Japan, and South Korea Seek to Limit Dollar's Rise," *Financial Times*, April 18, 2024, https://www.ft.com/content/63c36478-8cf3-438e-91e2-97a8888773d1.

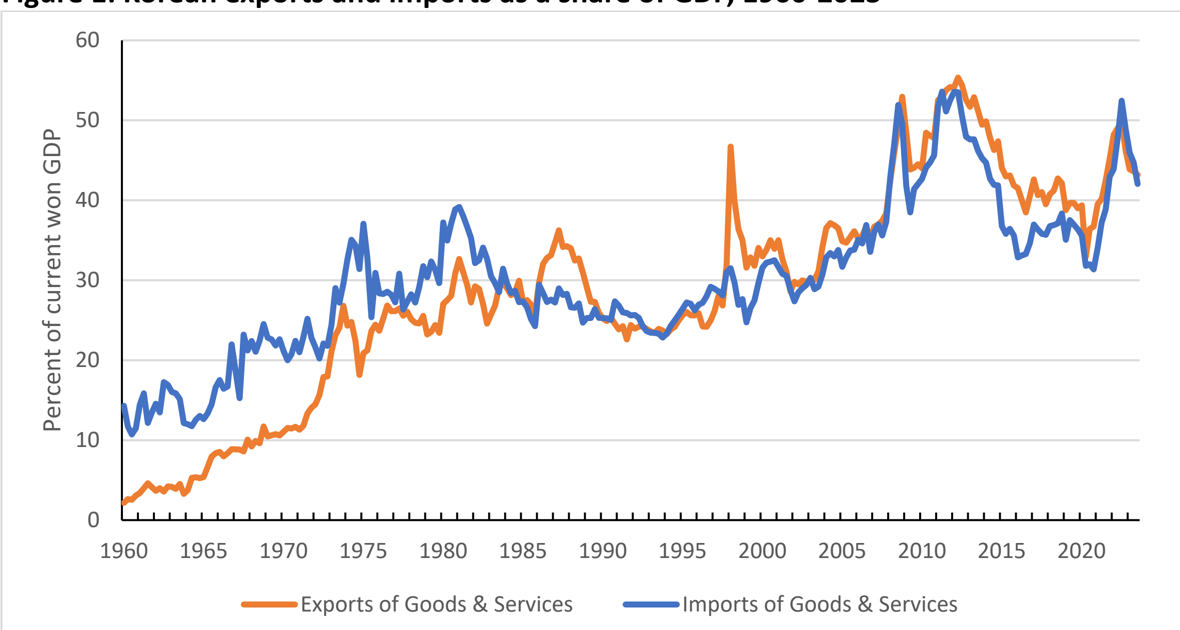
[4] See, for example, Cline and Williamson (2008) and the International Monetary Fund's External Balance Assessment modeling (IMF 2023).

inform the policymaker as to what approaches are likely to be most useful in understanding market developments. But we acknowledge that even ex post understanding of exchange rate movements—let alone prediction—is extremely challenging.

**II. Background**

Because of the difficulties Korea had in achieving macroeconomic stability in the aftermath of World War II and the Korean War of 1950-53, the government maintained a fixed nominal exchange rate of the won against the dollar and did not adjust that rate for the higher inflation rate in Korea. As a result, the won was often overvalued by a significant amount.[5] The overvaluation of the won suppressed exports and encouraged imports. The United States provided substantial foreign aid that allowed Korea to finance a large merchandise trade deficit in the 1950s and into the 1960s. As figure 1 shows, the trade deficit was nearly 10 percent of GDP in 1960, whereas exports were a tiny share of the economy.

**Figure 1: Korean exports and imports as a share of GDP, 1960-2023**




*Source*: Organization for Economic Cooperation and Development, Main Economic Indicators, via FRED.

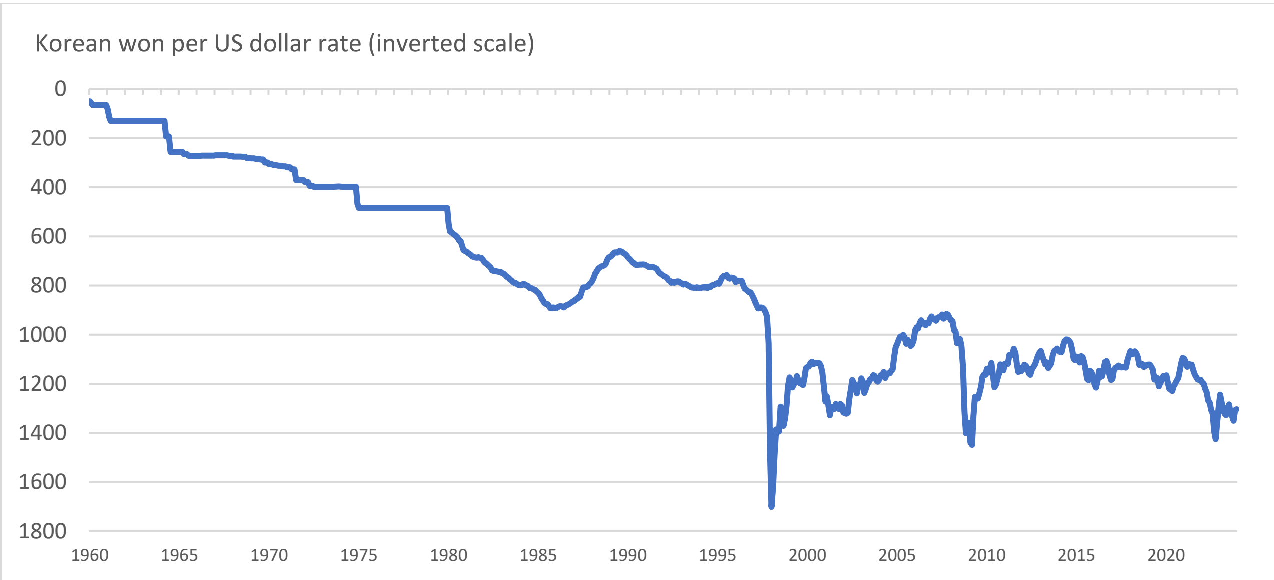
In the early 1960s, the United States began to curtail aid and urged the Korean authorities to devalue the won and boost its exports so that it would earn enough foreign exchange to pay for its imports. The United States succeeded in persuading Korea's government to undertake a large devaluation in 1961, after which the won was fixed and became overvalued

[5] The Korean government under Syngman Rhee (who was president from 1947 to 1960) resisted devaluation because it benefited from the overvaluation of the won. Under the "advance agreement" reached after the outbreak of the Korean War in 1950, Korea would advance the won to the United Nations Command for its expenditures in Korea and be reimbursed by the United States in dollars. The Korean government had a strong financial incentive to keep the domestic currency price of the dollar as low as possible, which would maximize the dollars received from a given won advance.

again. A subsequent devaluation in 1964 was accompanied by the government adopting a more flexible exchange rate regime to maintain a competitive and realistic real exchange rate (Irwin 2021). The government relied on relatively frequent adjustments to the nominal rate (figure 2) such that the black-market premium on the won was eliminated.

The establishment and maintenance of a realistic exchange rate set the stage for Korea's subsequent export success. As figure 1 shows, exports as a share of GDP started to rise in the mid-1960s and soon reached spectacular levels, about 30 percent of GDP by the early 1980s. Furthermore, Korea achieved roughly balanced trade by the mid-1980s, something that had been a long-term objective. The exchange rate was never freely floating during this period but was heavily managed and occasionally adjusted. Because Korea had a higher rate of inflation than the United States, there were relatively large nominal devaluations in 1971, 1974, and 1980.

**Figure 2: Korean won/US dollar nominal exchange rate, monthly, 1960-2023**




*Source:* Organization for Economic Cooperation and Development via FRED.

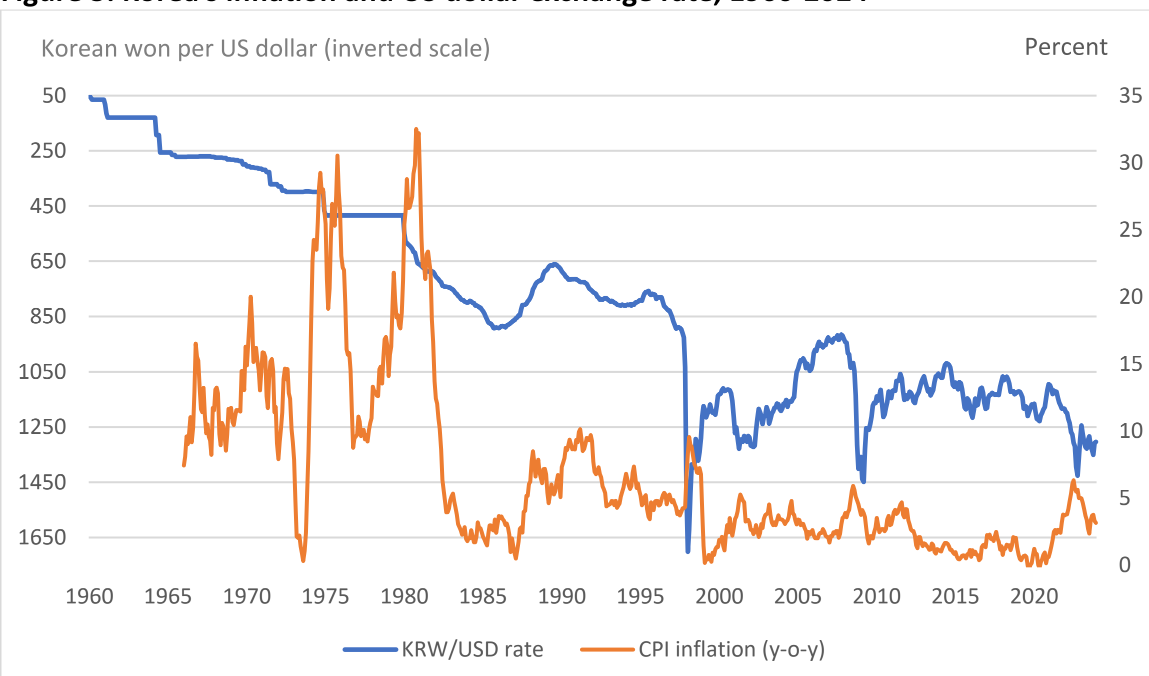
After 1980, Korea moved from a regime of fixed rates against the US dollar, with periodic devaluations, to a more flexible but still heavily managed regime. The new exchange rate system had the Korean won pegged to a basket of currencies for major trading partners and was designed to maintain a more stable real effective exchange rate when there were large fluctuations in the exchange rates of major trading partners (Nam and Kim 1999). Still, the movement of the dollar was critically important for Korea during this period: The 1980s saw, of course, the large appreciation of the dollar from 1979 to 1985 followed by its depreciation from 1985 to 1990, both of which are quite evident in figure 2.

In March 1990, a new exchange rate system known as the "market average rate" system replaced the multicurrency basket peg system. The won/dollar exchange rate was set within a specified range around the weighted average interbank rates of the previous day. The band was widened gradually over the course of the 1990s.

This post-1980s regime was interrupted by the devastating financial crisis in 1997-98. The massive depreciation of the won in 1998 sparked a rethinking of Korea's monetary, financial, and exchange rate framework. In 1998 the Bank of Korea adopted an inflation-targeting regime in which the core inflation rate is the target outcome, and the call money rate is the operational target for monetary policy (Kim and Park 2006). In choosing to stabilize the rate of inflation, the Bank largely gave up direct control over the won.

The shift from exchange rate targeting to inflation targeting implies that the Korean authorities refocused their emphasis from external to internal price stability. Figure 3 illustrates the policy shift during this period. Prior to 2000, Korea's inflation rate was highly unstable while the exchange rate was subject to periodic limited adjustments. Since the Asian Crisis, Korean inflation has been relatively stable (between 0 and 5 percent), with smaller spikes occurring during crisis periods, whereas nominal exchange rate fluctuations have been more pronounced. Since the global financial crisis, the nominal won rate has mostly moved within a band of approximately $\pm$20 percent. This illustrates the potential trade-offs, the dilemma (as John Maynard Keynes put it in his 1923 *Tract on Monetary Reform*) between stabilizing domestic prices and stabilizing the exchange rate.

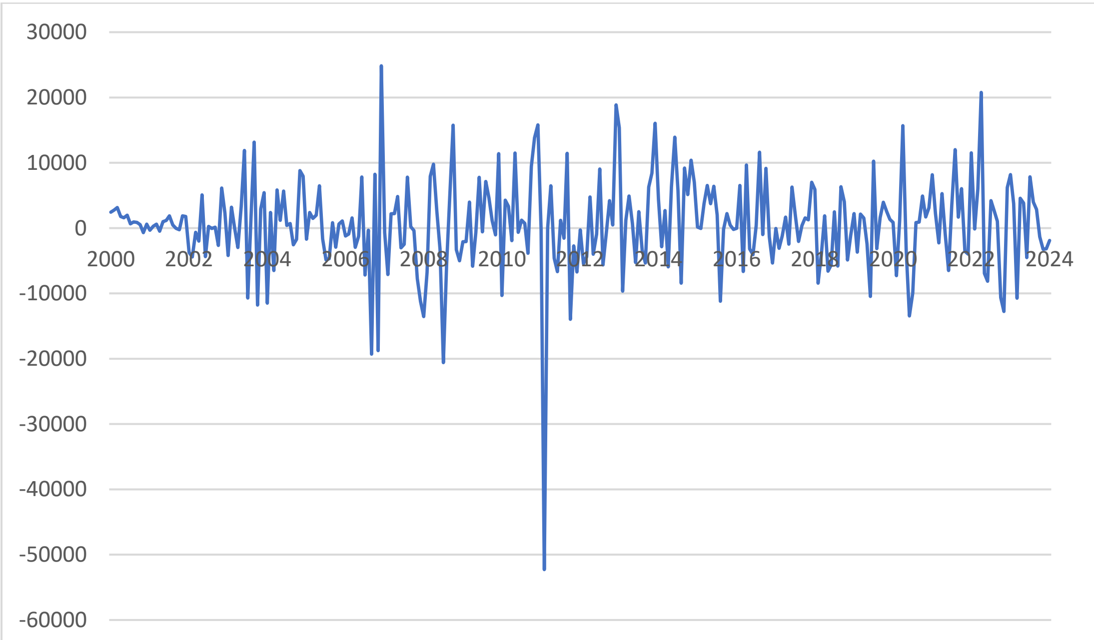
**Figure 3: Korea's inflation and US dollar exchange rate, 1960-2024**




*Source:* Organization for Economic Cooperation and Development via FRED and Statistics Korea.

Under the post-Asian Crisis regime, however, the Korean authorities did not forgo all efforts to stabilize the nominal exchange rate. Rather, they have attempted to dampen exchange rate volatility through periodic intervention in the foreign exchange market. Figure 4 shows that this has been a two-way intervention, both in support of the won and to dampen its appreciation. In the aftermath of the 1997-98 financial crisis, Korea built up its official international reserves, mainly between 1997 and 2004. During that period, Korea seems to have intervened more to resist the appreciation of the won to accumulate dollar reserves. Since 2010, official international reserves have been quite stable at around 25 percent of GDP, much higher than the 5.6 percent of GDP held in 1996.[6]

**Figure 4: Korea's intervention in foreign exchange markets (+ is purchases of US dollars), in millions of USD**




*Source:* Adler et al. (2024).

Consistent with this reserve accumulation, but by no means due to it exclusively, Korea has also tended to experience current account surpluses under the new monetary policy regime. Korea had large current account surpluses episodically—in 1998 around the Asian Crisis and in 2009—until the 2010s. From 2012 to 2021, Korea regularly achieved surpluses near 4 percent of GDP and higher. The International Monetary Fund (IMF) judged that Korea's current account surplus for 2022, at 1.8 percent of GDP, was "broadly in line with the level implied by medium-term fundamentals and desirable policies," but somewhat below the cyclically adjusted norm that the IMF's internal model implied (IMF 2023). The IMF accordingly concluded that the won was generally slightly overvalued in 2022 (by just under 3 percent), and

[6] This figure ignores the asset holdings of Korea's sovereign wealth fund, the Korea Investment Corporation (KIC), established in 2005. In 2023 it held about $190 billion, amounting to roughly 11 percent of Korean GDP. However, KIC assets cover a large range of countries and currencies and comprise not only bonds but also many assets that do not have the character of international reserves, including equities, real estate, venture capital, and alternative investments. The Korean National Pension Service held a globally diversified portfolio amounting to around $733 billion at the end of July 2023, also largely in nonreserve assets, with about half held overseas. See Reuters, "S. Korea Pension Fund to Keep Increasing Overseas Investments through 2028," October 26, 2023, https://www.reuters.com/article/idUSL1N3BX0C6/.

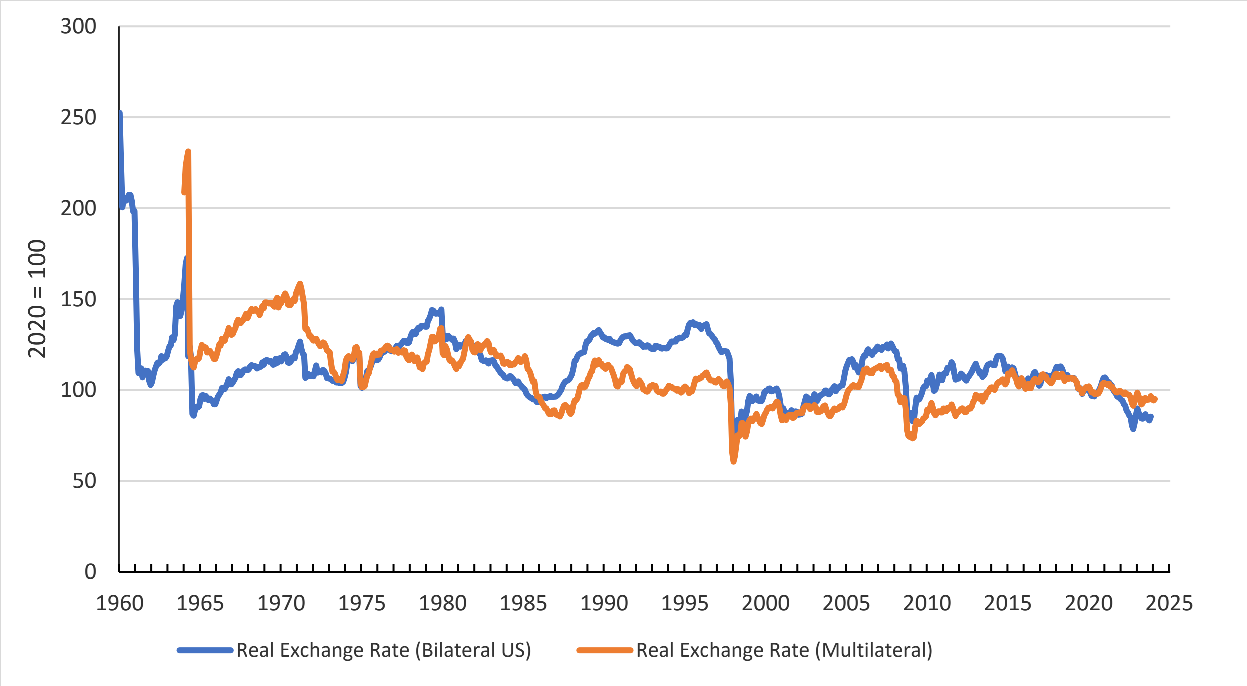
consistent with that judgment, the won has depreciated since then. Korea's current account rose to 2.1 percent of GDP in 2023.

### III. Evolution of Korea's Real Exchange Rate

While the nominal exchange rate has long been a policy tool, target, or indicator for the Korean authorities, the more economically consequential variable is the real exchange rate. How has the real exchange rate behaved under the current and previous monetary regimes?

Figure 5 presents two measures of Korea's real exchange rate: a bilateral rate with the United States (deflated by the respective consumer price indexes [CPIs]) and a multilateral rate against most of its trading partners (also based on CPIs). The series are defined so that a downward movement is a relative real depreciation of the won. Since the early 1970s, the two series have been highly correlated and tell essentially the same story: After the massive devaluations of the early 1960s established a realistic exchange rate, the real exchange rate has trended downward slowly (i.e., a real depreciation). However, the rate has fluctuated around its downward trend within a band of ±20 percentage points, enough to affect resource allocation significantly in the medium term.

**Figure 5: Bilateral (against the US dollar) and multilateral effective real exchange rates of the won**

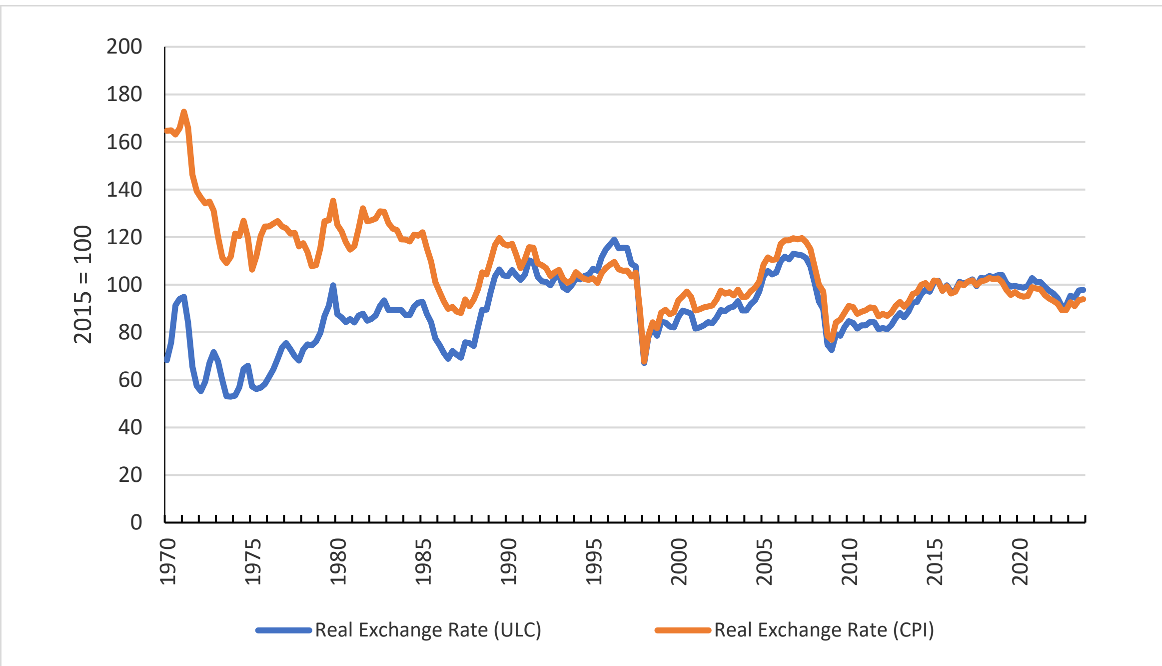



Note: Multilateral real effective exchange rate is the Bank for International Settlements monthly narrow index.
*Source*: Organization for Economic Cooperation and Development and Bank for International Settlements via FRED.

The real exchange rate is typically calculated using either the CPI or unit labor costs (ULC) as the domestic price index. There is some evidence that the ULC deflator may be more appropriate in determining the expenditure switching between home goods and imports needed to shift the trade balance.[7] Figure 6 presents the two series and shows that these alternative multilateral real exchange rates are highly correlated starting in 1990, suggesting that either measure may be useful in the Korean case. (In the 1970s and 1980s, the real exchange rate was depreciating based on the CPI but was stable to slightly appreciating with reference to ULCs.)

A simple organizing framework will guide our discussion of the won's real exchange rate. For simplicity, we will focus largely on the bilateral real rate against the dollar, which also seems to be a reference rate for financial markets and policymakers. Even though China has displaced the United States as Korea's main trade partner, China manages the yuan with reference to the US dollar, somewhat dampening real exchange rate fluctuations between the yuan and the dollar. Thus, as figure 5 attests, the won/dollar bilateral real rate is a good indicator of the multilateral real rate.

**Figure 6: Korea's multilateral real exchange rate, unit labor costs versus consumer prices, 1970-2023**




Note: Both real exchange rate measures are quarter averages.
*Source:* Organization for Economic Cooperation and Development via FRED.

## IV. Conceptual Framework for Real Exchange Rate Analysis

Turning to our analytical approach, let *P* be Korea's consumer price level and *P** that of the United States, with *E* the price of won in terms of dollars. Then the real exchange rate of the

[7] Ahn, Mano, and Zhou (2020) contrast real exchange rate (RER) measures based on different deflators (CPI, GDP deflator, and ULC) and find that only the RER deflated by ULC exhibits patterns consistent with the expenditure-switching mechanism.

won against the dollar (defined so that an increase is a relative real appreciation of the won) is $q = EP/P^*$.

Each country's consumer price level, in turn, depends on the domestic price indexes for tradable and nontradable goods, denoted $P_T$ and $P_N$ for Korea and $P_T^*$ and $P_N^*$ for the United States. In general, a rise in *E* (nominal won appreciation) or rise in *P/P** (rise in Korea's relative money price level) raises the price of consumer goods in Korea compared with the United States and thus is a real appreciation of the won against the dollar. As shown by Obstfeld and Rogoff (2007, 356), a useful approximation for the change in the log won real exchange rate (even without the assumption of Cobb-Douglas preferences) is

$$\Delta \log(q) \approx (1-\gamma)\Delta\, log\left(\frac{\frac{P_N}{P_T}}{\frac{P_N^*}{P_T^*}}\right) + \Delta log\left(\frac{EP_T}{P_T^*}\right), \qquad (1)$$

where $\gamma$ is the share of tradables in the CPI (assumed to be the same in the two countries).

This equation focuses attention on the two main determinants of the real exchange rate: the international ratio of relative prices of nontradables and the international relative price of tradables.[8] We explain these two factors in turn to understand the forces driving the dollar/won real exchange rate.

*The Internal Price Mechanism*

The international relative prices of nontradables are reflected in the first term above, $\Delta\, log\left(\frac{P_N/P_T}{P_N^*/P_T^*}\right)$, which is the "difference in differences" between the (internal) relative prices of nontradable and tradable goods in Korea and the United States. This relative price is the basis for the HBS approach to exchange rates, which presumes that productivity grows more quickly in tradable goods than nontradable goods, pushing up economywide real wages and leading to a rising price of nontradable goods in terms of tradables. This element of the HBS model is known as the Baumol-Bowen effect (Baumol and Bowen 1966) and has considerable empirical support in past data across a range of countries.

However, the HBS model goes further to derive a prediction about real exchange rates. Converging lower income countries with growing per capita incomes would be expected to have especially rapid productivity growth in tradables compared with nontradables, pushing relative nontradables prices to rise more quickly. If the prices of tradables are broadly similar across countries because of international arbitrage—a critical assumption, as we will discuss below—then the lower-income country's currency will appreciate in real terms over time as its relative price level rises.[9] An important implication of the HBS benchmark is that real appreciation

[8] The preceding formula assumes equal expenditure shares on nontradables in Korea and the United States. This is not too far off the facts insofar as official statistics allow a judgment. In fact, any decomposition of CPI basket elements into tradables and nontradables is inherently imperfect owing to the inclusion of nontradable elements (such as distribution services and rents) in the retail prices of tradable goods, a point to which we will return. At the cost of greater complexity, the formula could be generalized to handle heterogeneous preferences.

[9] The positive connection between per capita income levels and price levels is familiar from International Comparison Project data (Feenstra et al. 2015).

driven by relatively high productivity growth in export and import competing industries should not entail lower profitability in the manufacture and export of tradable goods.

Empirical evidence on the HBS effect as a factor in real exchange rate determination is decidedly mixed. Previous studies found little relationship between sectoral productivity differentials and real exchange rates for high-income countries with floating nominal exchange rates (Obstfeld 2011). However, Berka, Devereux, and Engel (2018) report that real exchange rate variation in the eurozone, both cross-country and time series, closely follows an amended Balassa-Samuelson interpretation that incorporates sectoral productivity shocks and a labor market wedge. Of course, the eurozone economies are special, as they are linked by a single currency and a single market. Both factors dampen the influence of international relative *tradables* prices (external relative prices) on the real exchange rate.

*International Relative Tradables Prices*

The second potential factor driving the real exchange rate is variation in the international relative price of consumer tradables, reflected in the term $\Delta log\left(\frac{EP_T}{P_T^*}\right)$ in equation 1.[10] In the simplest versions of the HBS model, consumer baskets of tradable goods are the same across countries and the law of one price holds for tradables, so $\Delta log\left(\frac{EP_T}{P_T^*}\right)$ is identically zero. In this case, changes in the nominal exchange rate do not have an effect on the real exchange rate as it simply adjusts to equate the prices of traded goods.

However, the tradable goods price ratio could change if consumption preferences for tradables differ across countries and there are relative price changes within the set of tradables. For example, the likelihood that a country's residents have a consumption bias toward domestically produced exportables introduces the possibility that a country's terms of trade—the price of exports in terms of imports—can influence its real exchange rate. *Home bias* means that in their preferred basket of tradable goods, the country's residents have a relative preference for consumption of their own exports. In this case, an improvement in the terms of trade, which we have defined as a rise in the relative price of exports in terms of imports, would raise $EP_T$ relative to $P_T^*$, thereby inducing a real currency appreciation.[11] In the case of Japan, Obstfeld (2011) found the yen's real exchange rate to be positively correlated with its terms of trade in data through 2008.

Other factors can drive a wedge between the prices of tradable goods across markets. Trade barriers, for example, can cause divergences across countries in tradable CPIs, even when consumption preferences for tradables are the same across national borders. In the extreme case where the domestic price of a tradable good is always the same as the one that exporters charge in foreign markets (when translated into domestic currency), net of trade costs, variable trade costs, or trade taxes can cause tradable CPIs to diverge internationally. Two other problems in relating conventional terms of trade measures to CPIs is that they incorporate trade

[10] One issue, noted above, is the nontraded content of a component of the price of tradable goods.

[11] A rise in the absolute export price raises the relative home tradable index, whereas a fall in the absolute import price lowers the relative foreign index, both of which contribute to real currency appreciation.

in intermediate goods (destined for firms, not consumers) and that they are sensitive to commodity prices, notably energy.

International trade costs may be so large for most economic actors that markets for tradable goods are effectively segmented. In such cases exporters may price to market, tailoring prices to local demand conditions. The domestic and foreign prices of tradable goods, measured in the exporter's currency, can then have separate lives, responding differently to various shocks, including exchange rate shocks. It is well known that pricing-to-market is pervasive among major Korean exporters, who invoice their exports in dollars and set prices in accordance with market conditions in different countries (Lee 1995). Pricing-to-market makes it inaccurate to identify the domestic prices of tradables with the prices of those same goods when sold abroad—as measured by the export price index. The presumption would be that Korean firms face more intense competition and hence higher trade elasticities abroad than at home and, accordingly, charge higher prices to domestic purchasers.

An extreme but simple example illustrates the dependence of the real exchange rate on the relative price of nontradables as well as the terms of trade and potential pricing-to-market. Assume that the rest of the world's consumption consists entirely of a single traded good that they export and that the home country imports. Assume also that the price of that good in its market and currency of origin is $(1+\mu^*)P_M^* = P^*$, where $\mu^*$ is a markup (reflecting pricing-to-market) and $P_M^*$ is the good's price in foreign currency in the country that imports it, and its home-currency price in the import market is $P_M = EP_M^* = EP^*/(1+\mu^*)$. Analogously, we assume that the price of the country's export good, when sold in the home market, is set at a variable markup of $1+\mu$ times the price $P_X$ (in domestic currency) at which the good sells abroad. The markups can be positive or negative numbers.

The home country's subutility for tradable goods has weights $\theta$ and $1-\theta$, respectively, on exportables and imports. However, for this basket to reach consumers, some nontradables must also be used (in the form of distribution services and the like), where the weight of such services in the "production function" for the home country's traded-goods consumption is $\alpha$. The implied price index for the home country's tradable consumption is therefore

$$P_T = (P_N)^{\alpha}\left[(1+\mu)^{\theta} P_X^{\theta} P_M^{1-\theta}\right]^{1-\alpha}.$$

The real exchange rate is given by

$$q = \frac{EP}{P^*} = \frac{E\left\{(P_N)^{\alpha}\left[(1+\mu)^{\theta} P_X^{\theta} P_M^{1-\theta}\right]^{1-\alpha}\right\}^{\gamma} P_N^{1-\gamma}}{(1+\mu^*)P_M^*}.$$

Simplifying, the real exchange rate can be expressed as

$$q = \frac{(1+\mu)^{(1-\alpha)\theta\gamma}}{(1+\mu^*)}\left(\frac{P_N}{P_X}\right)^{1-(1-\alpha)\gamma}\left(\frac{P_X}{P_M}\right)^{1-(1-\theta)(1-\alpha)\gamma}.$$

In summary, the real exchange rate is an increasing function of (i) the price of nontradables in terms of exports (which itself is positively related to the price of nontradables in terms of tradable goods in general) and (ii) the terms of trade.

An alternative rendition of the last expression, written in terms of the HBS nontradable-to-tradable price ratio and the terms of trade, is

$$q = \frac{(1+\mu)^{\theta}}{(1+\mu^{*})} \left(\frac{P_N}{P_T}\right)^{\frac{1-(1-\alpha)\gamma}{1-\alpha}} \left(\frac{P_X}{P_M}\right)^{\theta}. \quad (2)$$

This version shows compactly how the real exchange rate depends on the HBS price ratio, $P_N/P_T$, as well as the terms of trade, $P_X/P_M$—but also on the markup factors.

## V. Evidence on Internal and External Prices in Determining the Real Exchange Rate

We now consider the broad evidence on the two determinants of Korea's real exchange rate: the internal price ratio of nontraded goods to traded goods, and the external price ratio of domestic to foreign traded goods.

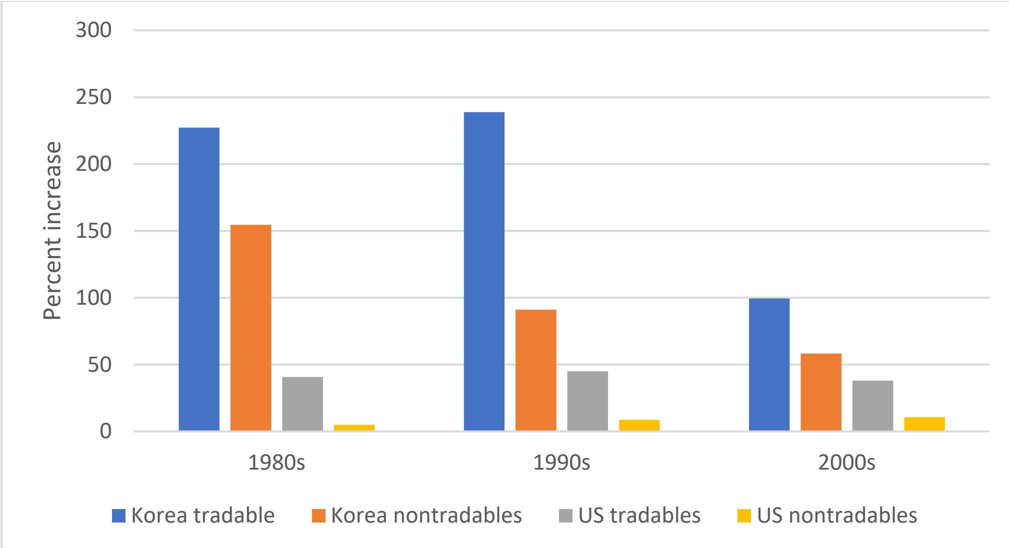
### *Evidence on the Internal Price Mechanism*

A key pillar of the HBS theory is that differential productivity growth in tradables and nontradables can drive changes in the relative price level *p* of nontradables in terms of tradable goods. As discussed in Obstfeld (2011), the evolution of this relative price will reflect total factor productivity as well as factor-price changes, but if we can approximate the technologies in traded and nontraded goods as Cobb-Douglas, we can view the change over time in *p* as reflecting labor productivity differentials. The HBS model then predicts that, other things equal, higher labor productivity growth in tradables compared with nontradables will, all else equal, lead to rising *p* and a trend of real currency appreciation. The prediction relies fundamentally on wages in the two sectors being equalized by labor mobility, forcing prices higher in nontradables to cover higher ULCs.

Figure 7 compares the paths of sectoral productivity levels for Korea and the United States. Productivity levels are based on annual productivity growth rates from the EU KLEMS database, where sectoral value-added productivity figures are constructed from less aggregated industry figures using a Törnqvist index with value-added weights.[12] Not only has productivity grown faster in both sectors in Korea, but the productivity gap between the tradable and nontradable sectors also widened significantly in Korea in the 1990s—and to a much greater extent than in the United States. While the gap between the sectors and countries narrowed in the 2000s, productivity growth in tradables still outstripped that in nontradables by a significant margin. The ratio of tradable to nontradable productivity rose 22 percent more in Korea than in the United States between 1980 and 2010. Other things being equal, the HBS theory suggests that these productivity dynamics should drive a secular real appreciation of the won.

[12] Tradables consist of agriculture, hunting, forestry, and fishing; mining and quarrying; total manufacturing; and electricity, gas, and water supply. Nontradables consist of construction; wholesale and retail trade; hotels and restaurants; transport, storage, and communication; finance, insurance, real estate, and business services; public administration and defense; compulsory social security; education, health, and social work; and other community, social, and personal services. For this dataset, Korean and US data extend only through the early 2010s at this point. EU KLEMS denotes "EU level analysis of capital (K), labor (L), energy (E), materials (M), and services (S) inputs."

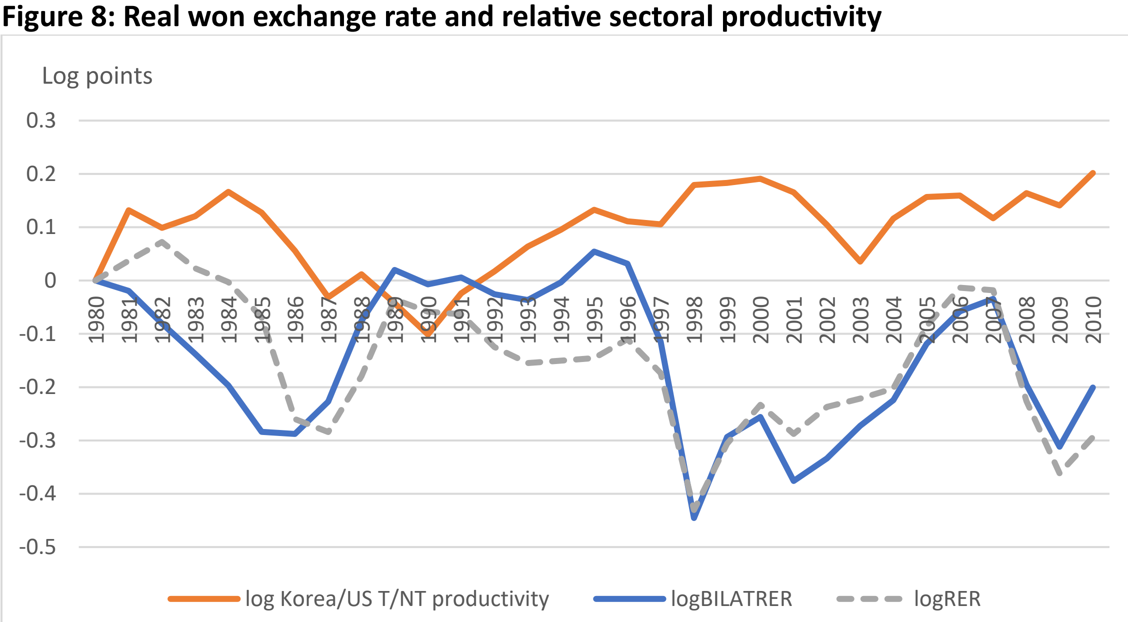
**Figure 7: Sectoral labor productivity evolution in Korea and the United States**




*Source:* Authors' calculations based on EU KLEMS.

Figure 8 plots the productivity data against the real won/dollar exchange rate from 1980 to 2010. (For reference, we also show the effective won rate as the dashed line.) Contrary to the HBS theory, there is no strong positive correlation, either year to year or over time, between the two variables. Over the entire period, the won's real exchange rate trends mildly downward even though the productivity trend in favor of Korean nontradables (relative to its tradables) is mildly upward. Only over some subperiods (1982-87, 1993-96, 2003-06) is the pattern consistent with the HBS model.

**Figure 8: Real won exchange rate and relative sectoral productivity**

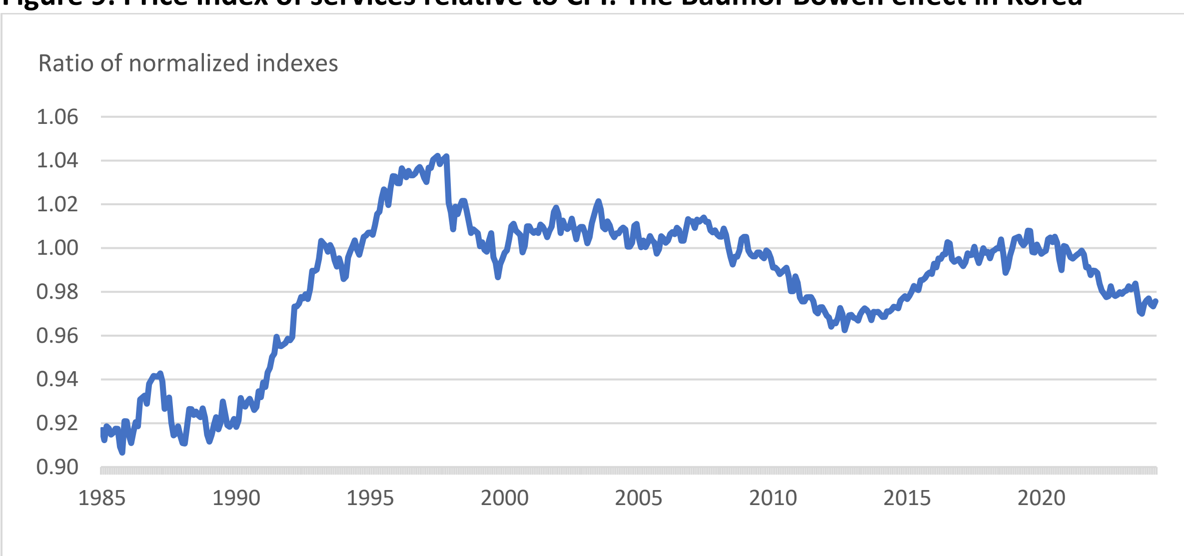



*Source:* Organization for Economic Cooperation and Development, US Bureau of Labor Statistics, Bank for International Settlements via FRED, and authors' calculations based on EU KLEMS.

Part of the reason for the weak performance of the HBS model is that for Korea, the Baumol-Bowen effect, which was quite powerful in the 1990s up to the Asian crisis, is absent thereafter. Figure 9 shows this surprising fact, which a few other scholars have also noted (e.g., Oh and Kim 2015). The ratio of the CPI for services to the overall CPI, shown in the figure, rises steadily in the 1990s up to the Asian crisis, but then it drops over 1997-99 and thereafter remains trendless.

The evidence that higher productivity growth in goods versus services drives the relative price of services higher is much stronger in general than the evidence for the HBS model's predictions on exchange rates (see Obstfeld [2011] for a detailed discussion). The absence of the Baumol-Bowen effect in Korea after the Asian Crisis is a puzzle but could be explained by several factors. For example, segmented labor markets or monopoly power could channel most of the gains from productivity growth into rents rather than wages. The analysis of Chun et al. (2021) points strongly to labor-market segmentation. The paper documents that over 1995-2015, Korean real wages (in terms of the CPI) rose by 64.3 percent in manufacturing but only by 22.5 percent in nonmanufacturing, whereas the rates of productivity increase in those sectors were 98.5 percent and 31.8 percent, respectively. The HBS model, however, assumes uniformity of real wages across the entire economy. Over the same period (1995-2015), labor's share of value-added in nonmanufacturing declined slightly, depressing wage growth there below average labor productivity growth, whereas its share in manufacturing rose considerably. Substantial wage inequality between large and smaller firms is a well-known phenomenon in Korea. The topic deserves more research, including at the industry level.[13]

**Figure 9: Price index of services relative to CPI: The Baumol-Bowen effect in Korea**



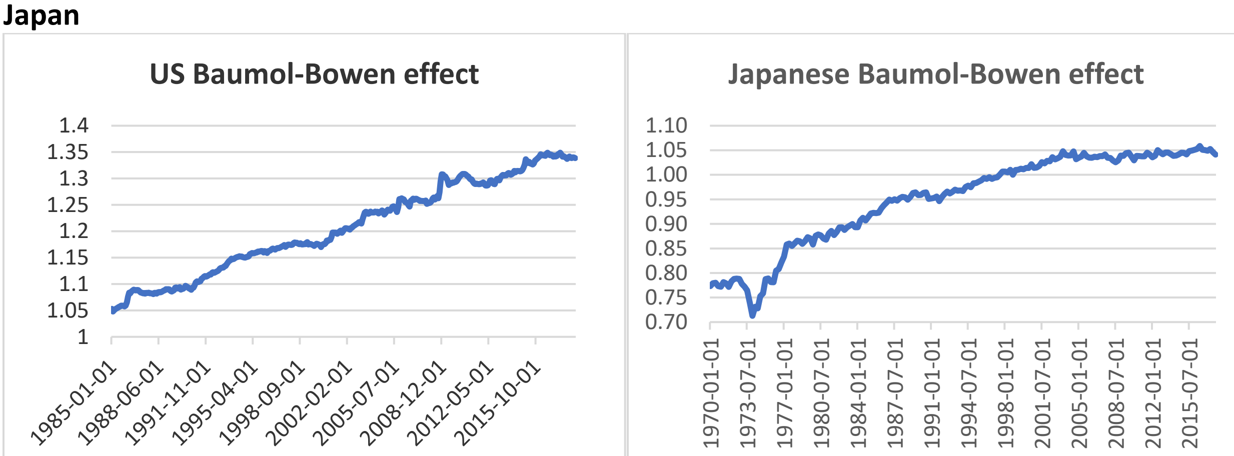

*Source:* CEIC.

[13] Song (2021) finds that the overall labor share of income in the Korean nonfarm business sector has declined since the middle 1990s. Both Chun et al. (2021) and Song (2021) make adjustments to address self-employment, but they use different methodologies and levels of aggregation. Changes in labor shares contradict our Cobb-Douglas assumption about production functions.

For comparison, figure 10 shows the ratio of services prices to the overall CPI for the United States (which is directly relevant for assessing the won/dollar bilateral real rate) and for Japan (an Asian country that earlier followed a development path similar to Korea's). For the United States, the Baumol-Bowen effect is notable until around 2015, although it slows after the global financial crisis. For Japan, however, the regularity ceases around 2003, a similar pattern to the Korean case in figure 9.

The model underlying the Baumol-Bowen effect and the HBS theory assumes that labor is an undifferentiated, homogeneous factor that can move easily between the tradable and nontradable sectors. A more plausible model for the past three decades of the digital revolution might hold that productivity gains in tradables (manufacturing in particular) attach to more highly skilled workers, whereas technological advance in that sector simultaneously reduces its demand for lower-skilled workers (Acemoglu and Restrepo 2019). If services use lower-skilled labor relatively intensively, skilled workers gain from productivity growth in tradables, whereas less-skilled workers may well lose. Since the tradable and nontradable sectors have different factor mixes (in terms of labor of different skills), we would see a growing wage differential (for aggregate sectoral wages) in favor of manufacturing along with no rise, or even a fall, in nontradables prices relative to tradables. This pattern seems to describe the data for Korea, as well as for some other industrial economies.

**Figure 10: Ratio of services CPI (net of housing costs) to overall CPI for the United States and Japan**




*Source:* Organization for Economic Cooperation and Development and US Bureau of Labor Statistics via FRED.

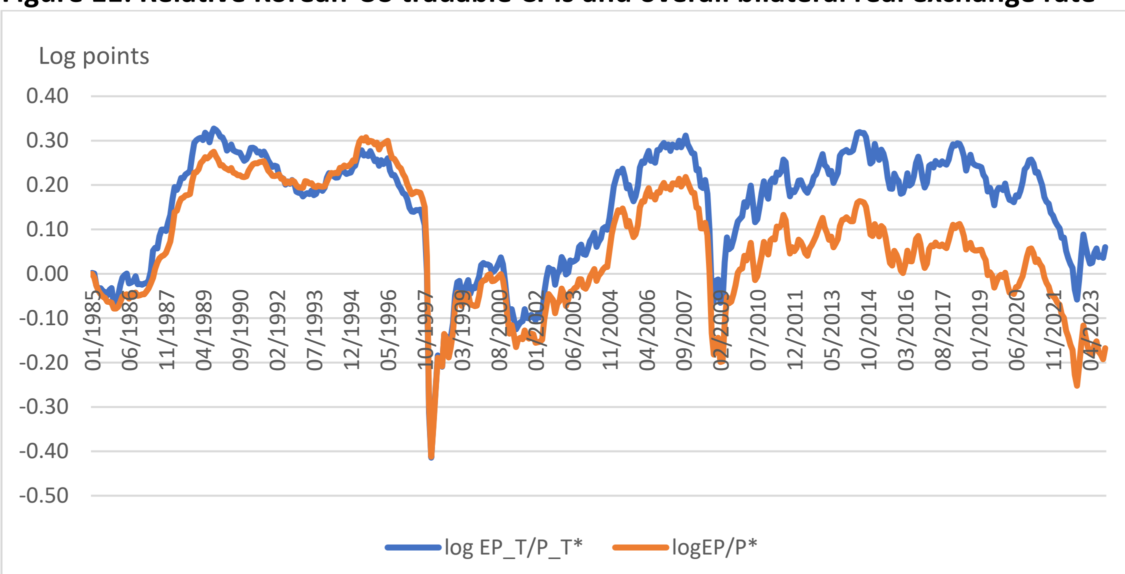
Given the absence of the Baumol-Bowen effect for Korea over recent decades, it is not surprising that it is hard to see a strong empirical relationship between the relative sectoral producivity trends that the HBS model highlights and the won's real exchange rate. Reinforcing this negative finding is the fact that most of the variability in the real exchange rate stems not from the productivity trends central to the HBS model but rather from the term $\Delta log\left(\frac{EP_T}{P_T^*}\right)$ in equation 1, which reflects international relative tradable CPIs. We next document this claim and explore the link between the tradables price ratio and export prices.

*Evidence on the External Price Mechanism*

The second term in equation 1 is the change in the relative price of tradable goods, $\Delta log\left(\frac{EP_T}{P_T^*}\right)$, and the second term in equation 2 is a function of the terms of trade, $P_X/P_M$. We will look at each of these in turn.

Figure 11 plots the ratio of Korean and US tradable CPIs against the overall bilateral real exchange rate. (We will explain how we construct tradable CPIs in the next section.) These variables move very closely together until around the Asian Crisis, but afterward, even though their short-term movements remain highly correlated, they gradually diverge, indicating a general tendency for the Korean internal relative price to fall compared with its US counterpart. This is consistent with the absence of the Baumol-Bowen effect, noted above. However, prices for domestic tradables in Korea are expensive—not only with respect to nontradables but also with respect to Korean exports.

**Figure 11: Relative Korean-US tradable CPIs and overall bilateral real exchange rate**




*Source:* Authors' calculations based on CEIC, Organization for Economic Cooperation and Development, and US Bureau of Labor Statistics via FRED.

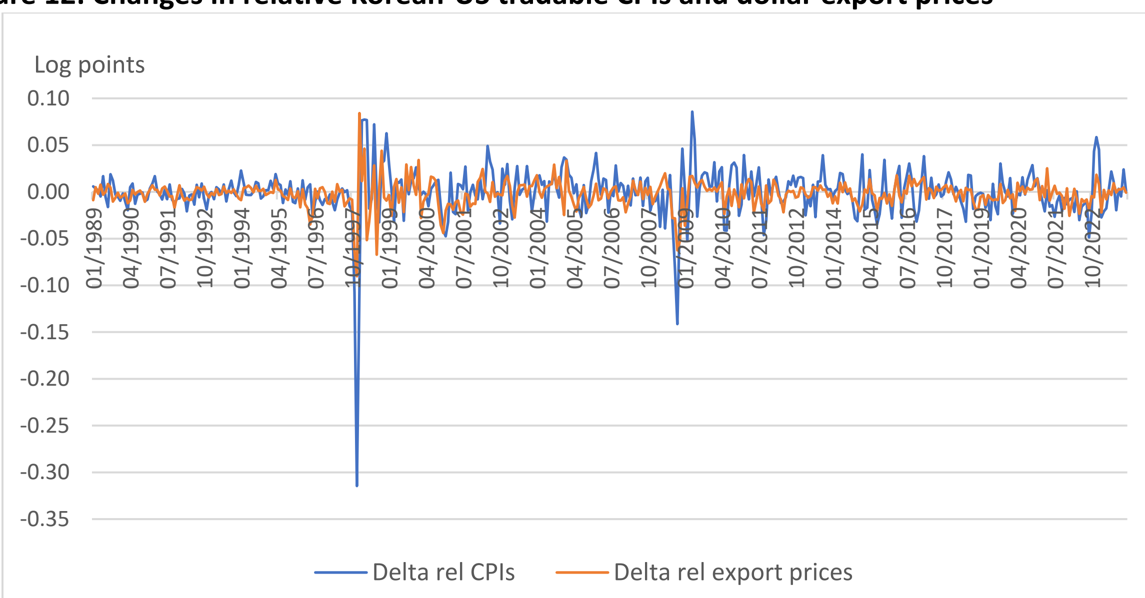
Do the relatively high prices that Koreans pay for tradables mean that Korean exports are uncompetitive on world markets? As noted earlier, Korean exporters typically engage in pricing-to-market, generally charging lower prices abroad (Lee 1995).

To understand the phenomenon, we compare the behavior of $log\left(\frac{EP_T}{P_T^*}\right)$ with that of the relative price index for Korean exports in terms of American exports, where we convert the Korean index into US dollars to perform the comparison. The second ratio, written in symbols as $log\left(\frac{EP_X}{P_X^*}\right)$, can be viewed as a measure of the relative competitiveness of Korean and US exports in head-to-head competition abroad.

First, consider the changes shown in figure 12. The figure has several implications. First, both series, which depend linearly on the nominal dollar/won exchange rate, become much more volatile after the Asian Crisis. This is in part due to Korea's transition to greater exchange rate flexibility after the late 1990s. Second, the two series are highly correlated. One might think that this is a mechanical consequence of their parallel dependence on the dollar/won exchange rate (in the case of relative export prices, to convert a won export price index into dollar terms). But it is not obvious that this should be so. The literature on "dominant currency pricing" suggests that many countries invoice their exports in US dollars, with the export prices sticky for long periods in terms of dollars (see Gopinath et al. 2020). In this case, the Korean export price index is constructed by taking dollar invoice prices and converting them to won using the won/dollar rate. But when one then converts them back into dollars using the dollar/won rate, the influence of the exchange rate disappears, leaving an export price index that is sticky in dollar terms. However, the high short-run correlation in figure 12 calls into question whether Korean exports are mainly priced in dollars, with dollar prices sticky over long durations.[14]

Third, the amplitude of movements in relative export prices is noticeably below that of relative CPIs (and thus of the nominal exchange rate because CPIs are sticky in the short run). This is consistent with pricing-to-market behavior, as emphasized by Atkeson and Burstein (2008). When the won rises against the dollar, making Korean exports more expensive for foreign buyers, Korean exporters tend to lower the won prices of their goods, partially offsetting the positive effect of the won appreciation with the aim of limiting their loss of market share. Thus, the relative export price index rises by less than the ratio of tradable CPIs when the won appreciates. Symmetrically, a won depreciation may lead exporters to raise the won prices of exports to take advantage of the resulting rise in foreign demand.

**Figure 12: Changes in relative Korean-US tradable CPIs and dollar export prices**

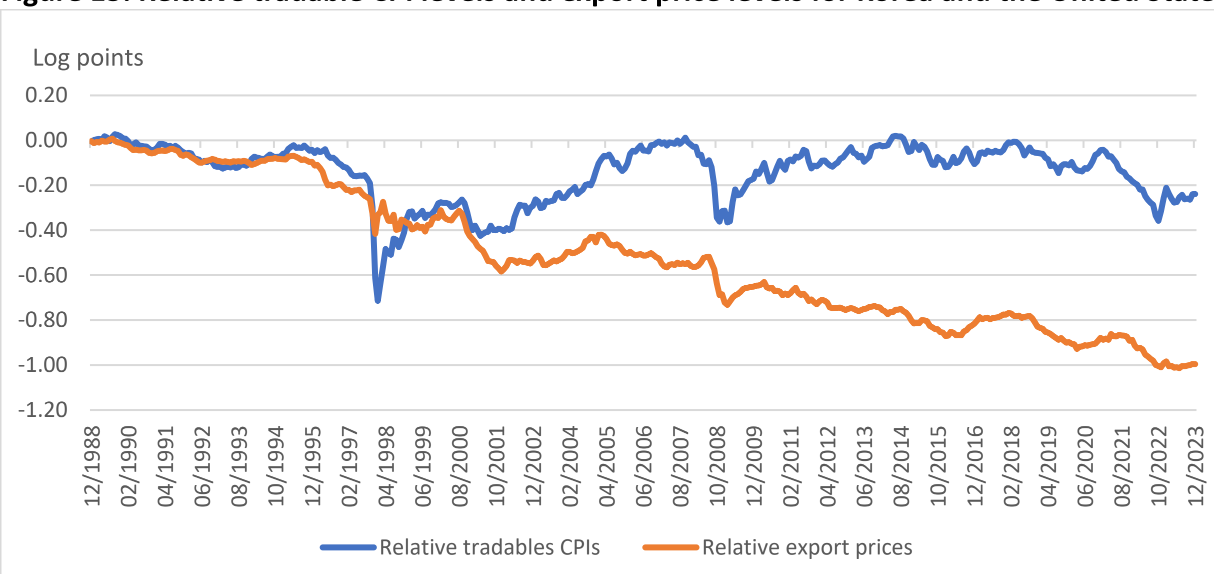



*Source:* Authors' calculations based on CEIC, Organization for Economic Cooperation and Development, US Bureau of Labor Statistics via FRED, and Bank of Korea.

[14] On this general point, see Gagnon and Sarsenbayev (2023).

However, a focus on short-run changes obscures the fact that Korean export prices have systematically declined over time compared with the prices of tradables that are sold domestically in Korea. In part, this reflects that the tradables CPI also reflects import prices, and these have risen relative to Korean export prices (Korea's terms of trade have fallen). Figure 13 illustrates this regularity, which is broadly consistent with the behavior of the terms of trade (which we will show later). Although the two relative prices trend closely together through the Asian Crisis, the relative price of Korean tradables for domestic consumers trends mildly upward afterward until recently, whereas export prices fall dramatically compared with US export prices. The two series decouple, and Korean relative export prices begin their progressive fall below relative tradable CPIs around the time China acquired permanent normal trade relations status from the United States and entered the World Trade Organization. The downward pressure on Korean export prices seems consistent with increasing competition in export markets.[15]

**Figure 13: Relative tradable CPI levels and export price levels for Korea and the United States**



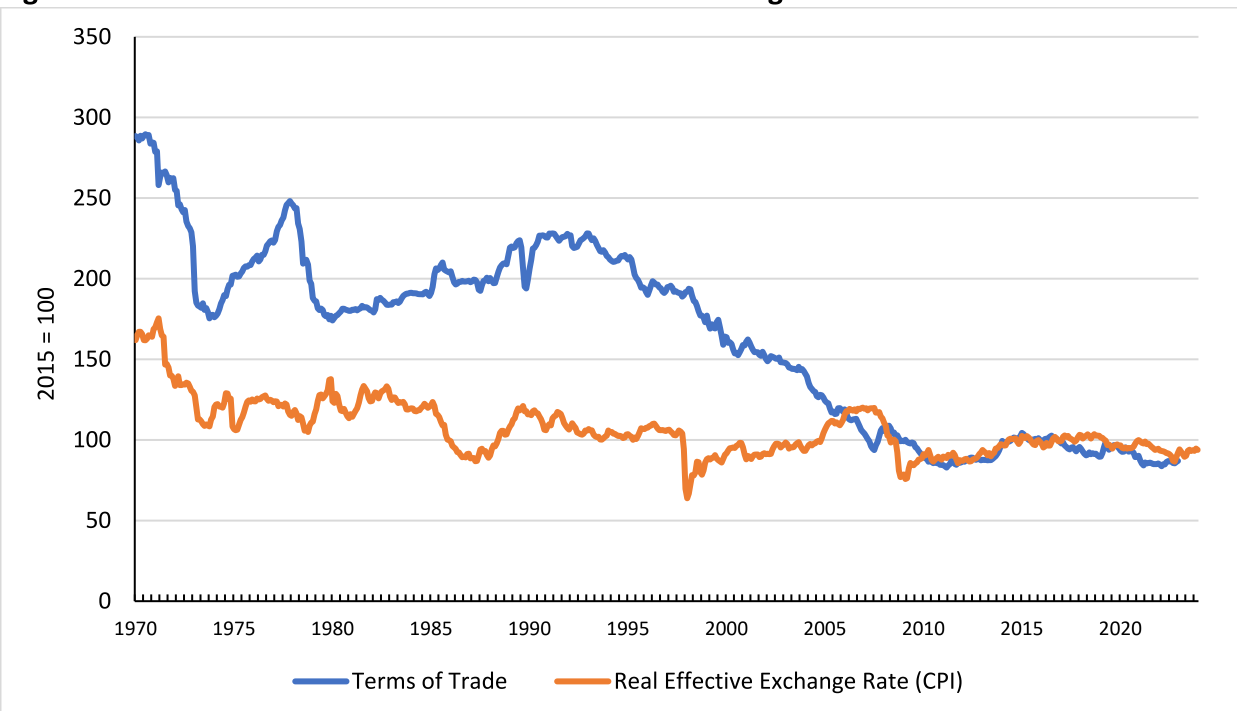

*Source:* Authors' calculations based on CEIC, Organization for Economic Cooperation Development, US Bureau of Labor Statistics via FRED, and Bank of Korea.

Turning to the real exchange rate and the terms of trade, figure 14 shows that the correlation between them is not very strong, certainly in first differences. At the same time, two

[15] Like Korea, but with a decade lag, China's export structure also experienced a structural shift toward the category of machinery and transportation equipment. Korea moved in this direction between 1985 and 1995, whereas China moved into that category between 1995 and 2005. While the product mix was very different—more transport equipment in the case of Korea and lower-priced variants of machinery in the case of China—the overlap did create some low-price competition for Korean producers and forced them further to upgrade product quality. It seems unlikely, however, that competition with China is a major factor behind the nonappreciation of the real won over time. The won appreciated bilaterally against the yuan in real terms after 2000, while remaining roughly constant in nominal terms since around 2009 following a big nominal appreciation over 2000-2008. (Puzzlingly, however, Bank for International Settlements data indicate that the real effective yuan rose after 2000, whereas the real effective won did not.)

trends are striking. First, the real exchange rate is much more stable over time than the terms of trade. The terms of trade fell significantly from the early 1990s until about 2010, when it stabilized again. That period saw a significant structural shift in the composition of Korea's exports away from heavy industrial goods toward automobiles and transportation equipment, as well as consumer electronics, whose relative price has fallen due to technological advances and productivity improvements (Eichengreen et al. 2015).

**Figure 14: Korea's terms of trade and real effective exchange rate**

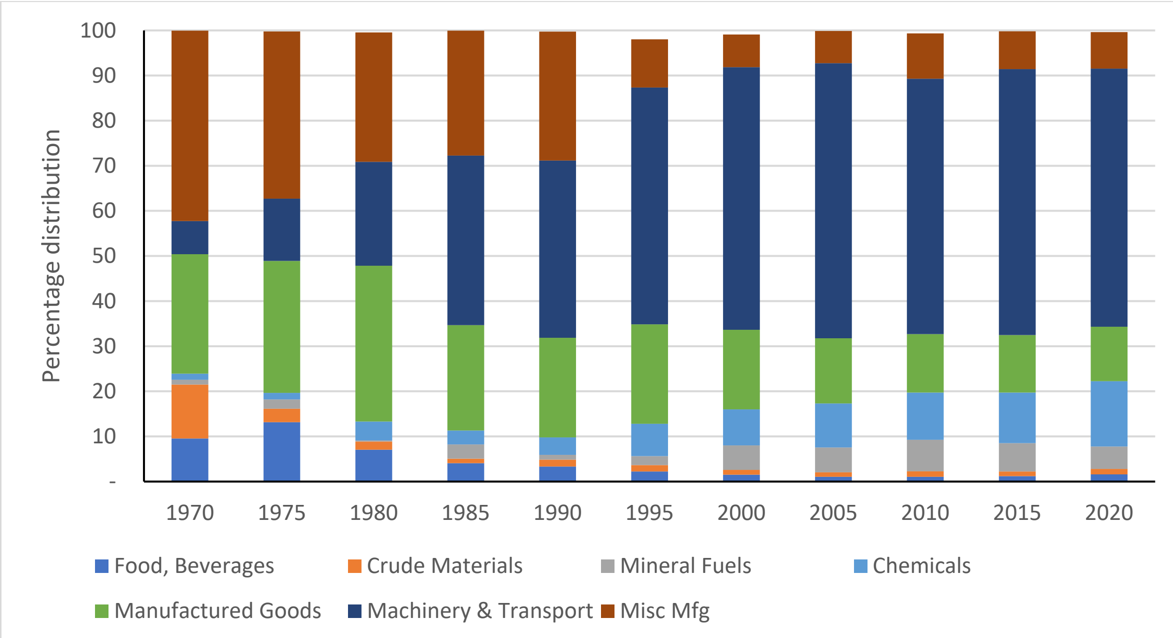



*Source:* Authors' calculations based on Bank of Korea and Organization for Economic Cooperation and Development via FRED.

Figure 15 documents the structural changes in Korea's exports during this period at a high level of aggregation.[16] Machinery and transport equipment grew from about 20 percent of Korea's exports in 1980 to nearly 60 percent in 2000 and then stabilized at that level. This broad category includes not only automobiles and other types of machinery but also electronics, including semiconductors and other equipment. Electronic goods are especially likely to have experienced large cost and price reductions over time.

[16] In doing so, we are updating Eichengreen et al. (2015, table 7.1), who also examined structural change in Korea's exports. The shifting composition of exports and imports suggests caution in interpreting terms of trade measures over long periods that encompass structural change. Figure 15 indicates that from around the early 2000s on, this effect may not be too important for Korean exports, at least at the level of aggregation we have assumed to construct the figure.

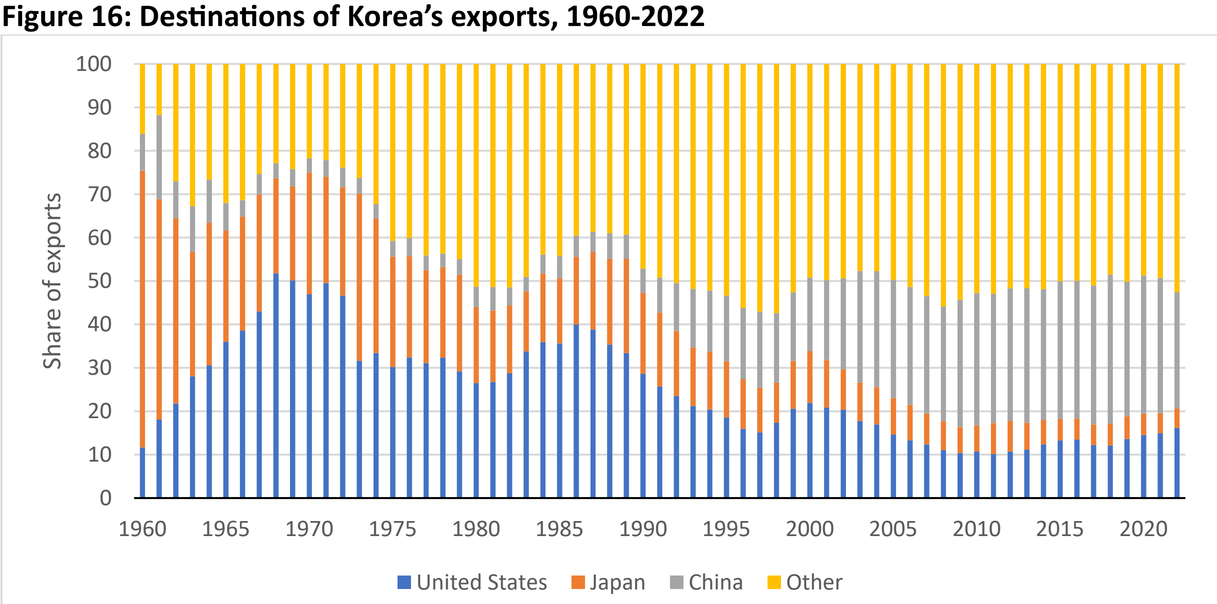
**Figure 15: Korea's export structure, 1970-2020**




*Source:* United Nations COMTRADE database.

This period not only saw the structure of Korea's exports changing but also a shift in the destination of these exports. Starting in the early 1980s, looking at figure 16, one can see a slight reversal in the declining share of exports going to the United States as a result of the strong dollar (weak won) and then a resumption of that declining share once the dollar fell in value after 1985. Exports first to Southeast Asia and then to China grew rapidly starting in the mid-1980s.

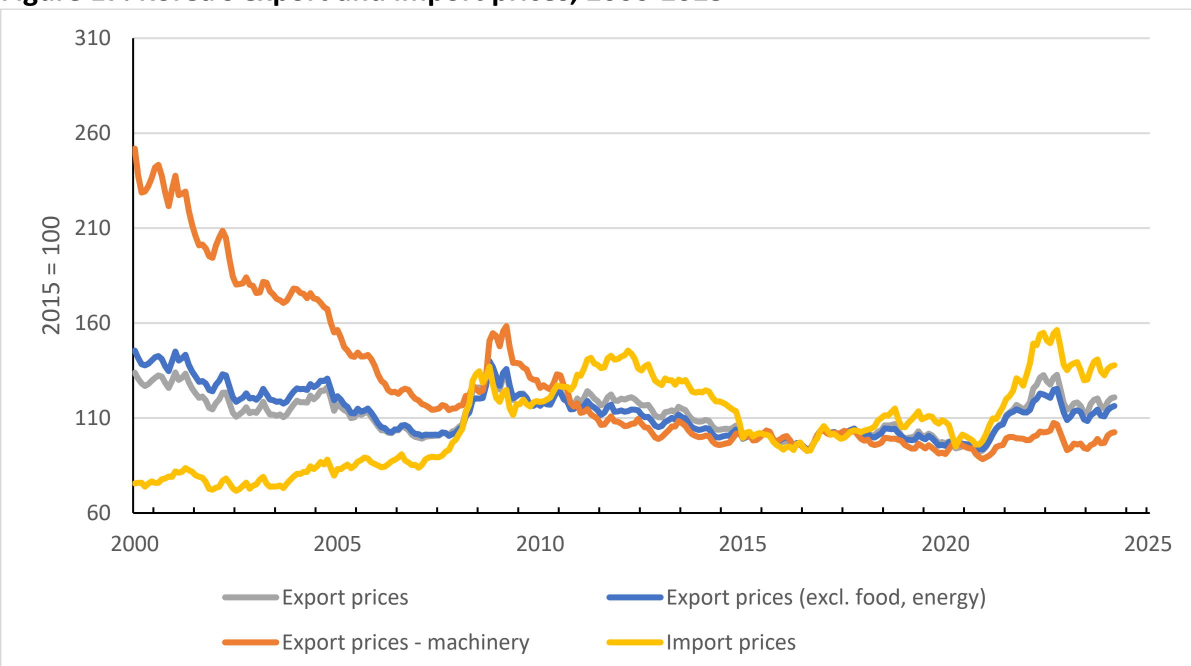
**Figure 16: Destinations of Korea's exports, 1960-2022**




Note: Exports to China include exports to Hong Kong Special Administrative Region.
*Source:* Organization for Economic Cooperation and Development, Direction of Trade Statistics.

Figure 17 presents some components of the terms of trade starting in 2000. While this dating misses the start of the deterioration in the terms of trade starting in the late 1980s, some of the data do not go back that far; still, there is an overlap with the period in which the terms of trade deteriorate and then flatten starting in mid-2000. The deterioration in the terms of trade up to about 2010 owes to both a gentle rise in import prices and a gentle decline in export prices. The main reason for the decline in export prices is the sharp fall in the export price of machinery and transportation equipment, which became the largest category of exports by the early 1990s and whose share had stabilized by 2000 (figure 15). This price decline may have been partly exogenous owing to the rise of China as a producer of some of these goods, but also an endogenous development that flowed from greater production efficiency in automobiles, washing machines, and electronics. The price decline continued until about 2010, when the prices of exports and imports largely stabilized until about 2020.

**Figure 17: Korea's export and import prices, 2000-2023**




*Source:* Korean Statistical Information Service, https://kosis.kr/eng/.

To conclude our discussion of the external price mechanism, real exchange rates can be explained in an accounting sense by relative prices across countries for nontradables and tradables. However, the tradables prices that enter the CPI can differ from export prices owing to pricing-to-market and the nontradable cost components in consumer prices. The external price ratio depends on the terms of trade as well as any differences between the domestic prices of exportable goods and the prices charged in foreign markets. For Korea, large terms of trade movements have been associated with big secular changes in export structure as well as with changes in commercial rivalry in global markets.

In sum, the path of the won's real exchange rate after the recovery from the Asian Crisis can be thought of as a confluence of a gently rising domestic relative price of tradables (with the caveats made earlier) and a declining (although puzzling) relative price of nontradables in terms of tradables. Harder to identify are the economic forces driving these trends as well as the sharp fall in relative Korean-US export prices and the behavior of Korea's overall terms of trade.

*Other Considerations*

As noted above, the Korean official sector has acquired considerable foreign assets in the form of foreign exchange reserves and the holdings of Korea's sovereign wealth fund (the Korea Investment Corporation) and the national pension service. Up to a point, such public sector holdings can fulfill valuable macroprudential and fiscal roles. However, some independent scholars, as well as the US Treasury Department at times, have expressed concerns that these official purchases have been excessive and, in part, amount to currency manipulation to hold Korea's nominal and real exchange rates at artificially weak levels (Gagnon 2012).[17]

Theoretically, under conditions of persistent unemployment and rigid domestic output prices, a country that could control its nominal exchange rate could achieve, even over the long term, a weak exchange rate and high prices for tradable goods relative to nontradables. While foreign exchange intervention may have played a supporting role over relatively brief periods, we think it is an implausible explanation for the long-term nonappreciation of Korea's real exchange rate. Korea has generally enjoyed low unemployment rates, and the documented two-sided variability of Korea's foreign exchange interventions and the high degree of financial integration with global capital markets suggest that long-term real exchange rate behavior has been driven mainly by structural factors such as the persistent sectoral wage differentials discussed earlier.

## VI. Assessing the Roles of the Internal and External Price Mechanisms

The impressionistic evidence that we have presented so far suggests that the won's real exchange rate is more obviously tied to the international relative prices of tradables than to productivity differences or even to the relative prices of nontradables. At the same time, international relative consumer prices of tradables closely depend on nominal exchange rates in the short run but apparently less so on the terms of trade. In an important paper, Engel (1999) advanced a methodology for assessing the relative importance to the real exchange rate's variability over time of the two terms in equation 1. The strength of Engel's method is that it allows for an evaluation of the contribution of internal versus external price ratios over any horizon. Potentially, the internal price factor could be relatively unimportant in the short run as short-term fluctuations in the prices of tradables, driven by sticky prices and a volatile nominal exchange rate, dominate over brief horizons. However, if forces of international arbitrage and price adjustment kick in over longer periods, we might expect the impact of international relative price changes to decay while the relative importance of internal price ratios grows.

[17] In the November 2023 edition of its biannual report on foreign exchange policies, now entitled *Macroeconomic and Foreign Exchange Policies of Major Trading Partners of the United States*, the US Treasury removed Korea from its "Monitoring List" of trade partners with large overall and bilateral (with the United States) external surpluses.

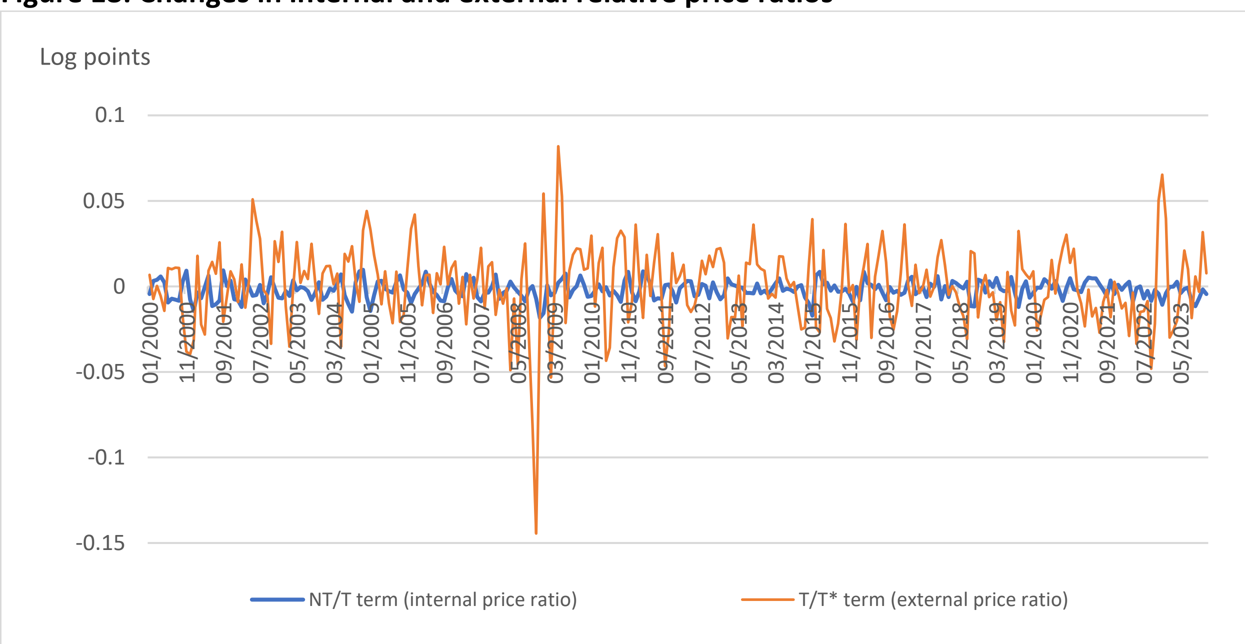
As a first step, we describe how we calculate the traded and nontraded components of the CPI at monthly frequency. From the relationship $logCPI = \gamma logP_T + (1-\gamma)logP_N$, we can calculate

$$logP_T = \frac{logCPI - (1-\gamma)logP_N}{\gamma}.$$

For $P_N$, we use data on the overall services CPI (including housing) from CEIC (Korea) and the US Bureau of Labor Statistics (available via Federal Reserve Economic Data [FRED] of the Federal Reserve Bank of St. Louis, series CUSR0000SAS). For $\gamma$, we assume a value of 0.58 for both countries.[18] Using these definitions and monthly data on the nominal dollar/won exchange rate, we can compute separately the two components on the right-hand side of equation 1.

Figure 18 shows the first differences of the components. An immediate takeaway is that the external price ratio is much more volatile than the internal ratio—as we would expect because the prices of goods and services tend to be sticky and the latter ratio moves proportionately with the nominal exchange rate, other things being equal.

**Figure 18: Changes in internal and external relative price ratios**



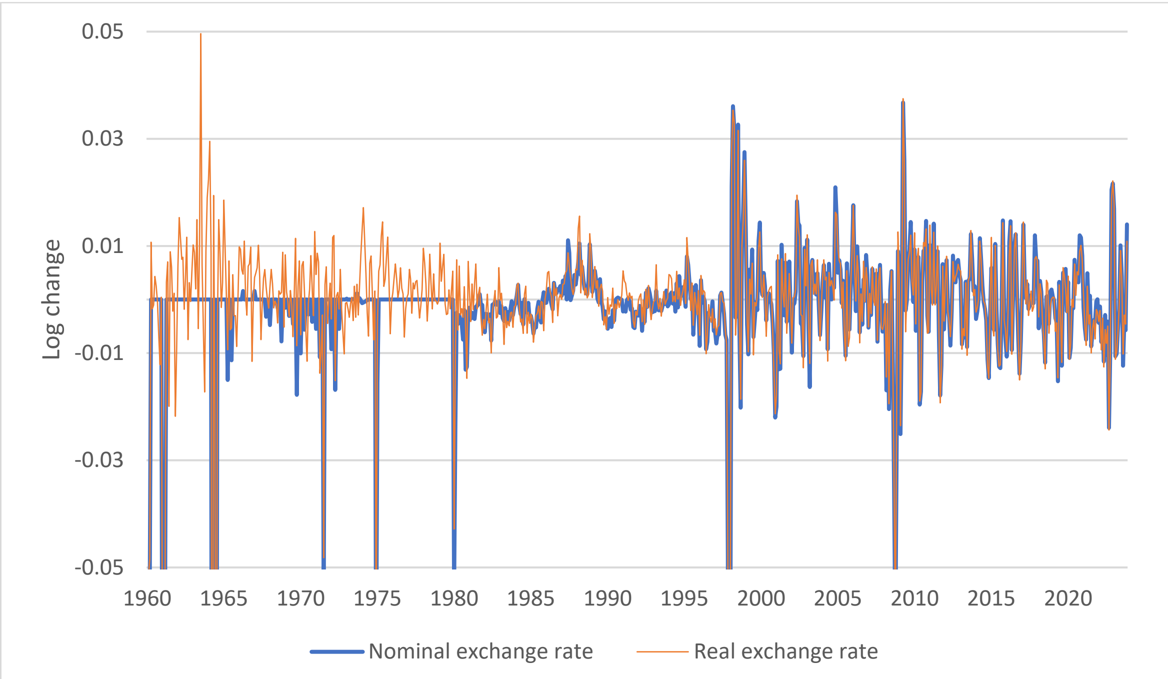

*Source:* Authors' calculations based on data from CEIC, Organization for Economic Cooperation and Development, and US Bureau of Labor Statistics via FRED.

Indeed, since about 1980, Korean real and nominal exchange rate changes have been closely correlated (correlation coefficient of 0.98), as figure 19 shows. This correlation has increased over time: It was 0.82 in the 1970s, 0.86 in the 1980s, and 0.98 from the 1990s to the

[18] The value for this weight that CEIC reports for Korea is constant over time at 0.5334. Weights for the United States, reported by the US Bureau of Labor Statistics, rise over time to a higher level. We could carry out the exercise below with different weights for the United States and Korea, but we believe the approach we take here is reasonably accurate.

present. This high correlation is one of the most robust regularities of modern floating exchange rate regimes (Itskhoki and Mukhin 2021).

**Figure 19: Log changes in nominal and real exchange rates, bilateral against the US dollar, monthly data**




*Source:* Organization for Economic Cooperation and Development, US Bureau of Labor Statistics, and Bank for International Settlements via FRED.

Next, we implement Engel's (1999) methodology. Building on the intuition from equation 1, define the *n*th differences:

$$x_t^n \equiv (1-\gamma)\left[log\left(\frac{P_{N,t}/P_{T,t}}{P_{N,t}^*/P_{T,t}^*}\right) - log\left(\frac{P_{N,t-n}/P_{T,t-n}}{P_{N,t-n}^*/P_{T,t-n}^*}\right)\right],$$

$$y_t^n \equiv \ log\left(\frac{E_t P_{T,t}}{P_{T,t}^*}\right) - log\left(\frac{E_{t-n}P_{T,t-n}}{P_{T-n}^*}\right).$$

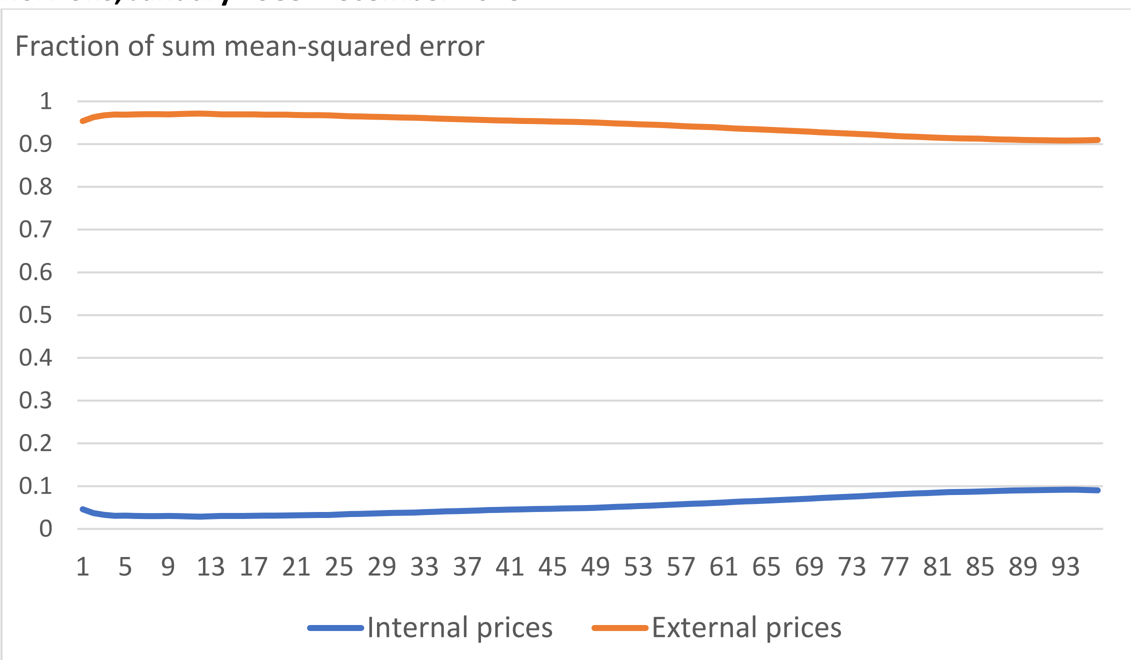
Figure 18 displays these two series (labeled as *internal* and *external price ratios*, respectively) for the first difference, $n = 1$.

Engel (1999) proceeds by calculating, for horizons $n = 1, 2, 3, .... T$, the fraction of mean-squared error (MSE) attributable to each of the two components, where the MSE is the sum of the variance and the squared mean, a measurement choice intended to capture component contributions to expected trend as well as to volatility. Thus, these are the objects of scrutiny for each horizon $n$:

$$\frac{MSE(x_t^n)}{MSE(x_t^n) + MSE(y_t^n)}, 1 - \frac{MSE(x_t^n)}{MSE(x_t^n) + MSE(y_t^n)}. \quad (3)$$

Figure 20 plots the statistics in equation 3 for horizons between $n = 1$ and $n = T = 96$ months (8 years). The data used cover the period January 1985-December 2023. Starting at about one year out, the contribution of internal prices begins to rise slowly but steadily and eventually nears 10 percent. This is somewhat in contrast to the findings of Engel (1999), who found that the contribution of tradables to overall real exchange rate variability remained very near 1 even at the five-year horizon in 1973-95 data for industrial countries versus the United States. But even at very long horizons, the contribution of external prices for Korea still remains slightly above 90 percent. Thus, developments in the internal price ratio have some impact on the long-run variability of the real exchange rate, but the impact is dwarfed by that of the external price ratio.[19]

**Figure 20: Contributions of internal and external prices to real exchange rate MSE at different horizons, January 1985-December 2023**




*Source:* Authors' calculations based on data from CEIC, Organization for Economic Cooperation and Development, and US Bureau of Labor Statistics via FRED.

It may seem rather circular to explain movements in the real exchange rate largely through movements in the nominal exchange rate, but this outcome is a consequence of sticky prices and their relatively slow adjustment in the face of shocks. The very slow mean reversion of real exchange rates has been a long-standing theme and a challenge for open-economy modelers (Rogoff 1996). Nominal exchange rate movements driven by asset-market shocks persistently affect real exchange rates (see Itskhoki and Mukhin 2021), but at the same time,

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[19] For these calculations, we use Engel's method B1 (Engel 1999, appendix B), which ignores covariation between the $x_t^n$ and $y_t^n$. In principle, these terms can be correlated, especially because both depend on domestic-currency price levels for tradables. There is no reliable way to allocate this covariation between the two series' influence. In practice, the correlations are small because of the comparative stickiness of prices for domestic tradables and the high variability of the nominal exchange rate. Moreover, in all cases the correlations are too small in absolute size to alter appreciably the results in the text (below 0.1 for all *n*). One can view these low correlations as another aspect of the "exchange rate disconnect" (Itskhoki and Mukhin 2021).

nominal exchange rates are theoretically anchored by some notion of a long-run equilibrium or "natural" real exchange rate. As in estimating *r** for monetary policy, estimating the natural real exchange rate is challenging. This rate may ultimately anchor short-run equilibriums, but even over the medium term, asset-market shocks that move exchange rates can generate medium-term deviations in real exchange rates from the long-run equilibrium rate, deviations that will be larger the bigger the initial nominal exchange rate movement.

To illustrate the potential for persistent shocks to exchange rates and relative prices, as well as the degree of persistence, table 1 reports simple first-order autoregressions for logarithms of the key relative prices in our analysis over the sample period 1990-2023. All variables are bilateral against the United States, and the regressions allow for deterministic trends (trend coefficients not reported).

**Table 1: First-order autoregression estimates for key exchange rates and relative prices, monthly data, 1990-2023**

| | $log(E)$ | $log(q)$ | $log\left(\frac{P_N/P_T}{P_N^*/P_T^*}\right)$ | $log\left(\frac{EP_T}{P_T^*}\right)$ | $log\left(\frac{EP_X}{P_X^*}\right)$ |
|---|---|---|---|---|---|
| First-order autocorrelation | 0.977 | 0.975 | 0.962 | 0.975 | 0.974 |
| Standard error | 0.029 | 0.028 | 0.009 | 0.028 | 0.014 |
| R-squared | 0.976 | 0.959 | 0.995 | 0.954 | 0.998 |
| Half-life (months) | 29.8 | 27.4 | 17.9 | 27.4 | 26.3 |

*Source:* Authors' calculations; deterministic time trends included.

The real and nominal won exchange rates against the dollar show the patterns common in monthly data for industrial economies with floating rates: high persistence and a similar volatility of the real and nominal exchange rates. The half-life of the real exchange rate is in the lower half of the range reported by Rogoff (1996), just below 2.5 years. Interestingly, the relative tradable CPI term, $log\left(\frac{EP_T}{P_T^*}\right)$, has the same persistence as the overall real exchange rate, whereas the HBS term has somewhat lower persistence and much lower conditional (one-step-ahead) variance (reflected in the standard error estimate). These findings are consistent with the picture in figure 20. Shocks to the nominal exchange rate drive the real exchange rate with persistent effects, the half-life being more than two years.

The relative Korea-United States export price, $log\left(\frac{EP_X}{P_X^*}\right)$, has a similar persistence to nominal and real exchange rates and to relative tradable CPIs. However, its one-step-ahead conditional volatility, while above that of the HBS term, is only half that of the log nominal exchange rate, consistent with exporters' pricing-to-market.

Even though our results suggest a limited role for the HBS term in explaining even longer-term real exchange rate variability, shocks to it are persistent and its role can be large over specific periods. In addition, of the five variables analyzed in table 1, only the HBS term and relative export prices display statistically significant (negative) time trends. To illustrate the historical relative roles of the HBS term and the relative tradables term in determining the real exchange rate, table 2 decomposes the bilateral won/dollar real exchange rate evolution since 1985 into the two factors in equation 1.

**Table 2: Accounting for the won's real exchange rate change against the US dollar over subperiods of 1985-2023**

| | *Harrod-Balassa-Samuelson term* | *Relative tradables term* | *Log real exchange rate* |
|---|---|---|---|
| January 1985-June 1997 | 0.04 | 0.14 | 0.18 |
| July 1997-December 1999 | -0.08 | -0.12 | -0.20 |
| January 2000-June 2008 | -0.05 | 0.17 | 0.12 |
| July 2008-November 2023 | -0.13 | -0.15 | -0.29 |
| **Total 1985-2023** | -0.22 | 0.04 | -0.19 |

*Source:* Authors' calculations.

Over the entire period 1985-2023, the major driver of real depreciation has been a substantial fall in the relative price of nontradables, notwithstanding the strong performance of Korean labor productivity in tradables relative to nontradables. Since shortly before the global financial crisis (July 2008), the won has depreciated significantly in real terms against the dollar, with the depreciation explained (in an accounting sense) by the two factors in equation 1 operating more or less in equal measure.

## VII. Conclusion and Policy Implications

This paper has studied the evolution of Korea's real exchange rate since the 1960s, focusing on the period since the mid-1980s and especially after the adoption of a new monetary framework in 2000. We will briefly conclude with some of the more significant findings and end with a few policy implications.

In a rapidly growing, technologically advancing economy such as Korea, most international economists would have expected to see a secular appreciation of the real exchange rate due to the HBS effect. The Korean puzzle is that we do not observe such an appreciation in any one of several measures of the real exchange rate. The relative productivity of tradable to nontradable goods sectors in Korea relative to the United States is positively correlated with the real exchange rate only for certain brief subperiods. When we decompose changes in the real exchange rate into internal prices (the relative price of tradables) and external prices (the relative prices of traded consumption goods or the terms of trade), we find that the latter explain most variability in the real exchange rate, even at long horizons. This variability is due to changes in the nominal exchange rate and exceeds that of changes in the terms of trade, perhaps owing to systematic pricing-to-market by exporters.

In the end, consistent with other studies, variability in the real exchange rate is dominated by movements in the nominal exchange rate rather than some of the other underlying factors commonly believed to be at work, and changes driven by the nominal exchange rate can be very persistent. However, a downward trend in Korea's relative price of nontradables, as compared with the United States, has been a key driver of its bilateral real exchange rate evolution over the long term since the mid-1980s and, particularly, since 2008.

These findings are suggestive of several policy implications. First, nominal exchange rate changes have persistent effects on the real exchange rate and, hence, on the competitive position of domestic producers of tradable goods. Therefore, nominal exchange rate movements driven by financial shocks, which likely are transitory, have long-lasting effects with half-lives up to 2.5 years. This may be a rationale for Korea's policy of two-sided smoothing of exchange rate movements through foreign exchange market intervention.

Second, with identical US and Korean inflation targets, the long-run nominal rate is governed by the long-run real rate, so authorities should be alert to underlying real rate changes in guiding intervention policy. In part, this requires them to try to ascertain the source of exchange rate shocks—a difficult task. Furthermore, actual real exchange rate behavior possibly reflects various domestic distortions, such as too-low real wages in nontradable sectors and possibly too-high prices that Korean consumers face in tradable sectors, where wage levels are high. The nature of technological change may also have played a role. Wage differentials across sectors contribute to Korea's higher level of inequality relative to other Asian countries. There is a case for addressing distortions with corrective policies, but more research is needed on those possible distortions to determine if they have important effects on the real exchange rate, and in what direction.

There are also implications for Korea's external imbalances. Addressing wage and price distortions might raise consumer purchasing power and shift the economy toward the production of more nontradable goods, leading to a bigger current account deficit and putting upward pressure on the won. This is contrary to the IMF (2023) assessment that the Korean surplus is too small (the IMF norm was 4.8 percent of GDP in its 2023 analysis), but the Fund's External Balance Assessment model incorporates domestic income distribution only indirectly and assesses exchange rate norms entirely based on trade elasticities.

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