Searching For Currency Regime Effects on Real Exchange Rate Adjustments: 1972 Okinawa Reversion

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Abstract

Utilizing the unique historical event of the reversion of Okinawa from the U.S. military occupation to the Japanese sovereignty in May 1972 as a relevant natural experiment, we evaluate currency regime effects on product-level real exchange rate adjustments. Our natural experiment, which is based on monthly data of retail prices of a variety of individual products sold in retail stores in both Okinawa and the mainland Japan around the period of the reversion, finds no clear evidence for a role of a common currency regime in facilitating real exchange rate adjustments. Our exercise rather reveals solid evidence for a strong deteriorating effect of a flexible exchange rate regime, as emphasized by New Keynesian models for real exchange rate fluctuations.

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1. Introduction

In the literature of international finance, it has been always the central task to describe data properties of real exchange rates precisely and understand fundamental economic drivers behind real exchange rate fluctuations. Relying on the distinction between tradable and non-tradable goods in the representative household's consumption basket, the classical Balassa-Samuelson hypothesis has been always at the center of the past researches of real exchange rate fluctuations. Recent empirical studies based on highly disaggregate retail price data, however, uncover significant violations of the law of one price (hereafter, LOP) even in products that should be categorized as tradable goods. These empirical findings strictly negate the empirical validity of the Balassa-Samuelson effect as a prime suspect behind real exchange rate fluctuations. Rather, as discussed by Mussa (1986), the literature puts more emphasis on short-run price stickiness as a main generator of real exchange rate movements.

Most lately, Berka et al. (2017) discover strong evidence for the Balassa-Samuelson effect in product-level real exchange rates among the Euro member countries adapting a fixed exchange rate or common currency regime, rather than other countries adapting flexible. Their finding implies that a fixed exchange rate or common currency regime, which is immune against volatile nominal exchange rate fluctuations, might yield efficient adjustments of real exchange rates to changes in the relative prices between tradable and non-tradable goods. A currency regime matters for efficacy of real exchange rate adjustments.

In a recent paper, Cavallo et al. (2014a) claim an empirically significant effect of a common currency regime on product-level real exchange rate adjustments. Exploiting internet online prices of identical products sold in various European countries by four large global retailers, they observe that the LOP holds in individual products among countries within the Euro zone, while the LOP is significantly violated among countries outside it. Although Berka et al. (2012) also point out the same difference in the empirical relevance of the LOP in disaggregate retail prices between inside and outside the Euro zone with different data set of retail prices, Cavallo et al. (2014a) interestingly reveal that the LOP is largely violated even among countries adapting fixed exchange rate regimes. This observation is eye-opening because it suggests that the unit of currency *per se* matters for product-level real exchange rate adjustments. Indeed, the proposed hypothesis of the "common currency effect" is a serious challenge to the conventional literature of New Keynesian models depending on price stickiness in terms of local currencies to generate real exchange rate fluctuations. This is because the conventional New Keynesian framework is absent from a theoretical distinction between common currency and fixed exchange rate regimes and still stands on a weak theoretical ground to say anything about the thesis of the common currency effect.

In this paper, we argue that an important reservation should be added to the inference on the hypothesis of the common currency effect drawn by Cavallo et al. (2014a). Our argument is as follows. They simply compare online prices of identical retail products between two countries that have already been in either a common currency area or a fixed exchange rate regime. They then report the degree of violation in the LOP is larger in the latter country pairs than in the former and claim a significant common currency effect to facilitate product-level real exchange rate adjustments. This inference, however, might be misleading because it could reflect time-invariant country pair-specific fixed effects that are not necessarily related to any direct effect of participating in a common

currency regime. In other words, it is always possible that the observed large LOP violation in a country pair with a fixed exchange rate regime, say between Germany and Denmark, simply reflects time-invariant Germany-Denmark pair-specific characteristics other than their adopting the fixed exchange rate regime *per se*.

The recent literature of policy evaluation suggests that, to make our inference on a common currency effect empirically plausible, we need to conduct a relevant natural experiment by constructing both "treatment" and "control" groups suitably. As the treatment group, we need to have data of country pairs that experienced both fixed exchange rate and common currency regimes and observe the degrees of the LOP deviation in the country pairs before and after participating in the latter regime from the former. Only the information from the treatment group is not sufficient to draw a correct inference on a common currency effect, though, because we cannot separate a pure common currency effect from other economic developments that might happened coincidently at the same time around adopting a common currency. Therefore, as the control group, we also need to have data of country pairs that have experienced no change in the currency regime during the whole sample period. For the control group, we also observe the degrees of the LOP deviation in the country pairs that share the same economic developments with those in the treatment group but do not take the treatment., i.e., a change in the currency regime. The literature of policy evaluation strictly tells us that only under such a suitable natural experiment environment, we can correctly evaluate any possible effect of the corresponding policy implementation — in our case adopting a common currency regime from a fixed exchange rate regime — relying on powerful econometric methods such as the difference-in-difference (DID) analysis or the regression discontinuity design (RDD).

To our best knowledge, there is no past paper which conducts either of DID or RDD or both for a common currency effect formally.[1] There are two exceptions to mention, though. First, Cavallo et al. (2014b) compare the degrees of the LOP deviation in retail prices of clothing products sold by the world largest clothing retailer, ZARA, between Latvia and the other Euro zone countries before and after the Latvian adoption of the Euro in 2014 from its currency peg to the Euro. They report that the distribution of the LOP deviation across a large number of clothing products largely shrinks to the mass point of zero after 2014. Although economic fundamentals behind the observed common currency effect are not identified precisely, they infer that the pricing strategy of ZARA might play an essential role. As correctly pointed out by Cavallo et al. (2014a) in their conclusion, an important caveat of their inference is that it depends heavily on the pricing strategy of a particular retailer even though the size of the retailer is quite large in terms of the global clothing market. However, the pricing behavior of ZARA as well as other global retailers is not necessarily representative of all other retail product sectors that should be counted in the Latvian purchasing power and aggregate real exchange rates.

The second exception is found in Takagi et al. (2004) who investigate a common currency effect on real exchange rate volatilities exploiting time-series data of aggregate consumer price

[1]Gorodnichenko and Tesar (2009) also discuss necessity of a relevant natural experiment with treatment and control groups for identification of any effect of cross-country border on LOP deviation. Morshed (2007) conducts a DID regression exercise using historical data of disaggregate relative prices before and after the independence of Bangladesh from Pakistan in 1971. Morshed concludes no robust border effect on the relative price structure of the two countries.

indexes (CPIs) of Okinawa in Japan. Okinawa is the farthest south one of the 47 prefectures in Japan with Naha as the prefectural capital city. Okinawa is placed at the geographical and economic centers of the Ryukyu Islands. As discussed in the next section in details, the Ryukyu Islands and Okinawa had been under the occupation of the U.S. military government between the landing of the U.S. naval force on Okinawa at the end of the Pacific War in April 1945 and the reversion of the Ryukyu Islands and Okinawa to the Japanese sovereignty in May 1972.

Astonishingly, during about 27 years of the U.S. military occupation, Okinawa was forced to experience six currency conversions. The historical events of Okinawa offer a unique opportunity of a relevant natural experiment to identify currency regime effects on real exchange rate adjustments. Indeed, Takagi et al. (2004) scrutinize aggregate real exchange rate volatilities under the three currency regimes that emerged by the fourth, fifth, and sixth currency conversions, respectively: in the fourth conversion in 1948, the B yen was introduced as the legal tender of Okinawa; the fifth conversion in 1958 replaced the B yen with the U.S. dollar; finally the sixth currency conversion due to the reversion in 1972 reintroduced the Japanese yen in Okinawa as the common currency with the mainland Japan. Using the CPI data of Japan, Okinawa, and the United States, Takagi et al. (2004) calculate the time-series variances of the Okinawan real exchange rates toward both Japan and the United States in each of the three currency regimes. Interestingly, they observe that during the U.S. dollar currency regime, the volatility of the Okinawan real exchange rate is much lower toward the United States than Japan. In contrast, during the Japanese yen currency regime, the Okinawan real exchange rate volatility is much smaller toward Japan than the United States. They interpret their finding as solid evidence for a significant common currency/monetary union effect on real exchange rate adjustments.

The inference of the common currency effect drawn by Takagi et al. (2004) should also be subject to crucial reservations. On the one hand, their inference mainly stems from the time-series variability of the degree of the absolute purchasing power parity (PPP) violation, i.e. the level of the real exchange rate, of Okinawa toward Japan or the United States. It is well-known, however, that an empirical test of the absolute PPP is always controversial because any two countries seldom share the identical construction of the CPIs.[2] On the other hand, Takagi et al. (2004) report a negligibly small difference in the time-series variance of the degree of the relative PPP violation, i.e., the rate of change in the real exchange rate, of Okinawa toward Japan or the United States, especially, under the U.S. dollar currency regime.[3] The apparent difference in the result between the absolute and relative PPP deviations casts a serious doubt of the robustness of the claimed common currency/monetary union effect.

Moreover, it is worth noting that Takagi et al. (2004) select substantially different lengths of the sample period over the three currency regimes. In particular, they choose a much longer sample period for the most recent Japanese yen currency regime than the other two regimes. However,

[2]For example see the discussion by Marsh et al.(2012).

[3]Recall that this sample period corresponds to the fixed exchange rate regime of the Japanese yen against the U.S. dollar under the Bretton Woods system. The Okinawan real currency return is nothing but the inflation rate differential between Okinawa and either of Japan or the United States. In other words, any difference in the time series volatility of the Okinawan relative PPP violation toward between Japan and the United States reflects the underlying difference in the inflation rate volatility between the two countries. Their result simply says that there is no significant CPI convergence effect of a common currency regime over a fixed exchange rate regime.

as emphasized in the literature of policy evaluation, it is necessary for a correct evaluation of a treatment effect that economic environments other than the treatment should be homogeneous and identical before and after the implementation of the treatment. It might be the case that choosing a much longer sample period after the treatment makes it possible for the inference of Takagi et al. (2004) to reflect a substantial change in the economic environment between Okinawa and the mainland Japan that happened more recently but independently to the Japanese yen currency regime *per se*.

In this paper, we follow the spirits of the above important predecessors, Takagi et al. (2004) and Cavallo et al. (2014a, b). On the one hand, as in Takagi et al. (2004), we also utilize the unique historical event of the reversion of Okinawa to the Japanese sovereignty in May 1972 as an opportunity of a relevant natural experiment to evaluate a common currency effect on product-level real exchange rate adjustments. On the other hand, rather than using aggregate CPI data as in Takagi et al. (2004), we investigate monthly survey data of retail prices of individual product items sold at retail stores in all prefectural capital cities across Japan including Naha. Specifically, we exploits the official retail price surveys that were conducted by the statistical offices of both the Government of the Ryukyu Islands for Naha during the period of the U.S. military occupation and the Government of Japan for the other 46 prefectural capital cities. Merging the two retail price surveys together in May 1972, we construct a panel data of retail prices over a broad range of individual product items spanning the period between January 1970 and December 1974. Because our panel data cover a variety of retail items produced by distinct producers for the purpose of aggregate CPI construction, our inference on currency regime effects is expected closer to the population aspect: it will not be affected by individual retailer/producer heterogeneity such as a particular pricing strategy of a particular dominant retailer. In particular, we focus on data of 41 product items categorized into food products in this draft, though.[4]

As exercised by Cavallo et al. (2014a, b), we estimate the sample distributions of product-level real exchange rates over a variety of product items among all the 47 prefectural capital cities in Japan. Our treatment group contains the product-level real exchange rates between Naha and each of the other 46 prefectural capital cities in the mainland Japan, while our control group includes those among the 46 prefectural capital cities in the mainland Japan. Most crucially, we decompose the whole sample period between January 1970 and December 1974 into three subsample periods depending on the currency regimes of Okinawa. The first currency regime is the U.S. dollar fixed exchange rate regime against the Japanese yen from January 1970 to July 1971 (hereafter, the USD fixed regime). The second one is the U.S. dollar flexible exchange rate regime against the Japanese yen from August 1971 to April 1972 (hereafter, the USD flexible regime). The third one is the Japanese yen common currency regime from May 1972 to December 1974 (hereafter, the JPY common regime). After controlling for economic developments found in the control group over the whole sample period, our DID exercise estimates whether or not the shape of the sample distribution of the product-level real exchange rates of the treatment group had been changed under the three currency regimes.

[4]The reason why we limit our investigation in this draft only to food products simply comes from data availability. Because electrically distributed data are not available for the past retail price surveys stretching back to the 1970s, we put each data point from the hard copies into an electrical file by hand. As an ongoing project, we plan to continue this time-consuming data collecting process to expand our exercise including other product categories too.

Importantly, our empirical exercise reveals no economically meaningful common currency effect. Indeed, we identify a significant change in the shape of the kernel-smoothed density of product-level real exchange rates in the treatment group before and after the 1972 reversion. The DID analysis, however, uncovers that the observed change in the sample distribution under the JPY common regime is too subtle to conclude that the JPY common regime generated any economically significant facilitating effect on product-level real exchange rate adjustments relative to the USD fixed regime. Furthermore, being consistent with the finding of Berka et al. (2012), we observe a strong deteriorating effect of the USD flexible regime on real exchange rate adjustments. Our natural experiment reveals that such a deterioration of real exchange rate adjustments under the USD flexible regime dominantly stems from the sticky retail prices of brand products in terms of the Okinawan local currency. Because brand products were mostly produced by major processed-food manufacturers in the mainland Japan and exported to Okinawa, this finding convinces us of our hypothesis that the observed deteriorating effect of the USD flexible regime mainly resulted from sticky local currency pricing (hereafter LCP) strategies that the major processed-food producers implemented in the Okinawan local market.

The rest of the paper is organized as follows. Section 2 describes the history of the Ryukyu Islands and Okinawa between the end of the Pacific War and the 1972 reversion in details. In this section, we narratively validate that the post-war history of Okinawa provides a unique and ideal natural experiment environment to identify currency regime effects on product-level real exchange rate adjustments. Section 3 discusses the description and construction of our data set. After reporting the main results in Section 4, we conclude in Section 5.

2. Natural experiment environment: economic and monetary history of Ryukyu Islands and Okinawa around 1972 reversion

In this section, we briefly review the economic and monetary history of Ryukyu Islands and Okinawa after the end of World War II and discuss the relevance of the natural experiment environment this paper exploits. Our historical review covers the period of years from the landing of the U.S. military forces in Okinawa at the near end of the Pacific War in April 1945 to the reversion of Okinawa to the Japanese sovereignty in May 1972. In particular, we emphasize the following four historical facts: (i) the Okinawan separation from and reversion to the Japanese sovereignty were the direct consequences of both the end of the Pacific War and the subsequent increase in the geopolitical importance of Okinawa for the U.S. military strategy. Being important for our natural experiment, these historical events were mostly exogenous for the Okinawan economy; (ii) even under the U.S. military occupation, the Okinawan economy had been highly integrated to the economy of the Japanese mainland; (iii) the U.S. dollar monetary regime, which was prevailed after the fifth currency conversion in 1958, was the result of the political decision making by the U.S. military government to attract foreign investment for development of the Okinawan economy, but was almost neutral against the relative price structure between Okinawa and the mainland of Japan; and (iv) the shift from the fixed exchange rate regime to the flexible one due to the Nixon shock in August 1971 was an unanticipated dramatic structural change in the international monetary system that was a pure exogenous event for the Okinawan economy.

2.1. Economic exogeneity of the Okinawan separation and reversion

The U.S. Navy, which was the main military body of the Allied Forces in the Pacific War, landed in Okinawa on April 1, 1945. On the same day of the landing, it issued the first proclamation that ordered the establishment of the U.S. Navy Military Government in the Ryukyu Islands.[5] Since then until the 1972 reversion, the Ryukyu Islands and Okinawa had been under the U.S. military occupation in everything but name.

The initial goal of the U.S. military occupation and governance over the Ryukyu Islands was to make the group of small islands a bridgehead toward capturing the Japanese Imperial Army at the end of the Pacific War. Although this initial goal was accomplished by Japan's unconditional surrender from accepting the Potsdam Declaration on August 14, 1945, the U.S. military government continued to occupy the Ryukyu Islands and Okinawa. On the one hand, the Combined Chiefs of Staff (CCS) firmly recognized the military strategic value and geopolitical importance of the Ryukyu Islands and strongly claimed the continuation of the strategic trusteeship by the U.S. military government. On the other hand, the U.S. Department of State argued that the Ryukyu Islands should be returned to the Japanese sovereignty after demilitalization. It was this political conflict between CCS and the U.S. State Department that had deferred and reserved the U.S. official decision on the territorial right and the corresponding administrative body of the Ryukyu Islands for several years. Bank of Ryukyu (1986) argues that this so-called "reservation policy" delayed and threw into great confusion the restoration and development policies for Okinawa after the end of the Pacific War. It was not until May 6, 1949, when U.S. President Harry Truman finally approved the long-term retention of the Ryukyu Islands by the U.S. government,[6] that the reservation policy ended and the U.S. government started full commitment to the restoration policy of the Okinawan economy.

It was in the Joint Statement of Japanese Prime Minister Eisaku Sato and U.S. President Lyndon Johnson on November 15, 1967 that a future possibility of the reversion of the Ryukyu Islands and Okinawa to the Japanese sovereignty was at first officially announced by the two countries. At that time, the sentiment of the Ryukyuwan people toward the then U.S. military government, the U.S. Civil Administration of the Ryukyu Islands (USCAR), had been sharply deteriorated by the "*gunyochi mondai*", i.e., the military land problem, which was caused by forced land acquisition for the U.S. military bases all around the Ryukyu Islands.[7] The military land problem gave rise to an intense resistance movement spread over the Ryukyu Islands, which was well known as "*shimagurumi toso*", i.e., the island-wide resistance movement. Moreover, the anti U.S. sentiment had grown badly not only in the Ryukyu Islands but also the mainland Japan due to the nationwide protest movement against the 1960 revision of the U.S.-Japan Security Treaty (*"Anpo toso"*). To repair and improve political relations with Japan and strengthen the Security Treaty, the U.S. Department of Secretary insisted on the need of more concession to political and economic requests of Japan and the Ryukyu Islands. The U.S. military, however, strictly opposed to any political concession because it might damage the strategic value of the U.S. military bases in the Ryukyu Islands and Okinawa. Fast growing geopolitical tension in the East Asia such as the intensification of the Vietnam War and the rise in power of Communist China further increased the strategic

[5]United States Navy Military Government Ryukyu Islands Proclamation No.1.

[6]Report by the National Security Council on Recommendation with respect to United States Policy toward Japan (NSC13/3), May 6, 1949.

[7]CA Ordinance No.109, "Land Acquisition Procedure".

importance of the Ryukyu Islands, and the possibility of Okinawa's reversion required the Japanese government to completely guarantee the U.S. military government unconstraint operations of its bases and facilities in Okinawa.

This sharp conflict of interests between the U.S. Department of Security and the U.S. military had been resolved only after the "special Ryukyu Island working group", which consisted of members from the U.S. Department of Secretary and the U.S. Department of Defense in June 1966, conducted detailed researches about all problems related to the Ryukyu Islands. The working group then concluded that the U.S. military government would be able to keep its military bases in Okinawa being operative under the U.S.-Japan Security Treaty even if the U.S. returned the administrative rights of the Ryukyu Islands to the Japanese sovereignty. This conclusion from the working group softened the rigid attitude of the U.S. military against the reversion of Okinawa greatly and effectively. At the same time, facing the intensification of Okinawa's reversion movements and the shape deterioration of public sentiments towards Okinawa' problems, the Japanese government also started recognizing Okinawa's reversion as a top political priority.

In the Sato and Johnson Joint Statement in 1967, the two countries agreed to keep under joint and continuous review the status of the Ryukyu Islands, guided by the aim of returning administrative rights over these islands to Japan, but postponed making a consensus on and officially announcing a specific plan of the the return of the administrative rights over Okinawa to Japan. It was indeed in the Joint Statement of Japanese Prime Minister Eisaku Sato and U.S. President Richard Nixon on November 21, 1969 that the two countries officially agreed the reversion during 1972. Under the Okinawa Reversion Agreement, which was signed between the two countries on June 17, 1971, the administrative rights of the Ryukyu Islands and Okinawa were returned to the Japanese sovereignty in May 15, 1972.[8] On the one hand, the 1971 reversion agreement guaranteed many benefits for the U.S. government: to continue to use the military bases in Okinawa; to maintain and strength the political alliance between the two countries including the US-Japan Security Treaty; and to cut down the fiscal burden from the administration of the Ryukyu Islands. On the other hand, the Japanese government also enjoyed plenty of political benefits from the reversion agreement: to regain the sovereignty over the territory separated and occupied after the Pacific War, calm down the domestic political tension and the anti-U.S. sentiment, and to maintain the US-Japan Security Treatment as a result. It is clear that there was a strong political incentive of Japan and the U.S. behind the Okinawa reversion in 1972. Bank of Ryukyu (1986) hence emphasizes this historical event as an important international political node that supported the two countries' alliance built on the US-Japan Security Treaty, *regardless any political will and intension of Okinawa.*

What is crucial for our natural experiment exercise is the historical fact that the territorial and economic separation of the Ryukyu Islands and Okinawa from the mainland Japan happened exogenously for the Okinawan economy; it was a pure outcome of the end of the Pacific War and the subsequent political and strategic decisions of the U.S. government. Moreover, it is also important to recognize that the Ryukyu Islands and Okinawa were returned to the Japanese sovereignty during the withdrawals of the U.S. troops from the Vietnam War under the initiative of President Nixon:

[8]The Okinawa Reversion Agreement, so to speak, was signed officially under the "Agreement between Japan and the United States of America concerning the Ryukyu Islands and the Daito Islands".

the Okinawa reversion was the result of the highly political decision of the U.S. government, which fully understood the strategic and geopolitical importance of these small south islands. In our natural experiment, we categorize all the city-pairs constructed from the capital cities of the 47 prefectures in Japan into either a treatment group that consists of only the city-pairs including Naha, the capital city of Okinawa prefecture, or a control group that collects all the city-pairs not including Naha. Our construction of the treatment and control groups stems from the tragedies occurred over the modern history of the Ryukyu Islands after the Pacific War, but most importantly, is made exogenously for the Okinawan economy. This strongly implies that inferences drawn from our natural experiment should be immune against a potential bias caused by endogeneity of the treatment.

2.2. Economic integration of Okinawa with mainland Japan

In this section, we confirm that even under the occupation by the U.S. military government, the Ryukyu Islands and Okinawa had been highly integrated to the mainland of Japan in terms of real side of economy. If the real economy of Okinawa had been segregated from that of the mainland and the bilateral trade of goods between the two regions had been inactive, it makes little sense for this paper to investigate the hypothesis of the law of one price in tradable goods. Hence it is crucial as well as necessary for our natural experiment to verify a high integration of the real economy of Okinawa with that of the mainland of Japan during the period of the U.S. occupation.

In short, the economy of the Ryukyu Islands and Okinawa during the period of the U.S. occupation is well characterized as a "military base-dependent import-oriented economy." As the consequence of the Battle of Okinawa at the end of the Pacific War, most of production capacity of Okinawa had been completely destroyed to ashes. As a result, Okinawa had always suffered from a high inflation pressure due to a severe shortage of goods. In particular, the construction boom of the U.S. military bases, which emerged between 1950 and 1952 after the U.S. decision of the long-term retention of the Ryukyu Islands and the resulting end of the reservation policy in May 1949, worsened the supply shortage problem all around the Ryukyu Islands. Moreover, because the U.S. military government needed to drastically raise wages for workers in the military bases to attract labour forces to base construction, this sharp increase in labor wage contributed to accelerate inflation further.

In response to the inflation pressure, the U.S. military government decided to set the fixed exchange rate of the then legal tender B yen to 120 B yen per U.S. dollar by issuing Ordinance No.6 "Military Conversion Rate of Type B Yen in the Ryukyu Islands" on April 12, 1950.[9] It is easy for us to understand how drastically the B yen was overvalued against the Japanese yen, once we remember that the fixed exchange rate of the Japanese yen against the U.S. dollar was 360 yen per U.S. dollar in 1950. It was this policy-induced overvaluation of the B yen against the Japanese yen and the resulting cheaper import prices that made it possible for the Ryukyu Islands and Okinawa to import tradable goods from the mainland Japan and resolve the goods

[9]The U.S. military government introduced B yen (officially called B type military scrip) as the unique legal tender in the Ryukyu Islands by Special Proclamation No.29 "Conversion and Issuance of New Currency" on June 26, 1948 (i.e., the fourth currency conversion). For detailed investigation of the economic rationale behind the devaluation of the B yen in 1950, see Makino (1993).

shortage problem. Meanwhile, because only the main exportable goods of the Ryukyu Islands were commodity goods of sugar, pineapple, and iron scrap, the Ryukyu Islands had always recorded huge trade deficits against Japan, which were financed by the U.S. military budget for the military bases and the financial and economic aids from the U.S. governments through the Government and Relief in Occupied Area (GARIOA) Program.

This import dependence of the Ryukyu Islands on the mainland Japan had been further fortified by privatization and liberalization of international trade, which was officially allowed by Military Government Ordinance No. 26 "Foreign Exchange and Trade Procedure in the Ryukyu Islands" on October 20, 1950. As a result, the amount of import of the Ryukyu Islands in 1958 became seven times as large as that in 1951. The import dependency of the Ryukyu Islands on the mainland Japan was apparent: its import to real GDP ratio recorded 65.5 %, and about 72 % of the total import was from the mainland Japan. Therefore, the Ryukyu Islands and Okinawa had a tight economic linkage with the mainland Japan. Bank of Ryukyu (1986, p.1082) mentions

> *"[I]n other words, ... the Okinawan economy was included into the mainland economy. It is natural that the relative price structure of Okinawa, whose import dependency ratio was close to 70 % and 80 % of whose import amount came from the mainland, was directly affected by that of the mainland. Moreover, labor wage was determined by the supply and demand conditions in the labor market of Okinawa as a local part of the whole labor market of the mainland. In fact, labor migration between Okinawa and the mainland was very large. The real side of the Okinawan economy was highly integrated to the mainland economy."*

Furthermore, in the introduction of his analysis of aggregate price movements in Okinawa after the 1972 reversion, Tanaka (1980) argues

> *"[B]efore the reversion, the Okinawan economy relied heavily on import and export, which put extremely large weights on the mainland Japan. This fundamental characteristic of the Okinawan economy had not changed even after the reversion. When we investigate aggregate price movements and their fundamental drivers in Okinawa with our careful recognition of such high dependence of the Okinawan economy on the mainland, it is quite relevant for us to presume that there is likely to be no significant difference in aggregate price dynamics between Okinawa and the mainland: the two regions shared common factors driving aggregate prices."*

This argument of Tanaka (1980) implies that during the sample period of our paper, Okinawa and the mainland shared a common tendency in their aggregate price movements. This then supports that our DID analysis is valid satisfying the common trend condition.

2.3. USD regime after the fifth currency conversion

As mentioned in the introduction, this paper investigates three types of currency regimes — the USD fixed regime, the USD flexible regime, and the JPY common regime. The conversion from the USD regime to the JPY regime was the result of the reversion of the sovereignty of the Ryukyu

Islands to Japan in May 1972, and the conversion from the USD fixed regime to the USD flexible regime was due to the Nixon Shock in August 1971 that we will discuss in the next section in more detail. In this section, we will explain why in the first place the USD regime was established in the Ryukyu Islands and Okinawa and argues that the currency conversion to the USD fixed regime was implemented by the strategic and political decision by the U.S. military government, which was completely unrelated to the relative price structures of both the Ryukyu Islands and the mainland Japan.

The U.S. dollar was adopted as the unique legal tender of the Ryukyu Islands by High Commissioner Ordinance No.14 "Currency" on September 15, 1958. It was by this fifth currency conversion that the B yen was forced to convert to the U.S. dollar at the conversion rate of 120 B yen per U.S. dollar. The basic characteristic of the former fourth currency regime with the B yen was a currency board system in which the U.S. dollar was accumulated as official reserve assets. The supply of the B yen was backed by the U.S. dollar reserve one-for-one. This currency board system means that when the U.S. dollar reserve is accumulated (decumulated) by the current account surplus (deficit), the money supply in the Ryukyu Islands and Okinawa automatically increases (decreases). In other words, the B yen currency regime can be recognized as the the "U.S. dollar exchange standard" system. The USD regime established in September 15, 1958 shares the same basic characteristic as the B yen regime. That is to say, an increase (a decrease) in the U.S. dollar reserve due to the current account surplus (deficit) expands (shrinks) the money supply because the Ryukyu Islands and Okinawa had no right to issue the U.S. dollar.

A natural question then is: why did the U.S. military government decide to adopt the USD regime through the fifth currency conversion, even though the two currency regimes with the B yen and the U.S. dollar share the same fundamental characteristic as a currency board system? Bank of Ryukyu (1986) insists as the fundamental reason behind the fifth currency conversion that the U.S. military government wanted to liberalize the Okinawan economy and promote regional economic development by attracting foreign direct investment under the USD currency regime.

As discussed before, the anti-U.S. sentiment had been sharply worsened around the Ryukyu Islands. The U.S. military government tried to manage the resistance movement by improving the economic welfare of the Ryukyu Islands and Okinawa through promoting economic development. The then Republican administration under U.S. President Dwight Eisenhower, however, sought fiscal consolidation. This fiscal contraction policy and the resulting shrinkage of the military budget made it difficult for the U.S. military government in Okinawa to finance economic development policies. In other words, the "military base-dependent import-oriented economy", which was established at the beginning of the B yen currency regime, had almost failed up by 1955. Under this situation, the U.S. military government tried to attract foreign direct investment as the main source for economic development by liberalizing international transactions of capital, trade, and foreign currencies in the Ryukyu Islands. Needless to say, the U.S. dollar, which was the international vehicle currency equipped with high international liquidity, had a greater practical value than the B yen, which was only a local currency without general acceptability in international settlement. In other words, the U.S. military government considered the USD currency regime as one of the necessary conditions for attracting foreign capital.

The USD fixed regime, hence, was established by the highly political decision by the U.S.

military government, which was completely unrelated to the relative price structures of the Ryukyu Islands and the mainland Japan as well.

2.4. Exogeneity of the Nixon shock to the Okinawan economy

The Nixon shock, so to speak, was a series of emergency economic policies that were publicly announced by U.S. President Richard Nixon on August 15, 1971. Under the title of "The Challenge of Peace," President Nixon undertook three policy measures, (i) suspending the U.S. dollar's convertibility to gold, (ii) freezing wages and prices for 90 days, and (iii) imposing an import surcharge of 10 %, to fix a confidence problem on the U.S. dollar and reduce the U.S. unemployment and inflation rates. The Nixon shock, in fact, had an unprecedented impact on international financial markets.

Under the Bretton Woods system, the international monetary order was characterized as a "gold exchange standard" with the U.S. dollar as the vehicle currency, in which the U.S. dollar was backed by gold at the fixed conversion rate of 35 dollars per ounce of gold and all other foreign currencies were fixed to the U.S. dollar. The suspension of backing the U.S. dollar with gold, hence, allowed the conversion rate of the U.S. dollar to gold to float, and the 10% import surcharge meant to abandon the fixed exchange rate system through implicitly devaluating the U.S. dollar against all other currencies. The Nixon shock, therefore, ended the Bretton Woods system. Right after the Nixon shock, the major western countries temporarily closed their foreign exchange markets and simultaneously started floating their exchange rates. Japan also shifted to a managed floating system by August 28, 1971 and started revaluating the Japanese yen from the official rate of 360 yens per dollar. The Smithonian agreement on December 20, 1971 revalued the Japanese yen up to the official rate of 308 yens per dollar. On the day of the Okinawa reversion, May 15, 1972, all the U.S. dollars circulated in the Ryukyu Islands were converted to the Japanese yens at the official rate of 305 yens per dollar (i.e., the six currency conversion).[10]

The primary reasons behind the Nixon shock can be summarized as follows. After 1958, the U.S. balance of payment had continuously recored large deficit due to the rapid economic recoveries of the West Germany and Japan from the ruin after the WWII and the generous amount of the U.S. official development assistance programs for foreign countries to maintain the western alliance. The U.S. balance of payment further had been deteriorated by the fiscal deficits and the resulting high inflation pressure through a sharp increase in the military spending due to the U.S. military intervention to the Vietnam war in 1965.

The U.S. balance of payment deficit resulted in excess supply of the U.S. dollars to the world economy. This excess liquidity of the U.S. dollar then created a fundamental credibility problem of the gold exchange standard under the Bretton Woods system.[11] Furthermore, in the 1970s,

[10]More precisely, the international monetary system returned to a fixed exchange rate system by the Smithonian agreement, even though it admitted intermittent devaluations of the U.S. dollar. Even under the Smithonian regime, massive speculative attacks to the U.S. dollar had not stopped. Advanced economies, as a result, subsequently adopted floating exchange rates. After Japan started floating the Japanese yen against major currencies completely on February 1973, the Smithonian regime finally collapsed.

[11]Due to the U.S. balance of payment deficit, other foreign countries with the balance of payment surpluses accumulated a huge amount of the U.S. dollar reserves. Once the amount of the U.S. dollar reserves in foreign countries had been much larger than that of the gold reserve that the U.S. Fed held, the U.S. dollar lost its credibility

the U.S. economy had suffered from the infamous "stagflation" problem with high inflation and unemployment simultaneously. In response to the deteriorations of both the internal and external balances, the U.S. government put its priority on the macroeconomic policy autonomy toward the domestic economy, but abandoned the international commitment to the fixed exchange rate system by the Nixon shock.[12]

In summary, the collapse of the Bretton Woods system and the historical shift in the international monetary order to the post-Bretton Woods flexible exchange rate regime by the Nixon shock were the direct results of the policy decisions of the U.S. to deal with the internal and external imbalances that the U.S. economy suffered and to correct the institutional limitation imposed on the Bretton Woods system. Therefore, it is apparent that the Nixon shock was an exogenous unanticipated historical event for the economy of the Ryukyu Islands and Okinawa. In this paper, we recognize this exogenous unanticipated shift in the currency regime in Okinawa from the U.S. dollar fixed exchange rate to the U.S. dollar flexible exchange rate by the Nixon shock as an ideal environment of a natural experiment to identify effects of currency regimes to real exchange rate adjustments.[13]

3. Data

In this paper, we investigate monthly data of retail prices that were surveyed at selected retail stores in the capital cities of the 47 prefectures in Japan, which includes Naha, the capital city of Okinawa, for the five years between January 1970 and December 1974. The data for the 46 prefectures in the mainland are reported in the retail price survey (hereafter, the "mainland survey") that was conducted by the statistic bureau at the office of the prime minister of Japan.[14]

because it would be impossible for all the foreign dollar reserves to be converted to gold at the official conversion rate. On the other hand, if the U.S. balance of payment had turned to be surplus, a serious shortage problem of the U.S. dollar as the international settlement currency would have emerged and that problem would have hurt the growth of the world economy. This inevitable destiny of the U.S. dollar as the international vehicle currency, which is well known as "Triffin's dilemma" named after Robert Triffin, was finally materialized as the Nixon shock.

[12] According to the thesis of the "open-economy trilemma", the U.S. policy maker allowed the U.S. dollar nominal exchange rates to adjust flexibly by shifting to a floating exchange rate regime, regained the monetary policy autonomy, and maintained the freedom of international capital flow.

[13] The unexpected shift to a flexible exchange rate regime by the Nixon shock and the resulting sharp devaluation of the U.S. dollar against the Japanese yen affected the Ryukyu Islands' economy devastatingly. In particular, it created social anxiety and uncertainty due to an expected decline in the amount received after the planed currency conversion from the U.S. dollar to the Japanese yen on the day of the reversion. The political negotiation between the Government of the Ryukyu Islands and the Japanese government with respect to the official conversion rate that will be applied to the sixth currency conversion on the reversion day found it extremely difficult to reach a final agreement. On October 18, 1971, the Japanese government officially announced to establish special compensation benefits related to currency conversion (*Tsuuka tou kirikae taisaku tokubetu kyuhukin*) to compensate pecuniary losses that would be caused by expected revaluation of the Japanese yen from the official conversion rate of 360 yens per dollar under the Bretton Woods system. Because the special compensation benefits would be provided to the residents in the Ryukyu Islands *ex post* after the reversion, the Government of the Ryukyu Islands, on behalf of the Japanese government, implemented currency confirmation for the U.S. dollar assets all around the Ryukyu Islands and Okinawa before the reversion on October 9, 1971. For the currency confirmation exercise for the U.S. dollar assets, see Karube (2012) and Kabira (2015) for more details.

[14] "Retail Price Survey", Bureau of Statistics, Office of Prime Minister Japan.

The problem here is that the mainland survey contains data for Naha only for the periods after January 1973. Fortunately, for the periods before December 1972, the statistics agency of the Government of the Ryukyu Islands had conducted a retail price survey for Naha (hereafter, the "Okinawa survey").[15] Most importantly, the Okinawa survey covers the almost same product items as does the mainland survey. It is this detail of the Okinawa survey that makes it possible for us to conduct a DID exercise by identifying almost identical products and comparing these retail prices of them between Okinawa and the other capital cities of the mainland during the whole sample period. It is worth while noting that the Okinawa survey reports retail prices in terms of the USD before May 1972 and in terms of the JPY between June and December 1972. To construct product-level real exchange rates, we use the official JPY/USD spot rate (monthly average) to convert the USD prices to the JPY ones in Naha.

In this paper, we select 41 product items that are included in large category "foods" in both the Okinawa and mainland surveys. Importantly, out of 41 product items, 24 items have specific brand names, while the others do not. We then split the whole sample into the two subsamples of "brands" and "non-brands". In the former subsample, we can match identical product items both in the two surveys. This makes it possible for us to construct precisely individual product-level real exchange rates. Moreover, because most of product items in the brand subsample are major products of large companies in the processed food industry, it is highly likely that these products had been imported to Okinawa from the mainland.[16] Therefore, it is quite relevant to consider that the behaviors of product-level real exchange rates of these brand items strictly reflect international pricing strategies of larger processed foods manufacturers. On the other hand, most of the product items included in the non-brand subsample of the Okinawa survey were locally produced and consumed within the Ryukyu Islands. Because these "island products" had been unlikely to be exported to the mainland, they should be mostly identified as non-tradable goods, we conjecture that there were only a few arbitrage opportunities of these island products between Okinawa and the mainland. This reasonable guess leads us to an important hypothesis of this paper: no currency regime had significantly affected the extent to which the law of one price held in the island products.

There are at least three reasons behind our choice of the sample period between January 1970 and December 1974. First, the Okinawa survey at each year before 1969 reports product categories and items that are too coarse to make sufficiently precise matches with those in the mainland counterparts and to construct product-level real exchange rates precisely. Second, if we choose a longer sample period beyond 1974, time-series variations in product-level real exchange rates most likely reflect not only any effects of changes in currency regime but also any other structural changes happened in the economic environment between Okinawa and the mainland. As a result, this paper's inference on the JPY common currency effect could be biased and might be misleading. Following the recent literature of policy evaluation, we limit our attention to a shorter time-series sample neighboring changes in the Okinawan currency regime in order to guarantee homogeneity in other economic structures between Okinawa and the mainland. We then empirically draw an inference about any discontinuous change in the shapes of cross-product distributions of product-level real exchange rates between Okinawa and the mainland.

[15] "Retail Price Survey", Agency of Statistics, Planning Department, Government of the Ryukyu Islands.

[16] The brand subsample contains data of, for example, "Nescafe", "Morinaga Milk Caramel", "Bireley's", and "Kikkoman Soy Saurce".

Finally, as the third reason, this sample period involves the three different currency regimes that the Ryukyu Islands and Okinawa experienced. The first sub-period, which is between January 1970 and July 1971, corresponds to the U.S. dollar fixed exchange rate regime (hereafter, the "USD fixed") with the official rate of 360 yens per dollar; the second sub-period, which is between August 1971 and May 1972, i.e., between the Nixon shock and the 1972 reversion, corresponds to the U.S. flexible exchange rate regime (hereafter, the "USD flexible"); and the third sub-period, which is between June 1972 and December 1974, corresponds to the Japanese yen common currency regime (hereafter, the "JPY common") after the reversion. Hence, even with this shorter sample period, our data contain rich variations in the currency regime of Okinawa to identify real exchange rate effects sharply.

Data of product-level real exchange rates are constructed as follows. Let $p_{c,j}(t)$ denote the natural logarithm of the retail price of product item $j(= 1, 2, \cdots, 41)$ in city $c(= 1, 2, \cdots, 47)$ at period $t(= 1, 2, \cdots, 60)$ in terms of the JPY. Let $q_{c,s,j}(t)$ denote the logarithm of the product-level real exchange rate of item j at period t between distinct cities c and $s(\neq c)$. Then $q_{c,s,j}(t)$ is given as

$$q_{c,s,j}(t) \equiv p_{c,j}(t) - p_{s,j}(t).$$

In this paper, we extract from each of $q_{c,s,j}(t)$ a time-invariant city-pair fixed-effect over the three currency regimes. For this purpose, we calculate the time-series average of $q_{c,s,j}(t)$ for city pair (c, s) and item j , i.e., $\bar{q}_{c,s,j} \equiv T^{-1} \sum_{t=1}^{T} q_{c,s,j}(t)$. We then subtract $\bar{q}_{c,s,j}$ from $q_{c,s,j}(t)$ to construct our sample of product-level real exchange rates $\hat{q}_{c,s,j}(t) \equiv q_{c,s,j}(t) - \bar{q}_{c,s,j}$.

4. Results

4.1. Descriptive statistics and Kernel-smoothed densities of product-level real exchange rates

Whole sample

Table 1 reports the descriptive statistics of the absolute values of the product-level real exchange rates $|\hat{q}_{c,s,j}(t)|$ over all the 41 product items. Table 1(a) and (b) correspond to the city-pairs including Naha (hereafter, the "Okinawa pair") and those not including Naha (hereafter, the "mainland pair"), respectively, and display the sample size, mean, median, and standard deviation (S.D.) for the whole sample and the three currency regimes, the USD fixed, USD flexible, and JPY common regimes. These tables reveal at least the following four facts. First, regardless of currency regimes, the mean, median, and S.D. of the Okinawa-pair data are much larger than those of the mainland-pair counterpart. This means that the distribution of the Okinawa-pair data is subject to a positive fixed effect with heteroskedasticity. Second, the distribution of the Okinawa-pair data shifts its position to right under the USD flexible regime. This second fact is confirmed by the fact that the median and S.D. of the Okinawa-pair data are the largest and smallest in the USD flexible regime among the three currency regimes. Third, the mean and median of the Okinawa-pair data under the JPY common regime are larger than those under the USD fixed regime. This fact implies that the common currency regime did not facilitate real exchange rate adjustments relative to the fixed exchange rate regime. Fourth, contrary to the Okinawa-pair data, we observe lower mean and median of the mainland-pair data under the USD flexible regime.

To reconfirm the above four facts graphically, Figure 1 plots the kernel-smoothed densities of the absolute values of the product-level real exchange rates for all the 41 product items. In particular, Figure 1(a) corresponds to the pooled sample; Figure 1(b) to the USD fixed regime; Figure 1(c) to the USD flexible regime; and Figure 1(d) to the JPY common regime, respectively. Each figure plots the kernel smoothed densities of the Okinawa-pair data as the solid black line and of the mainland-pair data as the dotted black line.[17] The first fact of a positive fixed effect with heteroskedasticity in the Okinawa-pair data is apparent in Figure 1: in each of Figures 1(a)-(d), the solid black line is much flatter than the dotted black line. With respect to the second fact of the right shift of the distribution of the Okinawa-pair data under the USD flexible regime, Figure 1(c) shows that the USD flexible regime generates the distribution of the Okinawa-pair data that loses a single peaked pattern and is much flatter than those under the other two currency regimes. This is the reason why the median of the Okinawa-pair data becomes the largest under the USD flexible regime. However, the empirical plausibility of the third fact of the negative effect of the JPY common regime on real exchange rate adjustments looks unclear from the casual observation that the shape of the solid black line in Figure 1(b) for the USD fixed regime is indistinguishable from that in Figure 1(d) for the JPY common regime. Finally, it is hard to reconfirm visually the fourth fact in Figures 1(b)-(d).

In summary, the descriptive statistics and the kernel-smoothed densities of the whole sample give us two important hypotheses in this paper. First, contrary to the main claim of Cavallo et al. (2014a), we observe no significant common currency effect on price-level real exchange rate adjustments in our data. We find no clear evidence that the JPY common currency regime facilitated real exchange rate adjustments in product level; rather, there is a tendency that the JPY common currency regime deteriorated product-level real exchange rate adjustments relative to the USD fixed exchange rate regime. Second, as claimed by Berka et al. (2012), it is highly likely that the USD flexible exchange rate regime hampered product-level real exchange rate adjustments.

Brand and non-brand subsamples

Table 2 reports the descriptive statistics of the absolute values of the product-level real exchange rates, $|\hat{q}_{c,s,j}(t)|$, specifically for the brand and non-brand subsamples. Table 2(a) corresponds to the brand subsample of the Okinawa-pair data; Table 2(b) to the brand subsample of the mainland-pair data; Table 2(c) to the non-brand subsample of the Okinawa-pair data; and Table 2(d) to the non-brand subsample of the mainland-pair data, respectively. We can reconfirm the fact that regardless of the brand or non-brand subsample, the Okinawa-pair data has a positive fixed effect with significant hetroskedasticity relative to the mainland-pair data. It is also worth while noting that the mean and median of the mainland-pair data slightly decline under the USD flexible regime. The most important finding in Table 2 is that as shown in Table 2(a), the mean and median of the brand subsample of the Okinawa-pair data are dramatically larger under the USD flexible regime than those under the other currency regimes. Indeed, the shift from the USD fixed regime to the USD flexible regime increases the mean and median of the Okinawa-pair data by 4.61 % and 5.00 %, respectively. However, as shown by Table 2(c), we find no significant change in the distribution of the non-brand subsample of the Okinawa-pair data under the USD flexible regime, though, with a slightly lower mean. Lastly, regardless of the brand or non-brand subsample, the

[17] We use the Gaussian kernel for kernel smoothing.

mean and median of the Okinawa-pair data under the JPY common regime are larger than those under the USD fixed regime.

We can graphically reconfirm the above facts that the brand and non-brand subsamples uncover. Figures 2 and 3 display the smoothed distributions of the absolute values of the product-level real exchange rates for the brand and non-brand subsamples. At each window in each figure, the kernel-smoothed density of the Okinawa-pair data is plotted as the solid black line and that of the mainland-pair data as the dotted black line, as in Figure 1. In particular, Figures 2(a) and 3(a) correspond to the pooled sample; Figures 2(b) and 3(b) to the USD fixed regime; Figures 2(c) and 3(c) to the USD flexible regime; and Figure 2(d) and 3(d) to the JPY common regime. On the one hand, comparing Figure 2(c) with Figures 2(b) and (d) clearly shows us that the kernel-smoothed density of the bland subsample of the Okinawa-pair data has multiple peaks and is much flatter than those under the other currency regime. On the other hand, it is difficult or us to find any significant difference in the kernel-smoothed density between the USD fixed and JPY common regimes. Furthermore, regardless of the Okinawa-pair data or the mainland-pair data, Figures 3(b), (c), and (d) find no graphical evidence for any significant distinction in the distributional shape among the three currency regimes.

In short, the brand and non-brand subsamples reveal the two important facts that (i) the deterioration of product-level real exchange rate adjustments under the USD flexible regime, which is identified in the whole sample, mainly stems from the brand subsample and that (ii) there is no clear evidence that relative to the USD fixed regime, the JPY common regime facilitated product-level real exchange rate adjustments; rather the JPY common regime is likely to worsen real exchange rate adjustments in the product level.

4.2. The DID analysis

In this section, we report the results of the DID analysis to identify currency regime effects on product-level real exchange rate adjustments.

The econometric model

To explain the econometric model with which we conduct our DID analysis, we introduce several dummy variables as follows. Let $\mathbf{D}_{c,s}^{\text{Okinawa}}$ denote the dummy variable for the Okinawa-pair data such that for 47 prefectural capital cities indexed by $s(= 1, 2, \cdots 47)$ and the 46 prefectural capital cities except Naha indexed by $c(= 1, 2, \cdots, 46)$, $\mathbf{D}_{c,s}^{\text{Okinawa}}$ takes the value of 1 if $s =$ Naha and 0 otherwise:

$$\mathbf{D}_{c,s}^{\text{Okinawa}} = \begin{cases} 1 & \text{if} \quad s = \text{Naha}, \\ 0 & \text{otherwise}. \end{cases}$$

Next we define the dummy variable for the USD flexible regime, $\mathbf{D}(t)^{\text{Flex}}$, such that it takes the value of 1 when time subscript t indicates a period between August 1971 and May 1972 and 0 otherwise. Similarly, $\mathbf{D}(t)^{\text{Com}}$ denotes the dummy variable for the JPY common regime that takes the value of 1 when time subscript t indicates a period between June 1972 and December 1974 and 0 otherwise:

$$\mathbf{D}^{\text{Flex}}(t) = \begin{cases} 1 & \text{if} \quad t = \text{August 1971, ..., May 1972}, \\ 0 & \text{otherwise}, \end{cases}$$

$$\mathbf{D}^{\text{Com}}(t) = \begin{cases} 1 & \text{if} \quad t = \text{June 1972, ..., December 1974,} \\ 0 & \text{otherwise.} \end{cases}$$

Letting α and $u_{c,s,j}(t)$ denote a constant term and an i.i.d. disturbance, we construct the following econometric model of the absolute value of the product-level real exchange rate $|\hat{q}_{c,s,j}(t)|$:[18]

$$|\hat{q}_{c,s,j}(t)| = \alpha + \beta_0 \mathbf{D}_{c,s}^{\text{Okinawa}} + \beta_1 \mathbf{D}^{\text{Flex}}(t) + \beta_2 \mathbf{D}^{\text{Com}}(t) + \gamma_0 \mathbf{D}_{c,s}^{\text{Okinawa}} * \mathbf{D}^{\text{Flex}}(t) + \gamma_1 \mathbf{D}_{c,s}^{\text{Okinawa}} * \mathbf{D}^{\text{Com}}(t) + u_{c,s,j}(t). \quad (1)$$

Table 3 summarizes how econometric model (1) identifies the average treatment effects of the three distinct currency regimes on the absolute value of the product-level real exchange rate *relative to the USD fixed regime*. The fixed effect of the Okinawa-pair data, which is observed in the last section, is identified by coefficient β_0. Our DID analysis then identifies the marginal effect of the USD flexible regime as coefficient γ_0 on the cross term between the dummy variables of the Okinawa-pair data and the USD flexible regime, $\mathbf{D}_{c,s}^{\text{Okinawa}} * \mathbf{D}^{\text{Flex}}(t)$. Similarly, the marginal effect of the JPY common regime is identified as coefficient γ_1 on the cross term between the dummy variables of the Okinawa-pair data and the JPY common regime, $\mathbf{D}_{c,s}^{\text{Okinawa}} * \mathbf{D}^{\text{Com}}(t)$.

Importantly, econometric model (1) gives us the null hypothesis for a common currency effect, which is emphasized by Cavallo et al.(2014a), as $H_0 : \gamma_1 \leq 0$. The model also provides the null hypothesis for a deteriorating effect of a flexible exchange rate regime, which is claimed by Berka et al. (2012), as $H_0 : \gamma_0 \geq 0$. Furthermore, to take into account not only the statistical significance of the null hypotheses but also the economic relevance of the currency regime effects, we construct the relative effects of the USD flexible regime and the JPY common regime on the Okinawa pair data:

$$\lambda_{Flex} = \frac{\gamma_0}{\alpha + \beta_0}, \quad \lambda_{Com} = \frac{\gamma_1}{\alpha + \beta_0},$$

where the denominator $\alpha + \beta_0$ captures the average affect of the USD fixed effect on the Okinawa-pair data. Relative effects λ_{Flex} and λ_{Com}, therefore, measure by what percent the USD flexible and JPY common regimes change the average price differential in the Okinawa-pair data *relative to the USD fixed regime*.

We estimate econometric model (1) by OLS. To take into account the apparent heteroskedasticity in the Okinawa-pair data, we calculate the White's heteroskedasticity-robust standard errors. For expositional purpose, the point estimates and standard errors reported below are provided in terms of percentage in the table.

Whole sample

Table 4 summarizes the results of our DID analysis. Table 4(a) reports the estimates of

[18] A drawback of the DID analysis in this paper is that econometric model (1) identifies only treatment effects of currency regimes on the mean of the distribution of the product-level real exchange rate. However, as suggested in the last section, a change in currency regime might affect the whole distributional shape that is represented by the median and standard deviation. It in fact is our future task to introduce a quantile regression method to capture such distributional effects econometrically.

econometric model (1) for the whole sample (the third column), the brand subsample (the fourth column), and the non-brand subsample (the fifth column), respectively.

As conveyed in the third column, we draw the following inferences from the whole sample. The point estimate of the constant term $\hat{\alpha}$ is positive (4.628) and statistically significant. This result means that there was about 4.6% average deviation from the LOP in the pooled sample of the mainland-pair data over the whole sample period. The point estimate of the coefficient on the dummy of the Okinawa pair, $\hat{\beta}_0$, is positive (6.685) and statistically significant, which implies that the average deviation from the LOP in the Okinawa-pair data was larger by about 6.7% than that in the mainland-pair data over the whole sample period. The point estimates of the coefficients on the dummy variables of the USD flexible regime and the JPY common regime, $\hat{\beta}_1$ and $\hat{\beta}_2$, are negative (-0.817) and positive (0.272) and the both are statistically significant. Especially, the former estimate repeats the observation in the last section that the average price differential in the mainland-pair data declined under the USD flexible regime.

The point estimate of the coefficient on the cross-term between the dummy variables for the Okinawa-pair data and the USD flexible regime, $\hat{\gamma}_0$, is positive (2.228) with statistical significance. The point estimate of the coefficient on the cross-term of the dummy variables for the Okinawa-pair data and the JPY common regime, $\hat{\gamma}_1$, is also positive (1.631) with statistical significance. Therefore, the whole sample cannot reject the null hypothesis of the deteriorating effect of the USD flexible regime, $H_0 : \gamma_0 \geq 0$, but can surely reject the null hypothesis of the common currency effect of the JPY common regime, $H_0 : \gamma_1 \leq 0$.

Table 4(b) displays the estimates of the average treatment effects of the three currency regimes. The third column suggests that the Okinawa-pair data suffers the average LOP deviations by 11.312% under the USD fixed regime, by 12.723% under the USD flexible regime, and by 13.215% under the JPY common regime, respectively. The differences among these average effects are statistically significant. However, the sizes of the differences are less than 2%. This implies that the average treatment effects of the three currency regimes are economically indistinguishable in the whole sample. Table 4(c) reports the estimated relative effects of the USD flexible and JPY common regimes relative the USD fixed regime, $\hat{\lambda}_{Flex} = 19.695\%$ and $\hat{\lambda}_{Com} = 14.418\%$. That is to say, after controlling for any average change in the price differential in the mainland-pair data, the USD fixed and JPY common regimes increase the average price differential in the Okinawa-pair data by about 20% and 15% relative to the USD fixed regime.

Brand subsample

The fourth column of Table 4(a) indicates the estimation results of econometric model (1) for the brand subsample. The point estimate of the coefficient on the cross term between the dummy variables for the Okinawa-pair data and the USD flexible regime, $\hat{\gamma}_0$, is positive (5.905) and statistically significant. This means that the deteriorating effect of the USD flexible regime on the price differential in the brand subsample of the Okinawa-pair data is estimated about 6% and economically significant. The point estimate of the coefficient on the cross term between the dummy variables for the Okinawa-pair data and the JPY common regime, $\hat{\gamma}_1$, is also positive (2.121) and statistically significant. Notice again that this result is inconsistent with the null hypothesis of the common currency effect $H_0 : \gamma_1 \leq 0$: the JPY common regime was likely to deteriorate the average

deviation from the LOP compared to the USD fixed regime. Indeed, as shown in Table 4(c), the relative effects in the brand subsample of the Okinawa-pair data are estimated $\hat{\lambda}_{Flex} = 86.280\%$ and $\hat{\lambda}_{Com} = 30.991\%$ for the USD flexible and JPY common regimes, respectively. Hence, the USD flexible and JPY common regimes increase the price differential in the brand subsample of the Okinawa-pair data by about 86% and 31% relative to the USD fixed regime.

For digging much deeper the statistically as well as economically significant real exchange rate effects of the currency regimes found in the brand subsample, the distribution of the *level* of the product-level real exchange rate $\hat{q}_{c,s,j}(t)$ is very informative. Figure 4 plots the kernel-smoothed densities of $\hat{q}_{c,s,j}(t)$ in the brand subsample of the Okinawa-pair data as the solid black line and of the mainland-pair data as the dotted black line. Figure 4(a) corresponds to the pooled sample; Figure 4(b) to the USD fixed regime; Figure 4(c) to the USD flexible regime; and Figure 4(d) to the JPY common regime, respectively. Notice again that Figure (4) plots the kernel-smoothed distribution of the *level* of the product-level real exchange rate, not the *absolute value* of it as in Figures 1-3. Further, note that a real exchange rate $\hat{q}_{c,s,j}(t)$ in the Okinawa-pair data is constructed by subtracting the logarithm of a retail price in Naha from that in another prefectural capital city in the mainland.

The outstanding observation from Figure 4(c) is that the kernel-smoothed density in the Okinawa-pair data greatly appears biased toward the right only under the USD flexible regime. The kernel-smoothed density in the mainland-pair data, however, is mostly symmetric around the center of zero under all the currency regimes. This observation clearly shows that the JPY retail prices of many of the brand product item in the city of Naha had been lower than those in the other prefectural capital cities in the mainland during the period of the USD flexible regime. In other words, Okinawa experienced product-level real depreciation against the mainland under the USD flexible regime. The intermittent nominal devaluations of the Okinawan currency (i.e., USD) after the Nixon shock were accompanied by the real currency depreciations. This crucial finding by our DID analysis perfectly echoes the two observations of Mussa (1986), i.e., almost one-to-one co-movement between nominal and real exchange rates and volatile real exchange rate fluctuations under flexible exchange rate regimes. Because most of 24 items included in the brand subsample of the Okinawa-pair data were produced by major processed-food companies in the mainland, the above finding can be fully understood by the hypothesis of incomplete pass-through from nominal exchange rate fluctuations to domestic retail prices, which is the primary theoretical prediction of a new Keynesian model with monopolistically competitive export firms conducting the pricing-to-market/local-currency-pricing strategy at the markets in both Okinawa and the other mainland cities.

Material forthcoming

Non-brand subsample

The fifth column of Table 4(a) corresponds to the estimation results of econometric model (1) for the non-brand subsample. The first important observation to be mentioned is that the point estimate of the constant is outstandingly large: $\hat{\alpha} = 12.710$. This implies that under the USD fixed regime, the average price differential observed in the non-brand subsample of the mainland-pair data is more than 12%. Because the point estimate of the fixed effect of the Okinawa-pair data

is also quite large ($\hat{\beta}_0 = 10.611$), the average price differential in the non-brand subsample of the Okinawa-pair data is greater than 23%.

Importantly, the large fixed effect estimated above makes the real exchange rate effects of the currency regimes economically ambiguous in the non-brand subsample of the Okinawa-pair data. To see this point, observe that the point estimate of the coefficient on the cross term between the dummy variables for the Okinawa-pair data and the USD flexible regime, $\hat{\gamma}_0$, is negative (-0.993) with statistical significance. Obviously, such a small point estimate implies that the marginal effect of the USD flexible regime on the price differential in the Okinawa-pair data should be economically insignificant. Moreover, as reported in Table 4(c), the relative effect of the USD flexible regime is estimated $\hat{\lambda}_{Flex} = -4.000\%$, which indicates that the USD flexible regime lowered the average price differential in the non-brand subsample of the Okinawa-pair data by 4% relative to the USD fixed regime. Comparing this size of the relative effect under the USD flexible regime to that estimated with the brand subsample (86.280%) simply tells us that the effect of the USD flexible regime on the price differential in the Okinawa-pair data is economically insignificant in the non-brand subsample.

The similar inference is obtained for the real exchange rate effect of the JPY common regime in the non-brand subsample of the Okinawa-pair data. The point estimate of the coefficient on the cross term between the dummy variables for the Okinawa-pair data and the JPY common regime, $\hat{\gamma}_1$, is positive (2.178) with statistical significance. The size of the marginal effect is about 2% and too small to find any economic significance. The relative effect of the JPY common regime is estimated $\hat{\lambda}_{Com} = 9.339\%$, which suggests that the JPY common regime increased the price differential in the non-brand subsample of the Okinawa-pair data by 9.3%. However, the size of the relative effect is also economically negligible when being compared to the size of the relative effect in the brand subsample (30.991%).

In summary, we draw a sharp inference of no economically important effect of the currency regimes on the product-level real exchange rate adjustments in the non-brand subsample of the Okinawa-pair data.The primary reason behind our inference is likely that the non-brand product items in the Okinawa-pair data include many of "island products" such as fresh products. These "island products" were locally produced and consumed only within the Ryukyu Islands and not exported to the mainland. Therefore, the non-brand product items in Naha should be identified as non-tradable goods. Because of the resulting absence of arbitrage opportunities between the non-brand items in Naha and the mainland cities, no currency regime has an economically significant effect on the price differential in the non-brand subsample of the Okinawa-pair data.

5. Conclusion

In this paper, exploiting the retail price surveys conducted in Okinawa and the mainland Japan around the reversion of Okinawa from the U.S. military occupation to the Japanese sovereignty in May 1972, we discuss that the unique historical event of the Ryukyu Islands and Okinawa after the Pacific War provides a powerful and ideal opportunity of a natural experiment to identify currency regime effects on product-level real exchange rate adjustments.

The main results from our DID analysis, which focuses only on 41 distinct product items categorized in food products, are summarized as follows. First, the USD flexible regime generated

a statistically significant and economically meaningful deterioration effect on product-level real exchange rate adjustments. This first result is obtained more sharply in the brand subsample in which the new Keynesian hypothesis of incomplete pass-through from nominal exchange rate fluctuations to local retail prices is more likely to be valid. Second, the JPY common regime produced no economically significant facilitating effect on product-level real exchange rate adjustments compared to the USD fixed regime. Finally, as the third important result, we find that product-level real exchange rate adjustments in non-brand products, many of which were non-tradable and produced and consumed locally within the Ryukyu Islands, were almost independent of the three currency regimes. On the one hand, the first result is mostly consistent with the role of fixed exchange rates to facilitate real exchange rate adjustments as in Berka et al.(2012, 2017). On the other hand, the second result casts a serious doubt on the common currency effect, which is proposed by Cavallo et al. (2014a,b), as an empirically robust thesis with a broad range of product items.

Of course, the above results of this paper are subject to several reservations. First, the above inferences are conditional on data of 41 distinct food products. It is our primary future task to extend our natural experiment by including data of a larger number of product items used for CPI construction. Second, all the inferences from our DID analysis are about the average treatment effects of the three currency regimes, i.e., the effects of the currency regimes on the mean of the distribution of absolute LOP deviations of individual product items. Our graphical investigation with the kernel-smoothed densities in Section 4.1, however, indicates that the currency regimes are likely to affect higher moments of the distribution too. To capture possible higher moment effects of currency regimes, we might need to conduct our policy evaluation applying a quantile regression method. Finally, our DID analysis also detects an economically significant deteriorating effect of the JPY common currency regime on real exchange rate adjustments in the brand subsample. This result is inconsistent with the main inference drawn by Takagi et al. (2004) from aggregate CPI data of Okinawa. Digging depper this inconsistency between the two papers should be an important task to be addressed by a future research.

References

Berka, M., Devereux, M. B., Engel, C., 2012, Real exchange rate adjustment in and out of the Eurozone, *American Economic Review* 102, 179-185.

Berka, M., Devereux, M. B., Engel, C., 2017, Real exchange rates and sectoral productivity in the Eurozone, Department of Economic, mimeo, University of Wisconsin, Madison.

Burstein A., Gopinath, G., 2014, International prices and exchange rates, in Gopinath, G., Helpman, E., and Rogoff, K. eds., *Handbook of International Economics, vol 4,* 391 − 451, North Holland/Elsevier, London.

Cavallo, A. Neiman, B., Rigobon, R., 2014a, Currency unions, product introductions, and the real exchange rate, *Quarterly Journal of Economics* 129, 529-595.

Cavallo, A. Neiman, B., Rigobon, R., 2014b, The price impact of joining a currency union: evidence from Latvia, *NBER Working Paper* 20225.

Crucini, M. J., Shintani, M., 2008, Persistence in law of one price deviations: Evidence from micro-data, *Journal of Monetary Economics* 55, 629-644.

Crucini, M. J., Telmer, C.I., 2012, Microeconomic sources of real exchange rate variability, *NBER Working Paper* 17978.

Engel, C., 1999, Accounting for U.S. real exchange rate changes, *Journal of Political Economy* 107, 507-538.

Gopinath, G., Gourinchas, P.-O., Hsieh, C.-T., Li, N., 2011, International prices, costs, and markup differences, *American Economic Review* 101, 2450-2486.

Gorodnichenko, Y. Tesar, L., 2009, Border effect or country effect? Seattle may not be so far from Vancouver after all, *American Economic Journal: Macroeconomics* 1, 219-241.

Kano, K., Kano, T., 2016, Searching for a common currency effect on price dispersion: 1972 Okinawa reversion, mimeo, Hitotsubashi University.

Kano, K., Kano, T., Takechi, K., 2013, Exaggerated death of distance: revisiting distance effects on regional price dispersions, *Journal of International Economics* 90, 403-413.

Kano, T., 2016, Trend inflation and exchange rate dynamics: a new Keynesian approach, Centre for Applied Macroeconomic Analysis (CAMA) Working Paper 74/2016.

Marsh, I.W., Passari, E., Sarno, L., 2012, Purchasing power parity in tradable goods, in James, J., Marsh. I.W., Sarno, L. eds. *Handbook of Exchange Rates*, chapter 7, John Wiley and Sons, Inc. Hoboken, NJ.

Monacelli, T, 2004, Into the Mussa puzzle: monetary policy regimes and the real exchange in a small open economy. *Journal of International Economics* 62, 191-217.

Morshed, A.K.M.M, 2007, Is there really a border effect? *Journal of International Money and Finance* 26, 1229-1238.

Mussa, M., 1986, Nominal exchange rate regimes and the behavior of real exchange rates: evidence and implications , *Carnegies-Rochester Conference Series on Public Policy* 25, 117-214.

Takagi, S., Shintani, M., Okamoto, T., 2004, Measuring the economic impact of monetary union: the case of Okinawa, *Review of Economics and Statistics* 86, 858-867.

Kouri bukka tokei chosa nenpo ("Annual Report on the Retail Price Survey"), 1970, 1971, 1972, 1973, 1974, Bureau of Statistics Office of the Prime Minister, Government of Japan.

Naha shi tokei sho, ("Naha City Statistics Books"), 1972, 1973, Department of Planning, City Office of Naha.

Okinawa tokei nenkan ("Okinawas Statistical Yearbook"), 1971, 1972, 1973, 1974, 1975, Agency of Statistics, Planning Department, Government of the Ryukyu Islands and Okinawa Prefecture Office.

Okinawa no tokei, ("Statistics of Okinawa"), No.2, 1973, Agency of Statistics, Planning Department, Okinawa Prefecture Office. .

Bank of Ryukyu, 1986, *Sengo Okinawa keizai shi* ("Post-war economic history of Okinawa"), Research Department, Bank of Ryukyu.

Kabira, N., 2015, *Okinawa Henkan to Tsuuka Panilku* ("Okinawa Reversion and Currency Panic"), Yoshikawa Koubunnkan.

Kano, K., Kano, T. , 2017, Real exchange rates and currency regimes: implications from 1972 Okinawa reversion, Hitotsubashi Instutute for Advanced Study Discussion Paper E-52 (in Japanese).

Karube, K., 2012, *Dokyumento Okinawa keizai shobun : mitsuyaku to doru kaishu*, Iwanami Shyoten.

Makino, H., 1993, *Sengo Okinawa no Tsuuka* ("Currency in Post-war Okinawa), Okinawa-bunko 31-1,2, Hirugi-sha.

Tanaka, H., 1980, *Bukka* ("Prices"), *Hondo hukki ni yoru Okinawa shakai keizai henndo tyosa houkokusyo* ("Research report on social and economic changes in Okinawa after reversion") Ch.15, p177-288, Committee of Social and Economics Changes in Okinawa.

Table 1: Descriptive Statistics of Product-Level Real Exchange Rates (%) : $|q_{c,s,j}(t)|$

Currency regime	Sample size	Mean	Median	S.D.
(a) *Okinawa pair*				
Pooled	104,817	18.74	11.41	22.77
USD fixed	28,185	18.19	9.96	24.64
USD flexible	18,516	18.62	13.63	18.83
JPY common	58,116	19.05	11.46	22.96
(b) *Mainland pair*				
Pooled	2,358,781	10.79	6.10	14.11
USD fixed	634,981	11.57	6.48	14.91
USD flexible	416,232	9.72	5.05	14.64
JPY common	1,307,568	10.75	6.28	13.50

Table 2: Descriptive Statistics of Product-Level Real Exchange Rates (%): Brand Products vs. Non-brand Products

Currency regime	Sample size	Mean	Median	S.D.
(a) *Okinawa pair: Brand products*				
Pooled	54,470	10.29	8.11	8.77
USD fixed	13,376	7.96	6.74	6.16
USD flexible	9,882	12.57	11.74	8.27
JPY common	31,212	10.56	7.99	9.61
(b) *Mainland pair: Brand products*				
Pooled	1,225,171	5.66	3.72	6.52
USD fixed	300,736	5.62	3.81	6.37
USD flexible	222,166	4.33	3.06	4.63
JPY common	702,269	6.09	3.93	7.01
(c) *Okinawa pair: Non-brand products*				
Pooled	50,347	27.89	18.59	28.89
USD fixed	14,809	27.42	16.65	30.69
USD flexible	8,634	25.55	17.77	24.34
JPY common	26,904	28.90	20.00	29.17
(d) *Mainland pair: Non-brand products*				
Pooled	1,133,610	16.33	11.00	17.58
USD fixed	334,245	16.92	11.33	18.04
USD flexible	194,066	15.88	9.95	19.07
JPY common	605,299	16.14	11.17	16.80

Table 3: DID Identification of Real Exchange Rate Effects of Currency Regimes

Average Effects	
Okinawa pair + USD fixed	Mainland pair + USD fixed
$\alpha + \beta_0$	α
Okinawa pair + USD flexible	Mainland pair + USD flexible
$\alpha + \beta_0 + \beta_1 + \gamma_0$	$\alpha + \beta_1$
Okinawa pair + JPY common	Mainland pair + JPY common
$\alpha + \beta_0 + \beta_2 + \gamma_1$	$\alpha + \beta_2$
Okinawa pair	β_0
Marginal effect of USD flexible	γ_0
Marginal effect of JPY common	γ_1
Relative effect of USD flexible	$\lambda_{Flex} = \frac{\gamma_0}{\alpha+\beta_0}$
Relative effect of JPY common	$\lambda_{Com} = \frac{\gamma_1}{\alpha+\beta_0}$

Table 4: Estimation Results of Econometric Model (1)

Explanatory	Coeff.	Whole	Brand	Non-brand
		(a) Estimates		
$\mathbf{D}_{c,s}^{\text{Okinawa}}$	β_0	6.685^{***}	2.338^{***}	10.611^{***}
		(0.125)	(0.056)	(0.228)
$\mathbf{D}_{c,s}^{\text{Flex}}$	β_1	-0.817^{***}	-0.953^{***}	-0.610^{***}
		(0.025)	(0.014)	(0.048)
$\mathbf{D}_{c,s}^{\text{Comm}}$	β_2	0.272^{***}	0.839^{***}	-0.329^{**}
		(0.019)	(0.014)	(0.035)
$\mathbf{D}_{c,s}^{\text{Okinawa}} * \mathbf{D}_{c,s}^{\text{Flex}}$	γ_0	2.228^{***}	5.905^{***}	-0.933^{***}
		(0.176)	(0.105)	(0.335)
$\mathbf{D}_{c,s}^{\text{Okinawa}} * \mathbf{D}_{c,s}^{\text{Comm}}$	γ_1	1.631^{***}	2.121^{***}	2.178^{***}
		(0.150)	(0.078)	(0.279)
Constant	α	4.628^{***}	4.505^{***}	12.710^{***}
		(0.021)	(0.019)	(0.076)
R^2		0.286	0.142	0.179
Nob		2,463,598	1,279,641	1,183,957
		(b) Average Effects (%)		
Okinawa pair + USD fixed	$\alpha + \beta_0$	11.312 (0.124)	6.844 (0.057)	23.321 (0.236)
Okinawa pair + USD flexible	$\alpha + \beta_0 + \beta_1 + \gamma_0$	12.723 (0.123)	11.796 (0.090)	21.778 (0.250)
Okinawa pair + JPY common	$\alpha + \beta_0 + \beta_2 + \gamma_1$	13.215 (0.082)	9.804 (0.056)	25.170 (0.172)
Mainland pair + USD fixed	α	4.628 (0.021)	4.505 (0.019)	12.710 (0.076)
Mainland pair + USD flexible	$\alpha + \beta_1$	3.811 (0.024)	3.552 (0.018)	12.100 (0.080)
Mainland + JPY common	$\alpha + \beta_2$	4.900 (0.186)	5.344 (0.017)	12.381 (0.071)
		(c) Relative Effects of Currency Regimes on Okinawa Pair (%)		
USD flexible	λ_{Flex}	19.695	86.280	-4.000
JPY common	λ_{Com}	14.418	30.991	9.339

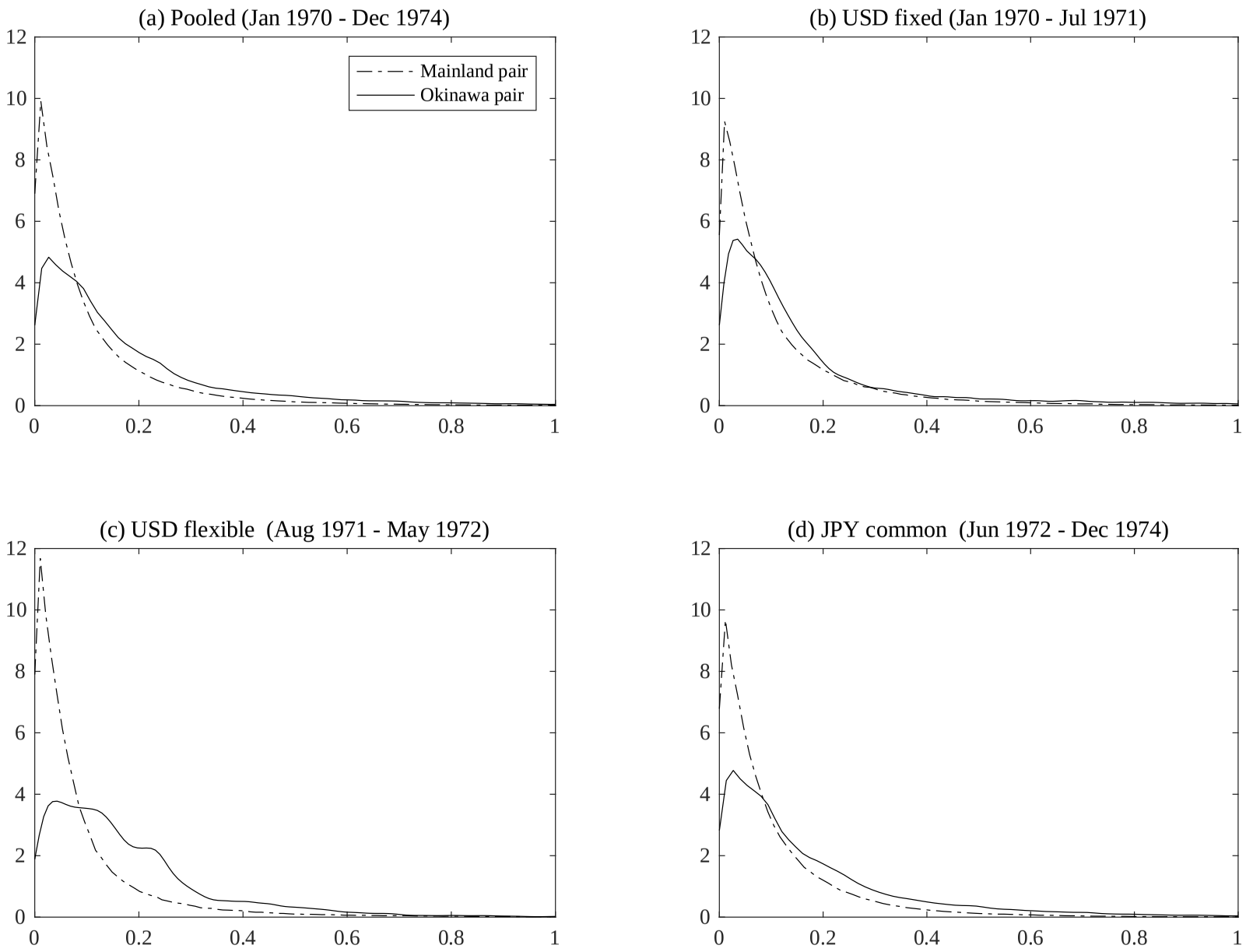

Figure 1: Kernel-smoothed Densities of Absolute Values of Product-level Real Exchange Rates: Pooled Sample

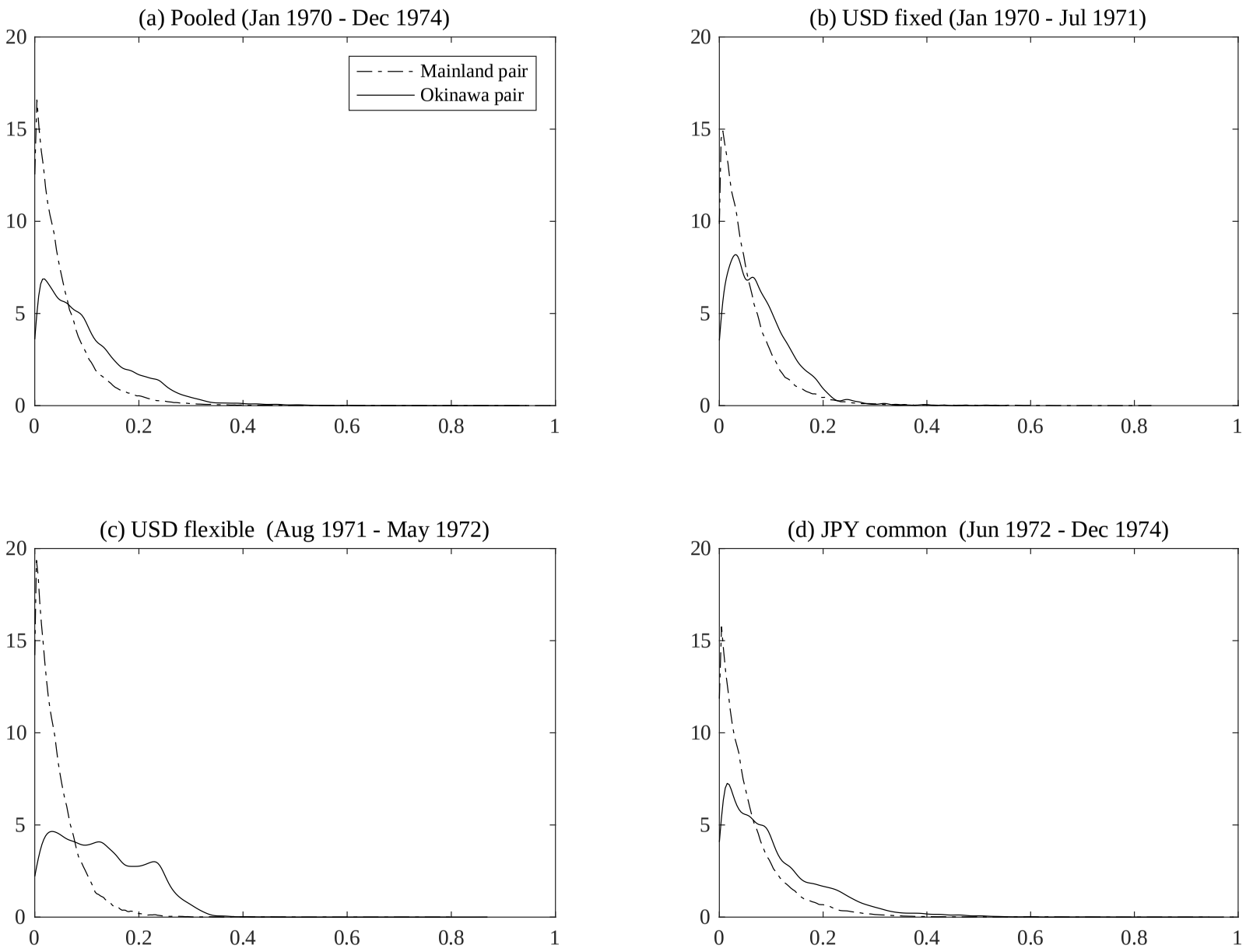

Figure 2: Kernel-smoothed Densities of Absolute Values of Product-level Real Exchange Rates: Brand Products

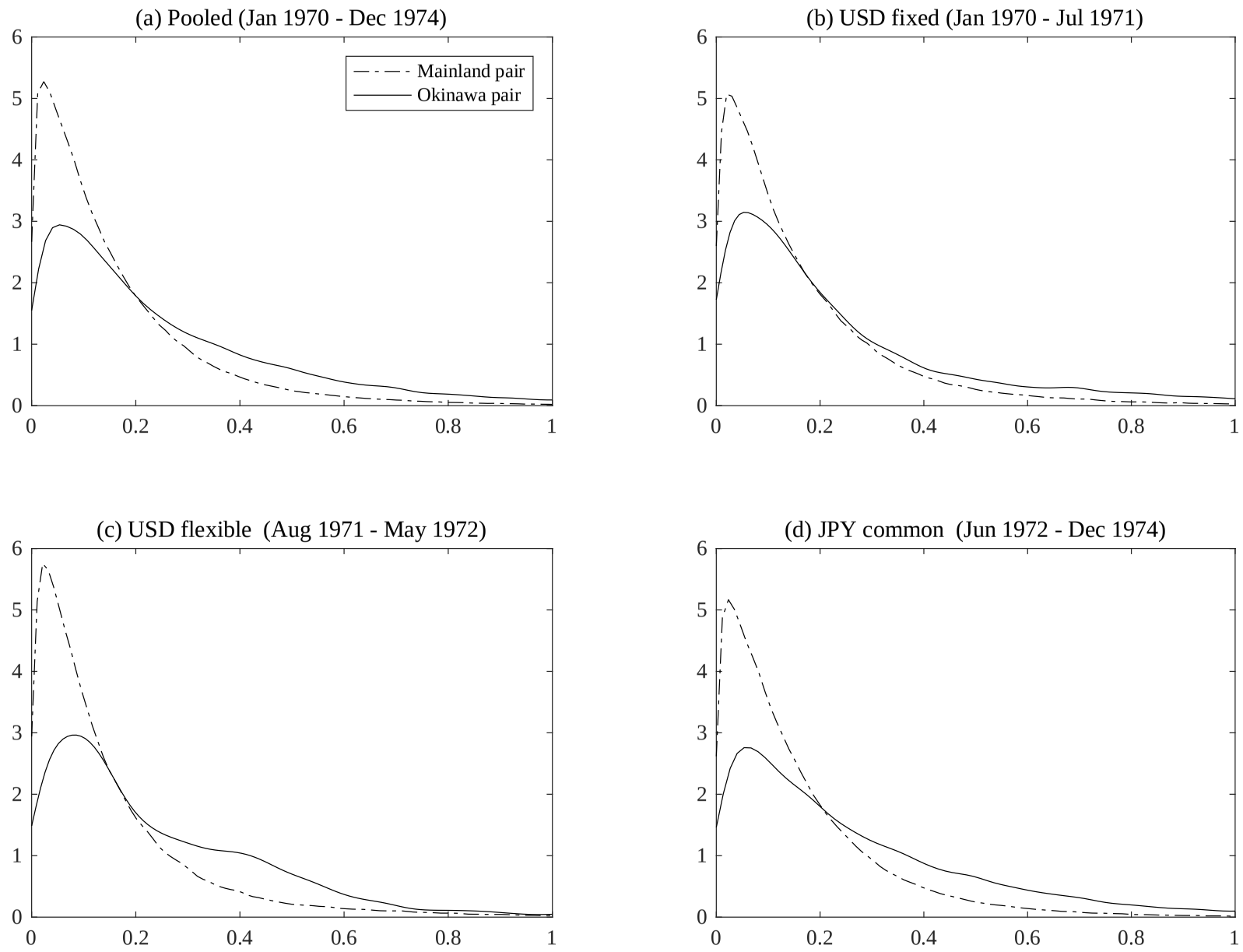

Figure 3: Kernel-smoothed Densities of Absolute Values of Product-level Real Exchange Rates: Non-brand Products

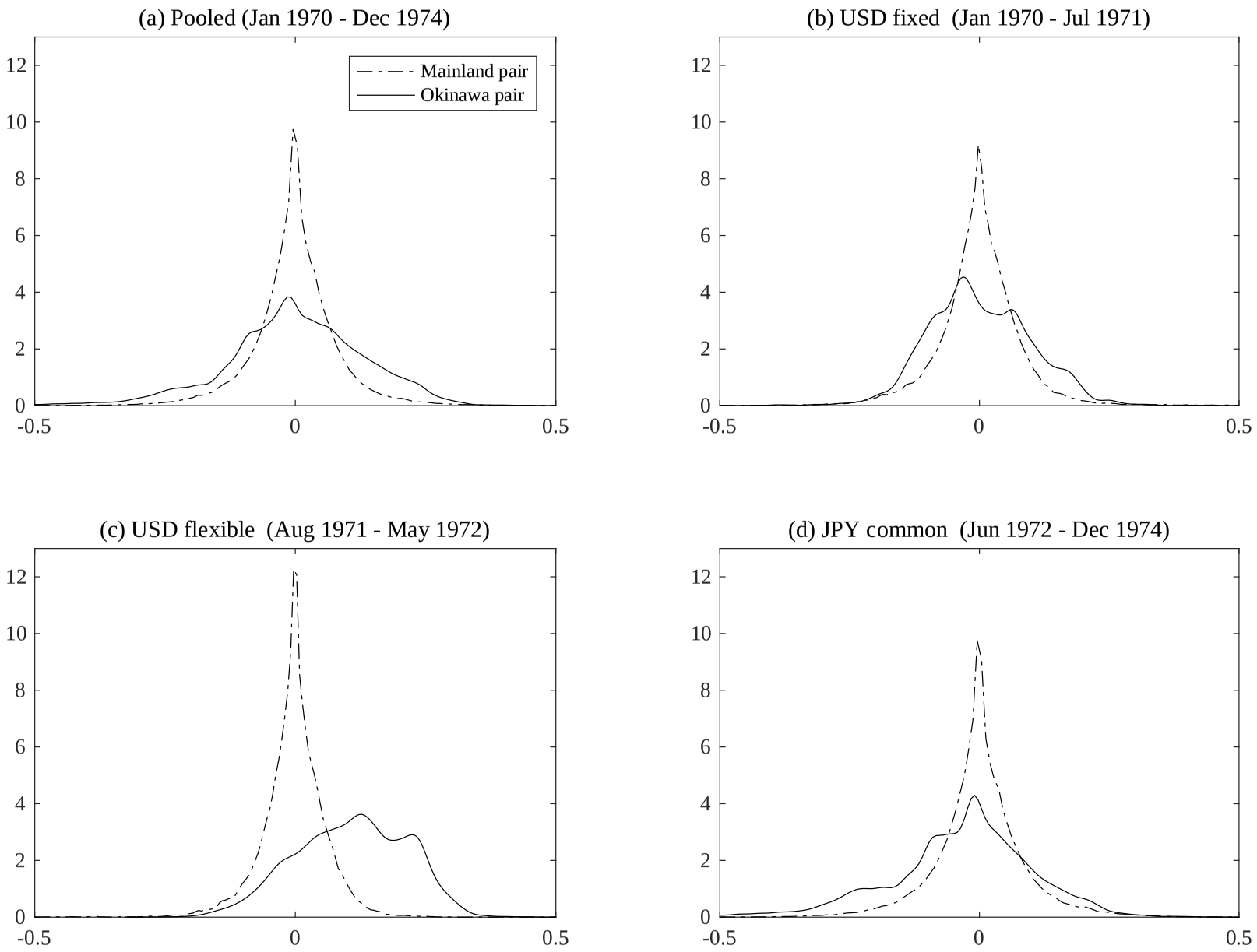

Figure 4: Kernel-smoothed Densities of Product-level Real Exchange Rates: Brand Products