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## Safe-Haven Korea? - Spillover Effects from UMPs

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**IMF Working Paper**

Asia and Pacific Department

**Safe-Haven Korea? — Spillover Effects from UMPs**

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**Abstract**

We examine how Korea's capital flows and trade have been affected by the quantitative easing (QE) of the United States and the quantitative and qualitative easing (QQME) of Japan. Korea is an intriguing case due to its borderline position between advanced and emerging market country groups, and the common perception that Korea competes fiercely with Japan in the world market for trade. We find that QE had little direct impact on capital flows to Korea, and tapering is unlikely to cause capital outflows from it owing to partial safe-haven behavior of capital flows to Korea. We also find that the exchange rate spillover from QQME to Korea has been limited both on trade and capital flow fronts.

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## I. INTRODUCTION

The discussion about spillovers from unconventional monetary policies (UMPs) has, until recently, focused on the impacts of quantitative easing (QE) of the United States through portfolio capital flows. Historically, capital flows tended to cause imbalance, at times severe ones, in the recipient economies—ranging from exchange rate overshooting and credit excess, to susceptibility to a sudden stop, and finally to a run-up to a balance of payments crisis. Worries about capital flow spillovers have thus prompted a global review of the policy tool kit available to respond to them.<sup>2</sup> More recently, the focus of the spillover discussion has rapidly shifted to the risks associated with QE exit, particularly since May 2013 when these risks began to trigger capital outflows from a number of emerging markets (EMs). The Bank of Japan's adoption of quantitative and qualitative easing (QQME) in April 2013 has also been an important recent development, the spillover of which is likely to add to the discussion.

In this paper, we examine how Korea's capital flows and trade have been affected by UMPs, focusing on QE and QQME. Korea makes an intriguing case because of its borderline position between advanced and emerging market country groups and the common perception that Korea fiercely competes with Japan in the world market. Since the 2008-09 global financial crisis, Korea has experienced some recovery of capital flows during QE and QQME expansions, in line with EMs, but the size of the recovery was very moderate compared to EMs on average. This is an important stylized fact indicating the global investors' growing tendency to differentiate Korea. Since May 2013, furthermore, the won has remained remarkably resilient despite the QE tapering turmoil. At the same time, the UMPs had also significantly affected Korea's exchange rate. In particular the won has appreciated by 25 percent against the yen since May 2012. In view of Korea's strong perceived competition in the third markets with Japan, the discussion on QQME spillovers to Korea has focused on the exchange rate channel. So far, however, the impact on Korea's exports has remained muted. This could be merely a matter of time required for the exchange rate effects to eventually filter through. Or it may be a reflection of the strengthened resilience of Korea's exports to price factors at play, which could have been also helped by other transitional factors (e.g., geopolitical tensions among countries in the region).

With the above-mentioned factors in mind, we examine the impact of UMPs on Korea through both financial and trade linkages. On the financial linkage, our main question would be whether QE and QQME have had a significant impact on capital flows to Korea, and thus the tapering of QE might cause a sudden stop of such flows. On the trade linkage, we ask (i) whether Korea's sensitivity to the won-yen exchange rates is significant; and (ii) if Korea's

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<sup>2</sup> IMF, "The Liberalization and Management of Capital Flows: An Institutional View," November 14, 2012 ([www.imf.org/external/np/pp/eng/2012/111412.pdf](http://www.imf.org/external/np/pp/eng/2012/111412.pdf)).

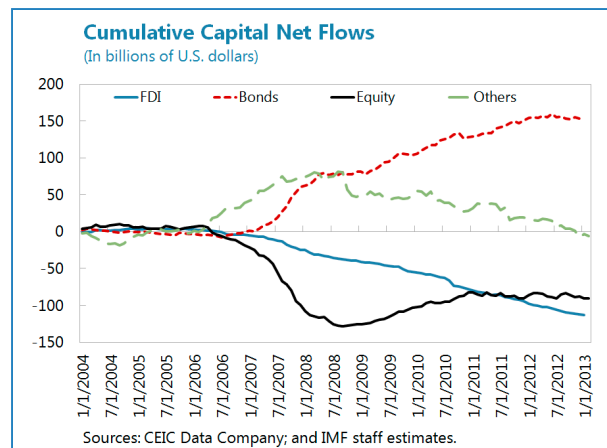
value chain link to imported inputs from Japan will help ameliorate negative competitiveness effects of the cheaper yen. We find that QE had little direct impact on capital flows to Korea, and the tapering is unlikely to cause capital outflows from it, owing partially to safe-haven behavior of capital flows to Korea (Section II). We also find that the exchange rate spillovers to Korea from QQME will be limited in the near term, although Korea's newly gained non-price competitiveness may unwind, should the yen's weakening cycle go deeper or become sufficiently prolonged (Section III).

## II. SPILLOVERS THROUGH THE FINANCIAL LINKAGE

### A. Korea—Capital Flow Trends

#### Early 2000s to 2008-09 Crisis

During the 2000s, Korea liberalized its capital account transactions, which introduced both new opportunities and risks. In the run-up to the 2008-09 crisis, expectations of trend appreciation in the won's exchange rate created a large demand for hedging by exporters. In conjunction with the lack of commensurate demand for hedging by the importers (particularly refineries), such expectations led to a large buildup of liquidity mismatch in the banking system: banks (particularly foreign bank branches) relied heavily on external borrowing, particularly short-term one with low interest rates, in order to offset currency risks arising from relatively long-term forward contracts.<sup>3</sup>



#### 2008-09 Crisis to Summer of 2013

In 2008Q4, global liquidity dry-ups caused a sudden outflow of about US\$ 33 billion (14 percent of Korea's gross international reserves) of banking capital from Korea. Stemming mainly from the unexpected repayment of short-term interbank FX loans—the bulk of which were interoffice loans—by the foreign bank branches, these outflows entailed the liquidation

<sup>3</sup> The model estimation suggests that a one percentage point increase in the net forward position (scaled by the total asset size) of a foreign bank branch is associated with a 0.3 percentage point increase in short-term external debt (scaled the same way) in the same quarter, and 0.2 percentage point increases in the subsequent quarters (see Jack Joo K. Ree, Kyoungsoo Yoon, and Hail Park, "FX Funding Risks and Exchange Rate Volatility—Korea's Case," IMF Working Paper, WP/12/268, November 2012).

of local bond positions and conversion of the won proceeds to U.S. dollars, and caused a sharp depreciation of the won (to a maximum of 36 percent during the crisis).

The outflows also caused Korea's gross international reserves to decrease by 34 billion dollars that quarter.<sup>4</sup> In response to the stress, the Korean authorities promptly put together a package of measures including monetary easing, fiscal stimulus, and the BOK's dollar swap injection, as well as government guarantees on banks' external debt. In addition, they also established bilateral currency swap facilities with the United States, as well as with Japan.

<b>Korea - Net Capital Flows During U.S. Quantitative Easing</b>			
(In billions of dollars, monthly average)			
	QE1	QE2	QE3
Net Bonds	1.7	0.2	0
Net Equity	1.8	0.1	-0.9
Net Other	-0.5	0.7	-2.4
Net FDI	-1.1	-1.6	-1.3
Net Derivatives	-0.4	0.2	0.5
Net Capital Flows	1.5	-0.3	-4.1
1/ QE1 (11/2005 - 3/2010); QE2 (11/2010 - 6/2011); QE3 (9/2012 - 2/2013)			
Source: CEIC data company Ltd.			
<b>EMs - EPFR Flows During U.S. Quantitative Easing</b>			
(In billions of dollars, monthly average)			
	QE1	QE2	QE3
Bonds	0	0.5	3.3
Equity	4.5	3.7	10.5
Total	4.5	4.1	13.8
1/ QE1 (2008.11-2010.3); QE2 (2010.11-2011.6); QE3 (2012.9-2013.2)			
Source: Haver Analytics.			

In 2009Q1, Korea was already able to stem the sudden stop in banking capital. The successful containment was not only due to the authorities' own actions, but also to measures adopted by policymakers at the epicenters of the crisis (including the U.S. quantitative easing). Since then Korea has continued to restore the strength of its external position with the current account surplus and portfolio capital inflows more than offsetting a continued orderly reduction in banks' external debt, which has allowed foreign direct investment (FDI) and reserve assets to build up over time. During this period, there were three waves of QE programs, Korea's

responses to which were visibly differentiated from EMs:

- Some push factor effects of the quantitative easing seem to have existed for Korea during QE1 (November 2008 to March 2010), but not so much during QE2 (November 2010 to June 2011) and QE3 (September 2012 to now) periods.<sup>5</sup> During QE1, the monthly capital flows to Korea were 1.5 billion U.S. dollar net inflows on average (the average net flow was negative during the QE2 and QE3), with strong bond and equity flows (3.5 billion

<sup>4</sup> This was a decline by 16 percent; the maximum decline during the 2008 global financial crisis (GFC) amounted to US\$ 65 billion dollars or a peak- to- trough fall of 24 percent.

<sup>5</sup> The regression analysis presented later does not allow us to decompose push and pull factors because of interaction variables. However, the IMF's *2013 Spillover Report* finds Korea at the borderline between emerging and advanced countries in terms of the significance of the global or regional common factors—which is larger for EMs—driving capital flows.

U.S. dollars) more than offsetting outflows in FDI, banking flows, and settlement payments related to derivative liabilities (i.e., valuation losses).

- The impact of quantitative easing on bond and equity flows appears to be significantly milder for Korea than EMs. The global bond and equity fund flows to emerging market countries tracked by data provider EPFR Global rose to an average of 14 billion dollars per month during QE3 from of 4-5 billion dollars per month during QE1 and QE2. In the case of Korea, monthly gross bond and equity flows rose from 2.1 billion dollars during QE1 to 2.4 billion dollars during QE2, but they fell back to 2.1 billion dollars during QE3.

In response to the resumption of capital flows, the authorities introduced macro-prudential regulations, including a ceiling on bank's FX derivative position. The objective was to curtail systemic risks from short-term external debt, foreign currency denominated domestic lending, and foreign bond holding. Owing, at least partly, to these measures, banks' external debt, led by short-term debt, sharply decreased from 220 billion dollars (short-term debt, 160 billion dollars) immediately prior to the crisis to 178 billion dollars (short-term debt, 77 billion dollars) in September 2013.<sup>6</sup>

### **Since May 2013**

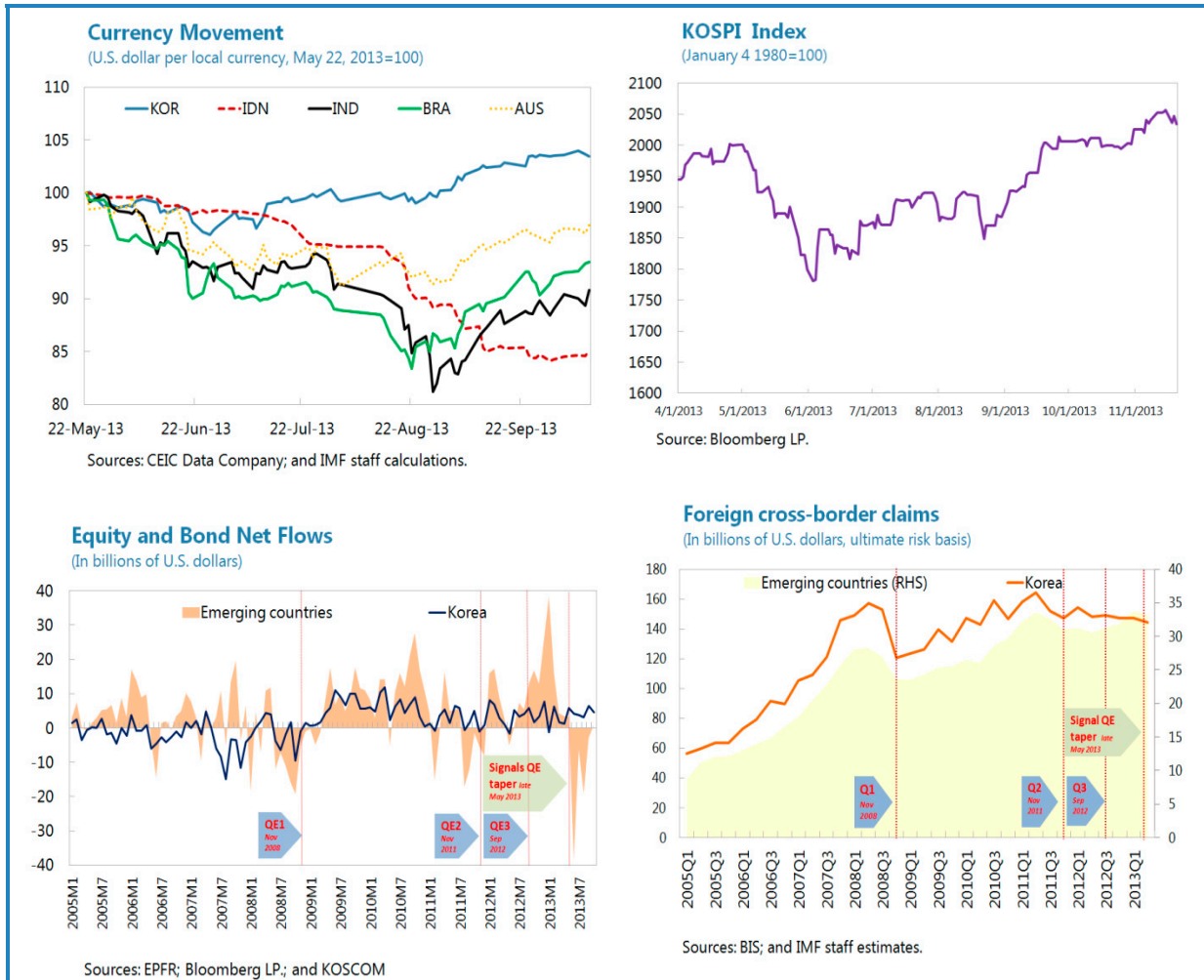
Since the 2008-09 crisis, the global financial market has continued to face recurring waves of volatility, and the current one is led by the fears about uncertainties related to the tapering of QE by the United States. On May 22, 2013, the Federal Reserve Chairman Ben Bernanke made a public comment indicating a possibility that the Federal Reserve's unconventional programs for monetary easing could be scaled back in the near future. From then on, spates of events, be they speeches or data release indicating the strength of the ongoing U.S. recovery, have increased financial market volatility, and triggered a significant amount of capital outflows from EMs. The latest wave of global financial volatility has taken harder hits on EMs with weaker fundamentals or policies, making them the most acute receivers of the negative spillovers from UMPs. As a means of defense, many EMs have strengthened capital flow measures, while striving to achieve an optimal balance between foreign exchange market intervention and allowing currency depreciation.

So far, however, Korea has done remarkably well, clearly differentiating itself, and, in fact, attracting significant inflows of both equity and bonds. This was partly because international investors have redirected their funds from emerging markets such as India, Indonesia, Brazil, and Turkey. This is an amazing departure from the past. Since the liberalization of the

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<sup>6</sup> However, an exact quantification of the affects of the measures is not easy because they were introduced during a period when both demand (reflecting a sharp decline in demand for FX hedging from shipbuilders owing to decreases in new orders) and supply (owing to deleveraging of global banks) of external short-term debt were declining.

capital account in the early 2000s, Korea has been commonly labeled by market analysts as a high financial beta market, meaning that its asset prices are highly sensitive to fluctuations in global risk appetite. So why have global investors behaved differently this time? There seems to be a number of interconnected reasons:



First, the overall resilience of Korea's financial system to external shocks has significantly increased since the 2008-09 global financial crisis, particularly because its banks have shed their external short-term debt, which used to be their key vulnerability to swings in capital flows.<sup>7</sup>

Second, Korea's post-crisis rebound of equity prices has been very modest compared to many emerging markets that enjoyed a surge. And Korea's specific factors that had dragged

<sup>7</sup> See Ree and others (2012).



on equity began to fade in the summer of 2013. Three major factors that had weighed on Korean equity were (i) North Korea risks, (ii) benchmark index change by one large EM index fund (Vanguard EM ETF) from MSCI Global Equity indices (which include Korea as an EM) to FTSE Emerging Market indices (which does not), and (iii) the yen's sharp depreciation since late 2012.

Third, bond flows are driven by increasingly diversifying the investor base, and hence are more stable. Moreover, our analysis presented later in the paper suggests that these investors have tended to increase exposure to Korea when the global market becomes more risk averse, at least up to a certain critical point, in a "safe-haven flow" sort of behavior.

Fourth, with a large current account surplus and the market's perception that the Korean authorities are pacing the won's appreciation, there seems to have been a one-sided expectation on the won's exchange rates.<sup>8</sup>

Given all this, it is not unreasonable to speculate that if a QE tapering takes place in an orderly fashion, driven by the recovery of the U.S. growth outlook, portfolio capital flows are likely to continue as Korea's economic outlook strengthens, as we will try to corroborate in the next section.

### B. Effects of UMPs on Capital Flows: Estimation

Here, we construct a regression model of capital flows aimed at identifying both direct and indirect effects of UMPs on capital flows to Korea, and thus provide a basis to plausibly quantify the impacts of future tapering of QE, as well as of the continued rollouts of QQME by the Bank of Japan (BOJ). The model is a simple ordinary least-square model using Korean specific time series and global factors of the following form (See Appendix 1 for the list of variables):

$$\mathbf{y}_t^h = \mathbf{a}^h + \mathbf{b}_1^h \mathbf{x}_t^h + \mathbf{b}_2^h \mathbf{z}_t^h + \mathbf{b}_2^h * \text{UMP}_t + \mathbf{u}_t^h, \text{ for } t=1, \dots, T$$

( $\mathbf{y}_t^h$ : capital flows of type  $h$ , from an array comprising portfolio bonds, portfolio equity, and bank flows,  $\mathbf{x}_t^h$ :  $m \times 1$  vector of push factors,  $\mathbf{z}_t^h$ :  $n \times 1$  vector of pull factors,  $\text{UMP}_t$ :  $n \times 1$  vector of UMPs proxy variables).

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<sup>8</sup> In concluding 2013 Article IV Consultation with Korea, the Executive Board of the International Monetary Fund "noted the widening of Korea's external imbalance and the increased pressure on the exchange rate, which the staff assessed as being moderately undervalued in real effective terms." (<http://www.imf.org/external/np/sec/pr/2014/pr1420.htm>).

## Data

For portfolio (equity and bonds) flows, our baseline model uses weekly data from January 2008 to June 2013, using net purchases of listed Korean stocks and bonds by foreigners as the dependent variable. Previous studies on the impact of UMPs on capital flows have used EPFR Global data, which provide information on equity and bond fund flows to various countries by tracking country and regional weightings adopted by the global funds covered by the dataset. In the case of Korea, however, the EPFR Global data have been unable to correctly capture foreign portfolio capital flows, particularly for bonds, whose investor base is much broader than institutional investors (e.g., about 40 percent of the total foreign flows are generated by central banks). Fortunately, Korea's major capital market institutions, such as the Korea Exchange, provide a detailed investor base breakdown of transaction flows on a daily basis.

For banking flows, however, the highest frequency data publicly available are the Bank of Korea's monthly balance of payments statistics. Quarterly frequency options would include Bank for International Settlements (BIS) cross-border banking statistics and the Bank of Korea's external debt statistics, both of which provide more delineated information than the standard balance of payments. However, given that quarterly frequency would smooth out the bulk of the most intriguing market dynamics, such as the impacts of market events and shifts in risk sentiment, which have been highly volatile, we used a monthly model as our baseline.

For proxies of UMP, we used the weekly change in the balance sheet of the U.S. Federal Reserve of the amount outstanding of unconventional operational measures, classifying the measures into Liquidity (LQ), Treasuries (TR), and MBS measures (mimicking the approach of Fratzscher and others (2013)). We also used an event dummy variable to capture the impact of QE announcements: a dummy variable equal to 1 (-1) in the two weeks following each announcement related to the expansion (reduction) of QE. For QQME, we were confined to the BOJ's published balance sheet data—our models used the BOJ's total asset stock (BOJ\_ASST) and government securities holdings (BOJ\_GS) as proxies for QQME—which is monthly frequency. Hence, we applied the QQME variable to the baseline bank flow model which is monthly. It is also applied to monthly equity and bond flow regressions.

Existing studies note that the expected signs of the direct impact of the QE measures and announcements can be equivocal. Because, depending on their nature and global financial setting (including risk appetite and perceived risk-adjusted return for EM assets relative to advance market (AM) assets), they may strengthen a safe-haven flow (negatively affecting equity and bond flows to many EMs) or crowd out private investors at the QE origin (positively affecting both equity and bond flows), exert push effects through a portfolio-rebalancing channel. Korean capital market's borderline positioning between AM and EM asset classes and market indication that Korean government bonds are attracting safe-haven

and reserve-diversification flows (including from central banks) add another layer of complication.

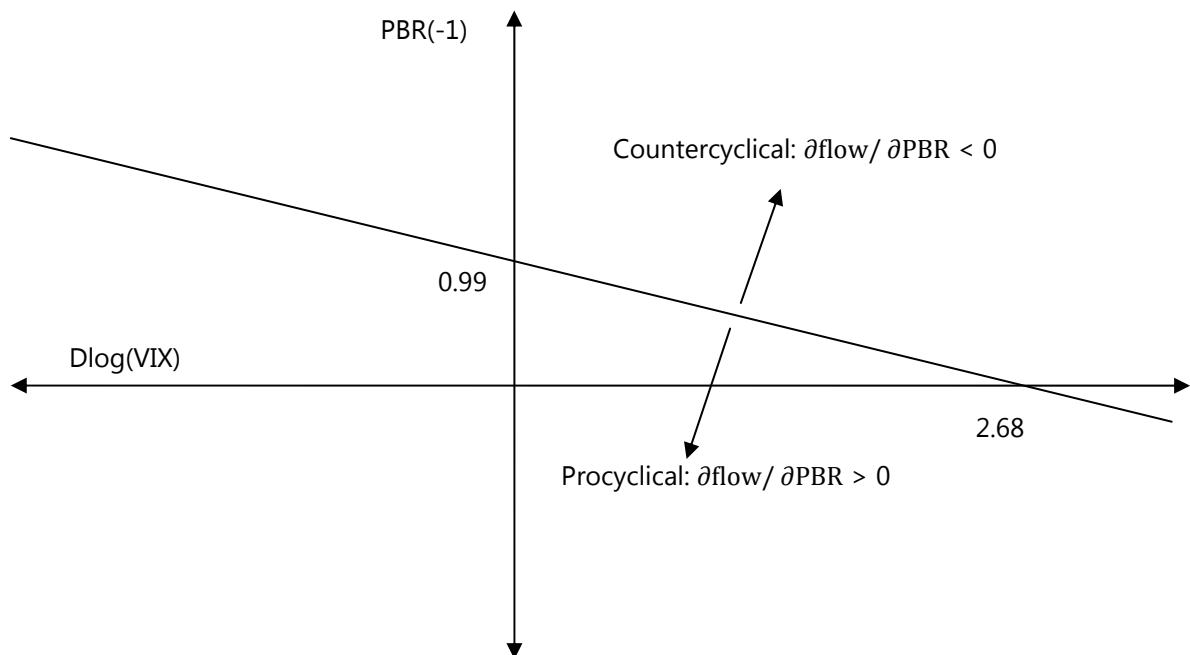
### Summary of Capital Flow Regressions

	Equity Flow	Bond Flow	Bank Flow
Direct effects from UMP (QE)		- (small)	+ (large)
Direct effects from UMP (QQME)	- (large)		
Yield curve steepening	+	-	+
Higher VIX	-	+/-	
Global liquidity stress (Libor-OIS spread)		-	-

Source: IMF staff estimates.

Note: / - denotes a negative impact, + a positive impact, and +/- a threshold behavior (all based on statistical significance)

### Foreign Equity Flow Response to PBR

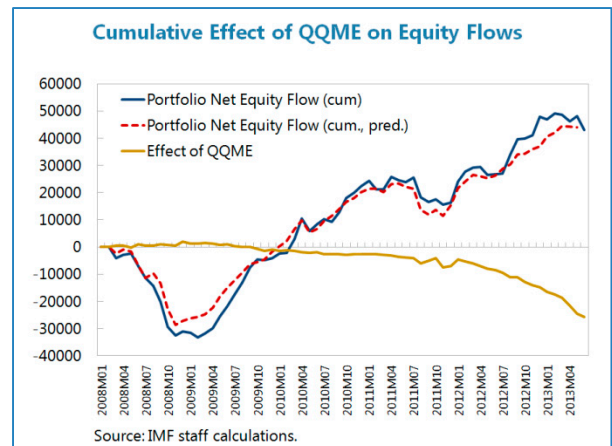


### Equity regression

The result of the benchmark equity regression is reported in Appendix 2. Interestingly, none of the QE variables was significant in the baseline model. The model, however, suggests that QE could have supported equity capital flows to the extent that the measures and announcements helped alleviate risk aversion. The model also shows that QE could have

affected the foreign investor response to stock fundamentals, particularly price-to-book ratio (PBR), through its interaction with risk aversion (VIX). It, too, shows that foreign equity flows to Korea may have reacted negatively on U.S. yield flattening.

- Negative impact of VIX:** Both the level (log) and the change (dlog) of VIX seem to have a negative association with equity flows. The equation indicates that a 1 percent increase in VIX can cause 0.6 billion dollars of outflows a week (which amounts to two-thirds of standard deviation from the average net flows over the sample period). Moreover, the impact of the change in VIX can be reinforced when the change is accelerated. For example, a one percentage point acceleration of sequential increases in VIX (e.g., additional 10 percent increase followed by a 9 percent increase in the previous week) can reduce the foreign equity flow response to PBR by 0.2 billion dollars for every one-tenth increase of PBR (e.g., from 1 to 1.1).
- Nonlinear response to PBR:** Foreign equity flows respond to PBR in a procyclical manner (i.e., a recent rise in valuation causes more inflows), until PBR reaches a certain valuation threshold (PBR\*), beyond which its behavior turns countercyclical (i.e., a recent rise in valuation causes less inflows). The threshold PBR\* decreases by about 0.36 (in ratio) with just a 1 percent increase in VIX. It collapses to zero when VIX increases by 2.7 percent in the current week, which implies that foreign equity flows would respond to PBR in a countercyclical manner regardless of levels of PBR during periods with a relatively small hiccup in VIX.
- Positive impact of U.S. yield curve (noncrisis period):** A 10 basis point acceleration of yield curve steepening (e.g., from 10 bps steepening to 20 bps steepening) is associated with about a 100 million dollar (or 1/10 of standard deviation over the sample period) increase in equity flows during the noncrisis period. During the crisis period, the positive correlation gets even stronger. This seems to be caused by the positive outlook for economic growth entailed by the yield curve.



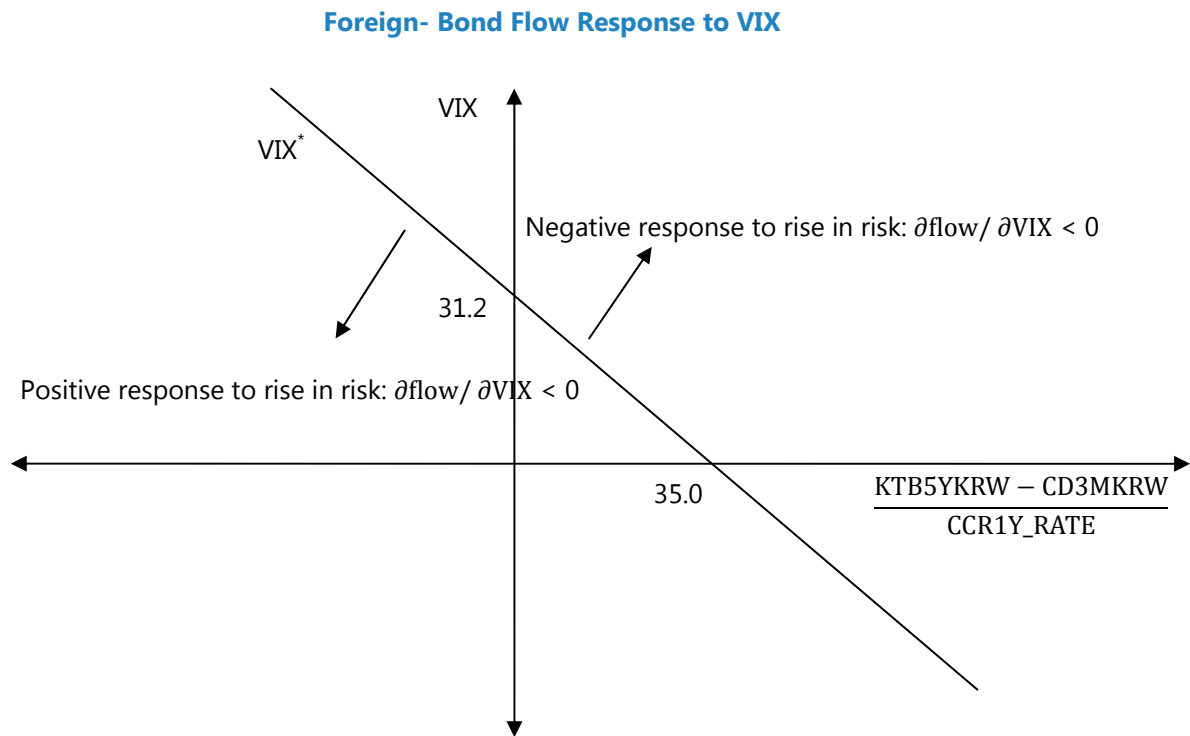
Our alternative monthly specification (Appendix 3) broadly confirms the main finding from the baseline weekly model, except that it shows a very significant negative association between QQME and equity flows to Korea.<sup>9</sup> This result supports the view that foreign

<sup>9</sup> The weekly model does not include QQME variables because of a lack of availability.

investors in the Korean equity market focused on expected negative exchange rate spillovers of QQME on Korean corporations, both as a driver of margin squeeze and as a potential game changer in the global competition with Japanese firms.

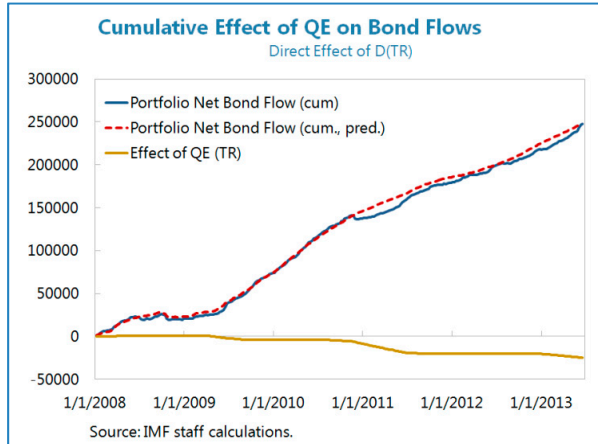
### Bond regression

The result of the benchmark bond regression is reported in Appendix 4. The bond-flow regression model shows that an increase in the Federal Reserve's bond-buying program (TR) can actually reduce foreign bond capital flows to Korea. It also shows that Korean bonds can benefit from "safe-haven" type flows when risk aversion remains below a certain threshold, which is positively associated with arbitrage gains, expected from currency-hedged trading positions on the Korea Treasury Bond (KTB) yield curve.



- Effects of UMPs:** The bond-flow regression establishes a highly significant and negative correlation between the Federal Reserve's Treasury Purchase Program (TR) and foreign bond flows. The result, while not immediately intuitive, is consistent with previous studies that found the U.S. Treasury Purchase Program had caused investor shift away from bonds (Fratzscher and others, 2013). The model however indicates that UMPs could have positively affected bond flows by easing global dollar liquidity stress (captured by LIBOR-OIS spread), an important (negative) push factor for bond flows to Korea. It could also have affected bond flows positively by putting breaks on VIX particularly during periods of tail elevation.

- **Nonlinear response to VIX:** Foreign bond flows positively respond to changes in



VIX until it reaches a certain threshold (VIX\*). In other words, larger VIX tends to bring more foreign investment in Korean bonds, in what appears as a search-for-safety. Such a behavioral pattern actually moves well with the continued upgrade of Korea's sovereign risk ratings since the 2008-09 crisis (they began to exceed those of Japan in 2012) and a significant increase of regional central banks in the foreign

investor base.<sup>10</sup> However, once the threshold VIX is breached, the foreign investor reaction to VIX shifts to negative (i.e., larger VIX causes a decrease in flows).

A decrease in the currency-swap basis spread (i.e., becoming more negative), however, will lower the threshold VIX except during the episodes of yield curve inversion, although it also increases arbitrage gains. This appears to reflect that a large prolonged decrease in the basis spread tended to occur during the episodes of dollar liquidity difficulties, during which foreign investors tended to sell off Korean bonds despite the spiking of arbitrage incentives.

When the term premium (TB5YKRW-CD3MKRW) is zero, the threshold risk aversion (VIX\*) above which bond flows start to respond negatively to VIX is 31.2 (close to one standard deviation above the median of VIX during the sample period). And yield curve steepening (by increasing arbitrage gains) will increase this threshold, implying that safe-haven flows would withstand higher levels of risk aversion.<sup>11</sup>

- **Interaction with domestic pull factors.** Our model thus suggests that the underlying cause of the foreign investors' nonlinear response to VIX is the interaction between VIX and domestic pull factors, in particular dollar funding conditions (captured by the cross currency swap basis spread) and term spread. These two variables determine

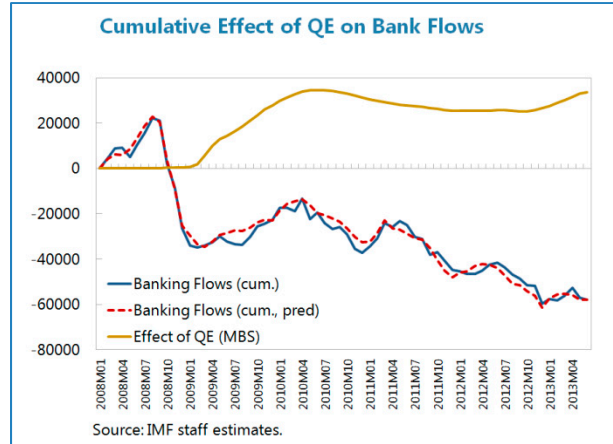
<sup>10</sup> See Ree and others (2012), page 19, Figure 10.

<sup>11</sup> In the graph, yield curve steepening is captured by movement along the VIX\* curve to the left because CCR1Y\_RATE is negative.

the profitability of a typical arbitrage position (i.e., the term premium minus the basis spread, which is normally negative) in Korean government bonds.<sup>12</sup>

### Bank- Flow Regression

The result of the benchmark bank flow—short-term other-flow gross liabilities from the balance of payments statistics are used here—regression is reported in Appendix 6. Most importantly, the result shows that one particular type of the Federal Reserve’s QE operation (i.e., Mortgage-Backed Securities (MBS) Purchase Program) had a very large direct impact on short-term banking capital flows to Korea, significantly slowing its continued large net outflows since the 2008-09 crisis. This positive spillover suggests that securitization market freeze may have been a major supply-side bottleneck affecting the cross-border lending to Korea right after the GFC. However, if that is the case, it is not clear that QE tapering will cause an equally significant negative impact on banking flows, unless it brings the U.S. MBS market back to dislocation.



The indirect impact of UMPs seems to have worked in both directions. On the one hand, it exerted a positive impact on banking flows by alleviating global liquidity strains—this channel is captured by the negative coefficient of LIBOR-OIS spread. However, our regression also suggests that the impact of UMPs could have been negative to the extent that they contributed to flattening the U.S. yield curve (its coefficient is positive). Thus, a benign growth-led exit from UMPs that is likely to leave both the term premium and LIBOR-OIS spread anchored is not likely to much affect cross-border banking flows to Korea.

### Implication for QE exit risks

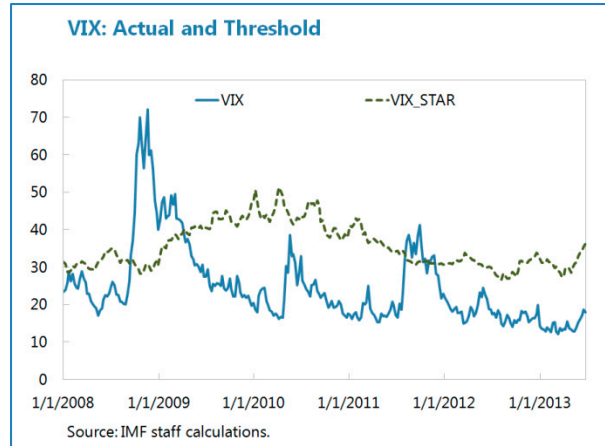
A growth-driven smooth QE exit, which leaves long-term U.S. rates anchored and does not hurt investor confidence, is unlikely to cause capital outflows from Korea. In fact, our model even suggests that a growth-driven QE exit could cause inflows to Korean equities, as well as banking flows, through positive signaling effects associated with an orderly steepening of the

<sup>12</sup> The interaction complicates the nonlinear response of bond flows to risk sentiments. For example, a QE expansion during a period in which VIX is below the threshold would increase the KTB term spread by dampening bond flows. However, the ensuing steeper yield curve will increase the threshold VIX\*, which would reinforce the robustness of safe-haven behavior of bond flows.



yield curve. However, a disorderly QE exit can cause capital outflows, through VIX (both equity and bonds), and the LIBOR-OIS spread (bonds and banking flows). The negative effects would likely be exacerbated, particularly for bond flows, if the unwinding of bond positions causes a dislocation of the onshore dollar funding market.

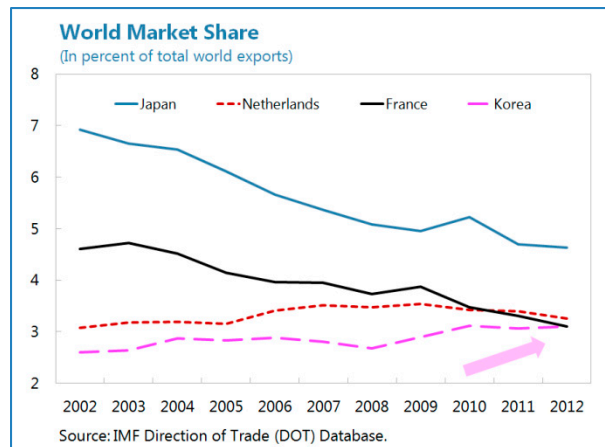
An increase in VIX associated with a disorderly QE exit can, however, have different implications across asset classes.<sup>13</sup> For equities, the impact would be unambiguously negative to capital flows. But for bonds, the impact can be positive (thus mitigating the negative impacts of dollar liquidity stress, particularly offshore) so long as it stays within about 1-1½ standard deviations from the historical median. A surge beyond these thresholds, however, can trigger a foreign investor sell-off.<sup>14</sup>



### III. SPILLOVERS THROUGH THE TRADE LINKAGE

#### A. Korea—Trends in Korea’s Exports after the Global Financial Crisis

The share of Korea in the global export market has advanced significantly since the 2008-09 global financial crisis. Korea’s world market share rose from 2.7 percent in 2008 to 3.1 percent in 2010, and has so far remained unchanged. During this period, Korea’s immediate upper-level competitors, particularly Japan and France, saw a loss in their market shares. There are three widely



<sup>13</sup> The latest global financial turmoil indicates that a disorderly QE exit can indeed steeply increase VIX, which rose from 50 on May 22 to 62 on June 21, 2013. Then VIX rapidly backed down to about 40 through early August, since when fluctuating in a 20-45 range,

<sup>14</sup> However, these findings should be read with due caution, bearing in mind that the behavior of capital flows during the periods of QE expansion (which occupy most of the sample period) may be different from one that would pan out during the periods of QE tapering, especially if it involves abrupt and nonlinear dynamics often seen during the bursting of financial bubbles. The non-linearity may set off tail risks, which could be chaotic and difficult to predict. That being said, Korea had not really had a capital flow-related credit bubble during the periods of QE expansion.



quoted explanations for this phenomenon:

- *Favorable Exchange Rate:* The won's depreciation in the wake of the 2008 crisis was sharper and more protracted than most competitor currencies. And this was particularly striking in the case of the won's exchange rate with the yen, which had fluctuated in the 12-15 won per yen range until the third quarter of 2012, as opposed to a range of between 8-11 won per yen before the crisis. Given Korea's strongly perceived export similarity with Japan,<sup>15</sup> Korea's exchange rate advantage has frequently been pointed to as the cause of Korea's market share gain.
- *Moving up the value chain:* Another explanation emphasizes the interplay between Korea's exchange rate gains and non-price competitiveness. Indeed, due credit should be given to Korean exporters' efforts to lock in the exchange rate gains by moving up the value chain. For example, Samsung Electronics has successfully refocused its product lines toward high-value final products—which requires companies' own branding powers (e.g., smart phones)—from its more conventional habitat of intermediate (e.g., semiconductor) products. The refocusing was accompanied by mutually reinforcing advances in branding, with Samsung moving up to the second place (next only to Apple, and followed by Google) in 2013 in the global brand ranking (it was ranked 43 in 2008).<sup>16</sup>

Global Market Share in Smart Phones				
	2008	2009	2011	12Q1
Samsung	4	8	19.9	30.1
Apple	9.1	15.9	19	23.8
Nokia	40.1	33.4	15.8	8.1
Source: Strategy Analytics, May 2012.				

- *Offshore production:* An increase in offshore production seems to have overall augmented Korea's global export share and made it more diversified and resilient. Since the crisis, Korean companies have aggressively moved their production overseas to garner the benefits of vertical integration (e.g., Information and Communication Technology (ICT) products), or to move closer to the markets (e.g., automobiles). Most

<sup>15</sup> Existing studies show somewhat mixed pictures on Korea-Japan export similarity, with some finding substantially lower export similarity under finer product category classifications but others finding high proximity in product spectrum across both product functions and price ranges.

<sup>16</sup> See <http://brandirectory.com/profile/samsung>.

notable examples are smart phone makers, which increased the proportion of offshore production from 16 percent in 2008 to 80 percent in 2012; as well as the automobile industry that stepped up the same proportion to 73 percent in 2012 (38 percent in 2008). Although moving existing production lines overseas would undermine exports by substituting domestic production, an expansion of overall production capacity focusing on the offshore would substitute less from domestic production and boost exports of intermediary inputs.

### B. Was Korea's Gain Japan's Loss?

Here we ask if Korea's postcrisis market share gain was at Japan's loss. This is an interesting question given the strikingly close magnitude between these two (about 0.4 percentage point for both), and Korea's accentuated exchange rate advantage over Japan since 2009. A positive answer to the question would strengthen a prediction that Korea's market share gains may unravel as the won-yen exchange rate moves back, in a lasting fashion, to the precrisis level or even lower owing to QQME.

A decomposition analysis, across both geographical and product markets, offers an intuitive initial path to explore the question. If Korea's gains and Japan's losses are indeed negatively correlated, then a dissection of the trade data into various market segments should lead to some evidence of demand substitution (e.g., demand in the U.S. automobile market shifting from Japan to Korea). On the contrary, if we fail to uncover any such evidence, the chance is higher that Korea's gains and Japan's losses may not be so closely connected, and the elevated levels of the won-to-yen exchange rate may have played a limited role in reshaping the market pie share.

The analysis is conducted based on the following accounting identity:

Decomposition of change in Korea's global market share at time  $t$  ( $\theta_t$ )

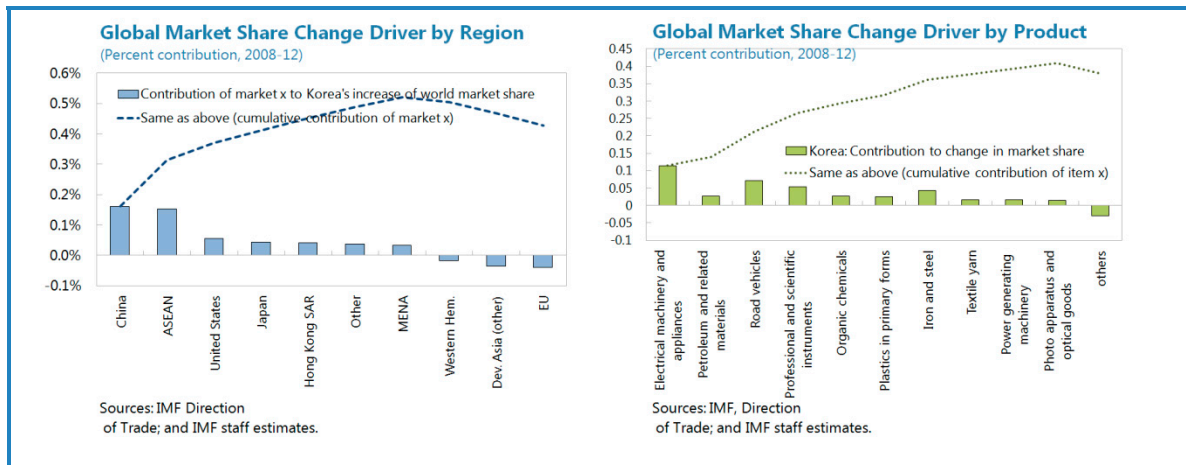
$$\begin{aligned}
 \theta_T^j - \theta_0^j &= \frac{1}{M_T} \sum_h x_{T,h}^j - \frac{1}{M_0} \sum_h x_{0,h}^j \\
 &= \frac{1}{M_T} \sum_h (x_{T,h}^j - x_{0,h}^j) + \frac{1}{M_T} \sum_h x_{0,h}^j - \frac{1}{M_0} \sum_h x_{0,h}^j \\
 &= \frac{1}{M_T} \sum_h (x_{T,h}^j - x_{0T,h}^j) + \frac{\sum_h x_{0,h}^j}{M_T} \left(1 - \frac{M_T}{M_0}\right) \\
 &= \sum_h \frac{X_T^j}{M_T} \frac{X_0^j}{X_T^j} \left( \frac{x_{T,h}^j - x_{0T,h}^j}{X_0^j} - \left( \frac{M_{T,h} - M_{0,h}}{M_0} \right) \right) \\
 &= \sum_h (\text{contribution of market segment } h)
 \end{aligned}$$

( $x_{t,h}^j$ : export of item h by country j at time t,  $X_t^j$ : export of all items by country j at time t,  $M_{t,h}$ : world's import of item h at time t,  $M_t$ : world's import of all items at time t)

Note that market segment h adds to (or subtracts from) the change in  $\theta$  to the extent that its contribution to country j's export growth ( $(x_{T,h}^j - x_{0,h}^j)/X_0$ ) exceeds its contribution to the growth of the aggregate world market ( $(M_{T,h} - M_{0,h})/M_0$ ). For example, if the contribution of beer (or Asia) in country j's exports was 1 percent, while its contribution to total global exports (=imports) was 2 percent, the beer (or Asia) would have contributed negatively in country j's market share gains. Notice that market segment h can be either a geographic or product dimension subset of the global export market or an intersection of both.

The decomposition analysis highlights the following:

- *Global market gains by region:* Korea's recent global market share gains were led by China and ASEAN, which account for 73 percent of the 0.4 percent gain during 2008-12. These are geographic markets where Korea is known to have a relatively strong complementary relationship with Japan through the so-called Asian value chain, in which Japan and Korea both provide intermediate inputs (which tend to be differentiated particularly in sectors such as electronics and metals) to the local manufacturers of final products.



- Exports to China:* Sixty-three percent of Korea's global market share gain owing to the Chinese market was made in professional and scientific instruments and electrical machinery, the same markets in which Japan has also either slightly gained or maintained its market share. In contrast, Korea's market share remained flat or declined in areas in which Japan's market share declined the most (e.g., petrochemicals and inorganic chemicals). Overall, Japan has lost only 0.04 percentage point of its global market share in China's market, which is one-tenth

of its overall market share loss, and one-fourth of Korea's gain (+0.26 percentage point) in this specific market.

- b. *Exports to ASEAN:* Korea's global market share gain attributed to the ASEAN market was substantially broader based than in the case of China. However, the largest gain was made in petrochemical exports (+0.027 percentage point), where Japan has lost the most (-0.023 percentage point). This appears to reflect Japan's energy supply shortage after the 2011 earthquake and tsunami. Both Korea and Japan increased their market share in road vehicles. Overall, Japan has lost only 0.01 percent of its global market share in the ASEAN market.
- *Global market gains by products:* A decomposition by Korea's export products indicates that a substantial portion of Korea's market share gains during 2008-12 may indeed reflect demand substitution from Japan, and hence may be more prone to an unwinding in the future if the won/yen exchange rate permanently reverts to the precrisis levels.
  - a. About one-fifth of Korea's market share gain was made in the global automobile market where Korean and Japanese firms fiercely compete under a limited degree of product differentiation (e.g., small passenger vehicles), and consumers tend to be sensitive to prices. Japan's loss in this market closely mirrored Korea's gain.
  - b. About one-fourth of Korea's market share gain was made in electrical machinery and appliances—areas in which Japan also suffered a considerable market share loss (Japan's loss in electrical machinery amounts to about 40 percent of Korea's gain in the sector).

In sum, about 70 percent of Korea's market share gains during 2008-2012 appear to have been achieved in geographical subsets (notably China and ASEAN) of the global market where Japan's market share has not changed much. However, the dissection of Korea's market share gains across product is suggestive of some demand shift from Japan.<sup>17</sup>

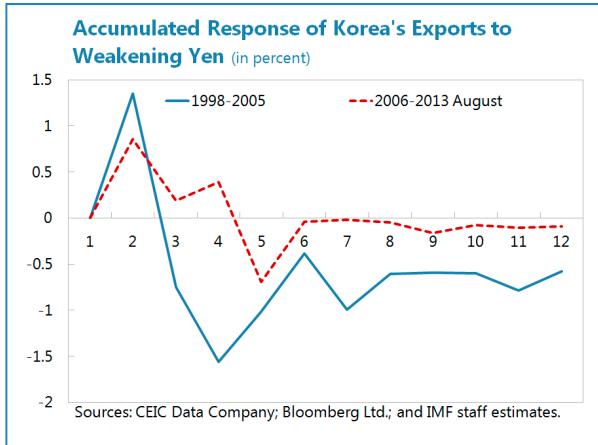
### C. How Sensitive Are Korea's Exports to the Japanese Yen?

In order to further corroborate the findings in the previous section, we examine the sensitivity of Korea's exports to the yen using a simple econometric model. We focus our analysis on

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<sup>17</sup> The two findings from the geographical and product dimension analyses may appear contradictory, but they are not. As an illustration, suppose two extreme assumptions: (i) none of Korea's gains in China and ASEAN markets was at Japan's loss, and (ii) all of Japan's loss in automobile and electrical machinery was captured by Korea. In this case, the two major contributors to Korea's market share gains (i.e., China and ASEAN markets on the one hand, and auto and electrical on the other) will be mutually exclusive. Even so, the sum of these two segments would not exceed 100 percent. In reality, there will be a considerably large intersection between the two sets, which would free space for other market segments to contribute to Korea's market share gains.

the following questions: (i) Have Korean exports become less sensitive to changes in the yen over time?; and (ii) How sensitive is Korea now, and how does it compare with other countries?



To answer these questions, we ran a simple Vector Auto Regression (VAR) model, spanning 1998M1-2013M8 on the following three variables: (i) Korea’s export value in terms of U.S. dollars (seasonally adjusted); (ii) Korea’s import value in U.S. dollars (seasonally adjusted); and (iii) the won’s exchange rate against the Japanese yen<sup>18</sup>; in the same Cholesky ordering. In addition to endogenous variables, the model also included a dummy variable for financial

crises (the 1997 Asian crisis and the 2008-09 global financial crisis), and CPB Netherlands Bureau for Economic Policy Analysis’s world trade value index (2005=100) as exogenous control variables.<sup>19</sup> The VARs uses four lags following Akaike criterion. .

Consistent with existing studies, the VAR estimation suggests that the sensitivity of Korea’s exports to the won/yen exchange rate has been reduced by about one-half since the late 1990s. The peak level of response of Korea’s exports to a 10 percent depreciation of the won/yen exchange rate fell to 0.7 percent (after five months of the shock) when fitting the model for the period 2006-13, compared to 1.5 percent (after four months of the shock) estimated for the period 1998-2005. Our model, however, suggests that the spillover effect of QQME through the exchange rate channel to Korea is relatively larger for Korea than its Asian competitors.

Peak Impulse (cumulative) to a 10 Percent Depreciation Against the Yen				
	Singapore	Malaysia	Thailand	Korea
Peak	-0.1	-0.1	-1.0	-0.7
Lag (months)	3	6	3	5

<sup>18</sup> A model using real effective exchange rates yielded a similar result with the peak level of response of Korea’s exports to a 10 percent depreciation declining from 1.4 percent (after four months of the shocks) for the sample period 1998-2005 to zero for 2006-13.

<sup>19</sup> The specification is similar to recent studies done in Korea, whose findings are broadly consistent with ours. See Lee (2013) and KIEP (2013).

#### D. Will Korea Benefit From a Weak Yen through Value Chain Effects?

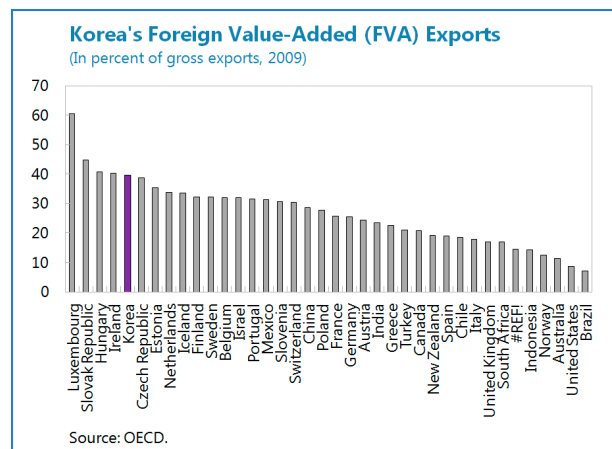
The cross-border integration of production, including through direct investment and global sourcing, has added another layer of complication to the channel through which exchange rates affect international trade. Negative spillover effects on one country's export price competitiveness from the currency depreciation of another, particularly a competitor in the global third markets, will be mitigated to the extent that the former sources intermediate inputs from the latter. Thus, countries that are more strongly integrated with the depreciating-currency country in the value chain would see their export cost competitiveness strengthened over third-party countries with less intense integration.

In this section, we study the positive effects from currency appreciation of this sort, particularly relative to the Japanese yen. We focus specifically on Korea's vertical production links within Asia and the rest of the world.

Korean manufacturers traditionally have developed strong upstream links to Japanese companies as suppliers of intermediate inputs. For example, Korean ICT companies, the most successful of which have now risen to the ranks of global leaders, continue to rely heavily on Japanese high-precision equipment, including to produce semiconductors (the share of Japan in imported inputs was 30 percent in 2010 compared to 42 percent in 2000) and Liquid Crystal Displays (LCDs; the same share of Japan was 81 percent in 2010 compared to 83 percent in 2000). They also use Japanese parts and components (e.g., system semiconductors) in products such as smart phones. Hence, Korea and Japan are usually viewed more as partners than competitors in ICT, which is buttressed by the fact that Korea's leading product spectrum (e.g., smart phones, memory chips, and LCDs) is differentiated from Japan's (e.g., system chips and game stations). However, the importance of China is rapidly growing in production linkages both to Korea and Japan, while Korea's reliance on Japan as the supplier of intermediary inputs has been steadily declining.

With these factors in mind, we examined the OECD's latest value-added-based trade statistics, which allows one to disentangle gross export value, first into domestic and foreign value added, and then, within the foreign value added, value components generated from some 40 source countries. Detailed data are reported in Appendices 7 and 8.

- *High degree of production linkage.* Foreign value added (FVA) accounts for 40 percent of Korea's gross export value, which makes



Korea's FVA to gross export ratio the fifth highest among the OECD countries and also substantially higher than its major competitors including Japan (15 percent) and China (33 percent). A high FVA share implies less exposure to exchange rate shocks for the exporters with larger offsets provided by prices of imported inputs.

- *Modest overall production link to Japan.* Yet, Korean exporters' dependence on Japan is modest with the share in gross export value of the FVA originating in Japan standing at 5.1 percent. The data show Korean-Chinese two-way (i.e., both up and downstream production links) value chain linkage may have already become stronger than Korea-Japan links (Appendix 7), likely reflecting vibrant and growing direct investment, mainly by Korean companies in China. Moreover, the domestic value-added ratio of Japan's exports (85 percent) is significantly higher than the ratios for most of the countries covered by the data. Hence, most of the competitive gains or losses from changes in the yen's exchange rate will fall on Japanese exporters, although Korean exporters will also receive some trickled-down gains.

#### Comparison of Japan Contents:

##### Korea's Top Export Sectors

(In percent; shares of FVA to gross exports)

	Korea	Japan	China	Indonesia	U.S.	Germany	France
Overall	5.1	85.2	4.4	1.4	0.9	0.8	1.8
Electrical	6.8	82.2	6.3	4.1	1.6	1.7	1.1
Transport	6.8	85.9	6.9	3.0	2.5	1.2	0.2
Chemical	4.1	78.9	4.0	0.9	0.8	0.7	0.9
Logistics	2.4	93.2	1.5	1.5	0.3	0.6	2.0
Metal	6.1	80.5	3.5	1.6	1.0	0.6	0.8

Sources: OECD; and IMF staff estimates.

- *But Korea's link to Japan is still larger than third-country competitors.* Although the positive spillover from the yen's depreciation through the production links to Japan would be modest, it can still help strengthen Korea's competitive edge against third-country competitors, which tend to gain even less from the yen's depreciation. For example, Korean transportation equipment manufacturers' FVA share owing to Japan (6.8 percent) is substantially higher than their competitors in the United States (2.5 percent) and Germany (1.2 percent).

In sum, while value chain links could mitigate negative spillovers from the depreciation of one country's currency to another, the mitigation effect would likely be relatively small in the case of Korea. Nonetheless, a depreciation of the Japanese yen would likely strengthen Korea's competitive edge against third-country competitors.

#### IV. CONCLUSION

In this paper, we assessed the impacts of UMPs on Korea through both financial and trade linkages. On the financial linkage, our question boils down to whether QE and QQME have had, so far, a significant impact on capital flows to Korea, and thus whether the tapering of QE will cause a sudden stop in such flows. Our capital flow regressions have identified a few intriguing observations that draw a clear distinction between Korea and EMs:

First, QE and QQME operations or announcements were found to have had little or no direct influence on capital flows to Korea. The only significant exception was the cross-border banking capital flows, whose sustained outflow was substantially offset by the positive impulse generated by the Federal Reserve's MBS purchase programs. This impulse likely would have stemmed from its role in thawing the U.S. MBS market, which was a very important source of bank liquidity.

Second, while the indirect effects of QE, through financial prices, seem to have been significant, impulse responses indicated the existence of an important nonlinear behavior. In particular, capital flows to Korean bonds have demonstrated a safe-haven behavior (i.e., flows increase with higher VIX), until the risk aversion has reached certain threshold levels. Overall, the indirect effects point to a largely positive impact of QE through the alleviation of risk aversion (captured by VIX) and global dollar liquidity stress (represented by the LIBOR-OIS spread).

In light of this, a growth-driven smooth QE exit, which leaves long-term U.S. rates anchored and does not hurt investor confidence, is unlikely to cause capital outflows from Korea.<sup>20</sup> A growth-driven QE exit could even cause inflows to Korean equity and bank debt through positive signaling effects associated with an orderly steepening of the yield curve. However, a disorderly QE exit can cause capital outflows, through VIX (equities and bonds), and the LIBOR-OIS spread (bonds and banking flows). The negative effects would likely be exacerbated, particularly for bond flows, if the unwinding of bond positions causes dislocation of the onshore dollar funding market.

An increase in VIX associated with a disorderly QE exit can, however, have different implications across asset classes. For equities, the impact would be unambiguously negative. But for bonds, the impact can be positive, except in the event of a tail eruption of VIX.

These analyses point to Korea's possible graduation from a high-capital-flow beta country, as corroborated by the impressive degree of resilience of the won and asset prices to recent QE tapering-related global turmoil. While there is a need for continued vigilance, Korea's sound

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<sup>20</sup> This is consistent with the IMF's 2013 *Spillover Report*.



macroeconomic fundamentals and policies should enable the country to weather external shocks much better than in the past and other EMs.

The findings are consistent with IMF's recent policy papers<sup>21</sup> on the challenges of UMPs. One of the policy papers concludes that the effects of an exit from UMPs on non-UMP countries will depend on their exposure (likelihood of a shock caused by a sudden stop related to an exit) and resilience (ability to absorb that shock), and identifies Korea as an example of a low-exposure country. This paper reinforces this through an in-depth examination of Korea's exposure and adds some insights on Korea's safe-haven characteristics. The other paper found significant financial spillovers of the UMPs through both asset price and capital flow channels, which have, overall, been benign for the recipient countries. Our case study of Korea too observes financial spillovers significant. However, we also find that the direction of the spillover can change depending on the levels of market stress against which UMPs are deployed.

On the trade side, we find that (i) the bulk of the increase in Korea's global market share since the crisis appears not to have been at Japan's loss, which coincidentally was in a very similar magnitude to Korea's gain; (ii) Korean exports are no longer as sensitive to the won/yen exchange rate as before although the sensitivity is larger than other Asian competitors; and (iii) expected positive spillovers from the yen's depreciation through value chain effects would also be small in Korea's case.

However, this paper's benign assessment of the spillovers from QQME through the trade linkage will need to be read cautiously. Given the margin compression suffered by large Japanese companies since the 2008-09 crisis, largely owing to the then-strong yen, it would be natural for them to first decompress margins as the yen weakens. Moreover, some Japanese companies have experienced the negative consequences of too much and too rapid expansion of their market shares (e.g., massive recalls on Japanese automobile manufacturers in 2010), and may not yet be ready to expand them back.

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<sup>21</sup> IMF, "Global Impact and Challenges of Unconventional Monetary Policies," October 7, 2013b ([www.imf.org/external/np/pp/eng/2013/090313.pdf](http://www.imf.org/external/np/pp/eng/2013/090313.pdf)) and IMF, "Unconventional Monetary Policies—Recent Experience and Prospects," April 18, 2013c (<https://www.imf.org/external/np/pp/eng/2013/041813a.pdf>). The first paper also finds that an exit from UMPs, even a well-managed one, can cause disruptive spillovers to non-UMP countries, and both exiting too soon and too early can hurt all. It stresses the need to make use of the space provided by UMP for reforms (UMP countries), to carefully manage communication (UMP central banks), and strengthen resilience to spillover shocks (non-UMP countries). "The Global Calculus of Unconventional Monetary Policies," a speech by IMF Managing Director also summarizes these points (<http://www.imf.org/external/np/speeches/2013/082313.htm>). Another helpful reference is a speech by IMF Deputy Managing Director Naoyuki Shinohara. "Unconventional Monetary Policies: Looking Ahead (<http://www.imf.org/external/np/speeches/2014/012314.htm>).

In view of this, if the yen's weakening cycle deepens or becomes sufficiently prolonged, Japanese companies will likely take strategic advantage, for example by foraying back into top-notch product streams that were sidelined (e.g., smart phones). This could lead to an unwinding of the product differentiation that Korea has managed to achieve so far. Korean companies should turn the challenge into an opportunity and continue to find ways to step up non-price competitiveness.

### Appendix 1. Regression Variables

Variables	Description
BOJ_GS	Bank of Japan's holding of government securities (in billions of yen)
BONDFLOW_ALL	Net foreign bond inflows (in millions of U.S. dollars)
CCR1Y_RATE	1-year cross country swap spreads (in basis points)
CCR5Y_RATE	5-year cross country swap spreads (in basis points)
CD3MKRW	Korea's 3 month CD interest rate (in percent)
CRISIS	Dummy variable that captures the existence of a financial crisis
DC_HH	Domestic claim by banks to households (in billions of won)
DC_PRVNF	Domestic claim by banks to nonfinancial private sector (in billions of won)
EQUITYFLOW	Net foreign equity inflows (in millions of U.S. dollars)
IPI	Korean industrial production index (2010=100)
KOSPL_PBR	Price-to-book ratio for KOSPI index
TB5YKRW	Korea 5-year government bond yield (in percent)
LIBOIS_SPREAD_USD	LIBOR-OIS spread for U.S. dollars (in percent)
LQ	Outstanding amount of the U.S. Federal Reserve's liquidity facility (weekly average, in billions of U.S. dollars).
MBS	Outstanding amount of the Federal Reserve's MBS facility (weekly average, in billions of U.S. dollars).
OIL_STL	Korean balance of payments-short-term other inflows (in millions of U.S. dollars)
OIS3M_USD	U.S. dollar-OIS spread (in percent)
PINL_DEBT	Korean balance of payments-Portfolio bond inflows (in millions of U.S. dollars)
PINL_EQ	Korean balance of payments-Portfolio bond inflows (in millions of U.S. dollars)
SOV_CDS_KR	Korean sovereign credit default spread (in basis points)
TB5YKRW	5-year Korean government Bond
TREND	Time trend
USGB10YR	U.S. 10-year government bond yield (in percent)
VIX	The Chicago Board Options Exchange Market Volatility Index

Source: Authors.

### Appendix 2. Equity Regression (Baseline)

Dependent Variable: EQUITYFLOW

Method: Least Squares

Sample (adjusted): 1/15/2008 - 6/25/2013

Included observations: 285 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRISIS	-2313.369	356.6128	-6.487062	0
LOG(VIX)	-614.2112	198.5488	-3.093503	0.0022
DLOG(VIX)*KOSPI_PBR(-1)	-2378.536	413.8241	-5.747698	0
D(OIS3M_USD)	13905.34	7513.301	1.850763	0.0653
DLOG(KOSPI(-1))	9075.035	1674.681	5.418964	0
D(USGB10YR-OIS3M_USD)	1090.736	423.1369	2.577738	0.0105
(USGB10YR-OIS3M_USD)*CRISIS	695.0036	113.5719	6.119501	0
D(OIS3M_USD)*CRISIS	-13186.18	7628.783	-1.728478	0.085
KOSPI_PBR(-1)	6357.298	1673.361	3.79912	0.0002
KOSPI_PBR(-1)^2	-3218.339	873.1274	-3.685991	0.0003
@TREND	-5.235676	1.300901	-4.024653	0.0001
R-squared	0.437907	Mean dependent var		29.16361
Adjusted R-squared	0.417393	S.D. dependent var		947.5578
S.E. of regression	723.2586	Akaike info criterion		16.04324
Sum squared resid	1.43E+08	Schwarz criterion		16.18422
Log likelihood	-2275.162	Hannan-Quinn criter.		16.09976
Durbin-Watson stat	1.688911			

Source: Authors' estimates.

### Appendix 3. Equity Regression (Alternative)

Dependent Variable: PINL\_EQ

Method: Least Squares

Sample (adjusted): 2008M03 - 2013M06

Included observations: 64 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(BOJ_GS)	-0.329963	0.122261	-2.698837	0.0092
LOG(VIX)	-4098.354	1132.019	-3.620394	0.0006
DLOG(VIX)*KOSPI_PBR(-1)	-6559.339	1447.157	-4.532571	0
D(USGB10YR-OIS3M_USD)	-1659.991	1149.549	-1.444037	0.1544
DLOG(KOSPI(-1))	15252.78	6356.279	2.39964	0.0198
KOSPI_PBR(-1)	56054.85	21596.36	2.595569	0.0121
KOSPI_PBR(-1)^2	-27735.99	9704.225	-2.858136	0.006
D(IPI)	119.9348	148.0279	0.810218	0.4213
@TREND	-34.92013	25.78497	-1.354282	0.1812
R-squared	0.652723	Mean dependent var		659.9547
Adjusted R-squared	0.60221	S.D. dependent var		3607.325
S.E. of regression	2275.16	Akaike info criterion		18.42719
Sum squared resid	2.85E+08	Schwarz criterion		18.73078
Log likelihood	-580.67	Hannan-Quinn criter.		18.54679
Durbin-Watson stat	2.109061			

Source: Authors' estimates.

### Appendix 4. Bond Regression (Baseline)

Dependent Variable: BONDFLOW\_ALL

Method: Least Squares

Sample (adjusted): 1/08/2008 - 6/18/2013

Included observations: 285 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1728.232	168.7346	10.24231	0
CRISIS	-2162.402	483.8886	-4.468801	0
D(TR)	-0.017879	0.005791	-3.087533	0.0022
LIBOIS_SPREAD_USD	-802.0172	235.4032	-3.406994	0.0008
SOV_CDS_KR	-5.204942	1.304547	-3.989847	0.0001
CCR1Y_RATE*CRISIS	-9.37297	2.345515	-3.996124	0.0001
CCR5Y_RATE	2.409907	1.118084	2.155391	0.032
CCR1Y_RATE*VIX	-0.180255	0.064917	-2.776677	0.0059
CCR1Y_RATE*VIX^2	0.002886	0.000925	3.121489	0.002
100*(TB5YKRW-CD3MKRW)*VIX	0.063313	0.025471	2.485738	0.0135
R-squared	0.319349	Mean dependent var		869.4192
Adjusted R-squared	0.297073	S.D. dependent var		933.2361
S.E. of regression	782.4322	Akaike info criterion		16.19715
Sum squared resid	1.68E+08	Schwarz criterion		16.32531
Log likelihood	-2298.094	Hannan-Quinn criter.		16.24852
F-statistic	14.33608	Durbin-Watson stat		1.421518
Prob(F-statistic)	0			

Source: Authors' estimates.

### Appendix 5. Bond Regression (Alternative)

Dependent Variable: PINL\_DEBT

Method: Least Squares

Sample (adjusted): 2008M02 - 2013M06

Included observations: 65 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LQ)	-0.022822	0.010156	-2.24707	0.0286
D(BOJ_GS)	0.114267	0.11997	0.952459	0.345
VIX	155.3552	76.2724	2.036847	0.0464
USGB10YR-OIS3M_USD	871.2663	582.2696	1.496328	0.1402
D(KOSPI)	13.12321	4.539852	2.89067	0.0055
SOV_CDS_KR	-20.58093	11.32564	-1.817197	0.0745
CCR1Y_RATE*VIX^2	0.003978	0.00249	1.597396	0.1158
TB5YKRW-CD3MKRW	-1449.414	688.0612	-2.106519	0.0397
D(IPI)	84.38745	187.6741	0.449649	0.6547
R-squared	0.526079	Mean dependent var		1558.149
Adjusted R-squared	0.458376	S.D. dependent var		3522.924
S.E. of regression	2592.7	Akaike info criterion		18.68667
Sum squared resid	3.76E+08	Schwarz criterion		18.98774
Log likelihood	-598.3169	Hannan-Quinn criter.		18.80547
Durbin-Watson stat	2.154972			

Source: Authors' estimates.

### Appendix 6. Bank Flow Regression (Baseline)

Dependent Variable: OIL\_STL

Method: Least Squares

Sample (adjusted): 2008M02 - 2013M06

Included observations: 65 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MBS)	0.026934	0.011371	2.368575	0.0215
D(BOJ_GS)	-0.010558	0.159223	-0.06631	0.9474
D(LIBOIS_SPREAD_USD)	-3191.42	1560.517	-2.045105	0.0458
USGB10YR-OIS3M_USD	2681.553	681.3272	3.935778	0.0002
OIS3M_USD	3452.462	726.3519	4.753154	0
D(KOSPI)	-15.24552	5.156699	-2.956449	0.0046
CCR5Y_RATE	-34.57652	10.72605	-3.223604	0.0022
CCR1Y_RATE*VIX	0.776977	0.104984	7.400905	0
DLOG(IPI)	-10194.13	21038.99	-0.484535	0.63
D(DC_PRVNF)	0.008116	0.03017	0.269016	0.789
D(DC_HH)	-0.524886	0.135891	-3.862555	0.0003
@TREND	-23.59134	6.745452	-3.497369	0.001
R-squared	0.726795	Mean dependent var		-891.0846
Adjusted R-squared	0.670092	S.D. dependent var		4958.822
S.E. of regression	2848.229	Akaike info criterion		18.91192
Sum squared resid	4.30E+08	Schwarz criterion		19.31334
Log likelihood	-602.6373	Hannan-Quinn criter.		19.07031
Durbin-Watson stat	2.359909			

Source: Authors' estimates.



## Appendix 7. Value Chain Links to Japanese Origin Inputs

(In percent)

	Korea	Japan 1/	China	Indonesia	United States	Germany	France
<b>Value Chain - Snap Shot</b>							
FVA/EXPORT (all country i and sector j)	40.6	14.8	32.6	14.4	11.3	26.6	73.6
Of which: largest contributor country (contribution: FVAi/EXPORT)	Japan	United States	Japan	United States	Canada	United States	Germany
Of which: largest contributor sector (contribution: FVAj/EXPORT)	Electrical	Electrical	Electrical	Chemical	Chemical	Chemical	Busi servcs
	13.6	4.3	14.3	2.7	3.3	6.1	16.9
<b>Significance of Japan</b>							
Japan's contribution (FVAjp/EXPORT)	5.1	85.2	4.4	1.4	0.9	0.8	1.8
Max Japan content sector: MAXj(FVAjp, j/EXPORTj) 2/ (FVA ratio of that sector)	Electrical 6.8	Financial 96.8	Transport 6.9	Machinery 6.6	Transport 2.5	Electrical 1.7	Busi servcs 7.0
<b>Significance of Asia</b>							
Asia 6's contribution (FVAasia6/EXPORT)	13.5	4.0	9.8	4.3	2.5	2.7	7.5
Top 5 FVA contributors (country)	Japan 5.0 China 4.7 United States 4.5 Australia 1.8 Germany 1.5	United States 2.1 China 1.6 Australia 0.9 Korea 0.6 Indonesia 0.5	Japan 4.3 United States 3.6 Korea 2.9 Germany 1.5 Australia 1.2	United States 1.5 Japan 1.4 China 1.3 Korea 0.6 Germany 0.5	Canada 1.4 China 0.9 Japan 0.8 Mexico 0.7 Germany 0.5	United States 2.7 France 1.8 United Kingdom 1.7 Italy 1.6 Russian Federation 1.3	Germany 8.2 United States 7.8 United Kingdom 5.8 Italy 5.7 Spain 4.4
Top 5 Japan content sectors (FVAjp, j/EXPORTj) 1/	Electrical 6.8 Transport 6.7 Metal 6.0 Machinery 5.1 Chemical 4.1	Financial 96. Business services 96. Trade, Hotel, Restaurant 95. Oth servcs 94. Logistics 93.	Transport 6.9 Electrical 6.3 Machinery 5.9 Utility 3.9 Chemical 3.9	Machinery 6.6 Electrical 4.1 Transport 2.9 Oth servcs 1.6 Manufacturing nec 1.5	Transport 2.4 Electrical 1.5 Machinery 1.5 Textile 1.1 Metal 0.9	Electrical 1.6 Transport 1.2 Machinery 1.0 Manufacturing nec 0.7 Textile 0.7	Busi servcs 7.0 Financial 5.3 Oth servcs 4.0 Utility 3.9 Trade, Hotel, Restaurant 3.7

Sources: OECD; and IMF staff estimates.

1/ For Japan, Japanese contents refers to domestic value added to export in each sector.

2/ FVAi, j represents foreign value added for product group j originating from country i. For each product group j, FVA captures value-added contents of a country's gross export that is attributed to country i which is supplying inputs for those exports.

## Appendix 8. Value Chain Links for Korea's Top Export Products: Comparison with Its Global Competitors

(In percent)

	Korea	Japan	China	Indonesia	United States	Germany	France
<b>Value Chain - Snap Shot</b>							
Electrical	China 8.80	China 2.88	Japan 6.32	Japan 4.11	China 1.70	United States 2.94	United States 4.58
	Japan 6.84	Korea 1.05	Korea 5.39	United States 3.11	Japan 1.58	China 1.72	Germany 4.23
	United States 5.74	Germany 0.71	United States 4.51	China 2.70	Mexico 1.02	Japan 1.65	Italy 3.78
	Germany 1.82	Indonesia 0.59	Germany 1.74	Germany 1.42	Canada 0.97	France 1.58	United Kingdom 2.87
	Australia 0.98	Australia 0.57	Australia 0.93	Korea 1.15	Korea 0.67	Italy 1.44	Spain 2.24
Transport	Japan 6.75	Australia 0.62	United States 1.93	United States 1.88	Canada 1.02	United States 2.11	United States 11.4
	United States 4.77	China 0.39	Japan 1.46	Japan 1.47	Russian Federation 0.48	United Kingdom 1.40	Germany 9.65
	China 4.40	Indonesia 0.27	Australia 1.04	China 1.00	Mexico 0.43	Russian Federation 1.34	United Kingdom 8.08
	Germany 2.21	Russian Federation 0.22	Russian Federation 0.83	Australia 0.50	Japan 0.29	France 1.26	Italy 6.52
	Australia 1.42	Germany 0.14	Korea 0.78	Korea 0.43	United Kingdom 0.28	Spain 1.07	Belgium 5.24
Chemical	Australia 4.80	Australia 2.14	United States 4.37	United States 1.18	Canada 3.50	United States 4.00	Germany 5.46
	Japan 4.14	China 1.19	Japan 3.97	Japan 0.92	Mexico 1.36	Russian Federation 3.20	United States 4.82
	United States 3.96	Indonesia 0.90	Australia 2.87	China 0.88	Japan 0.83	United Kingdom 2.99	Italy 3.56
	Indonesia 2.90	Russian Federation 0.67	Korea 2.10	Korea 0.40	Russian Federation 0.82	Netherlands 2.03	Spain 3.36
	Russian Federation 2.56	Germany 0.66	Russian Federation 1.86	Germany 0.37	United Kingdom 0.82	France 1.86	United Kingdom 3.33
Logistics	United States 5.88	Australia 0.62	United States 1.93	United States 1.88	Canada 1.02	United States 2.11	United States 11.4
	Japan 2.39	China 0.39	Japan 1.46	Japan 1.47	Russian Federation 0.48	United Kingdom 1.40	Germany 9.65
	China 2.26	Indonesia 0.27	Australia 1.04	China 1.00	Mexico 0.43	Russian Federation 1.34	United Kingdom 8.08
	Australia 1.69	Russian Federation 0.22	Russian Federation 0.83	Australia 0.50	Japan 0.29	France 1.26	Italy 6.52
	Russian Federation 1.27	Germany 0.14	Korea 0.78	Korea 0.43	United Kingdom 0.28	Spain 1.07	Belgium 5.24
Metal	Japan 6.07	United States 1.29	Japan 3.50	Japan 1.55	Canada 1.88	Russian Federation 2.74	Germany 6.70
	China 3.74	Indonesia 1.20	Australia 2.98	China 1.27	China 1.22	France 2.62	United States 4.71
	Australia 3.09	China 0.98	United States 2.23	United States 1.27	Mexico 1.07	Italy 2.47	Italy 4.16
	United States 2.81	Russian Federation 0.98	Russian Federation 1.91	Australia 0.62	Japan 0.97	United States 2.32	Spain 3.78
	Russian Federation 2.03	Korea 0.64	Brazil 1.50	Korea 0.57	Germany 0.67	United Kingdom 2.31	United Kingdom 3.21

Sources: OECD; and IMF staff estimates.

1/ For each country in column i, cell (i, j) shows top five input source countries in FVA terms for its export product j (in row j). For example, China contributes 14.2 percent of total value added of Korea's gross electrical exports.

2/ For Japan, Japaneses contents refers to domestic value added to export in each sector

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