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ABSTRACT

We investigate whether and to what extent macroprudential policies affect the financial link between the center economies (CEs, i.e., the U.S., Japan, and the Euro area), and the peripheral economies (PHs). We first estimate the correlation of the policy interest rates between the CEs and the PHs and use that as a measure of financial sensitivity. We then estimate the determinants of the estimated measure of financial sensitivity as a function of country-specific macroeconomic conditions and policies. The potential determinant of our focus is the variable that represents the extensity of macroprudential policies. From the estimation exercise, we find that a more extensive implementation of macroprudential policies would lead PHs to (re)gain monetary independence from the CEs when the CEs implement expansionary monetary policy; when PHs run current account deficit; when they hold lower levels of international reserves (IR); when their financial markets are relatively closed; when they are experiencing an increase in net portfolio flows; and when they are experiencing credit expansion. Thus, macroprudential policies can be regarded as a set of policy tools to pursue financial stability independent from the three policies in the trilemma.

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1. Introduction

The Global Financial Crisis of 2008 led many countries, including both advanced and developing ones, to face many policy challenges. In the aftermath of the crisis, with the hope of jumpstarting moribund economies, policy makers in the advanced economies, or the center economies (CEs), have implemented, sometimes experimentally, policies that had been deemed as unconventional such as the zero or negative interest rate policy and quantitative easing (QE).

The lax monetary environment of the advanced economies caused an influx of capital from low-yielding CEs to high-yielding emerging markets in the peripheries (PHs), bringing about a rise in capital inflows and currency appreciation pressure for the latter. Soon after the United States economy started showing signs of recovery in the early 2010s, however, the tide started turning around. In 2013, a mere mention by then Federal Reserve Board (FRB) chairman, Ben Bernanke, of the possibility of tapering off QE sent jitters to the emerging currency and bond markets ("taper tantrum"). As the U.S. Fed did actually start tightening monetary policy with the halt of QE in 2014 followed by the lift of the zero interest rate policy in 2015, capital flows started flowing back to the U.S. and other advanced economies, leading to the expectation of U.S. dollar appreciation and the depreciation of emerging market currencies. As the currencies became expected to get weaker, the perceived level of risk among EMEs rose because many of the firms in those economies were indebted in the dollar, which meant the debt burden would rise as the dollar appreciates.

This development of international macroeconomic events indicates how open emerging market economies are vulnerable to changes in the external environment, especially the financial conditions in the CEs. This background led the "global financial cycles" view by Rey (2015) to become widely debated. According to this view, exchange rate regimes no longer insulate countries from global financial cycles. Financial globalization has made countries' macroeconomic conditions more sensitive to the "global financial cycles" in capital flows, asset prices, and credit growth, so that the famous "monetary trilemma," or just "trilemma" – countries can only achieve the full extent of implementation in two, not all, of the three open macro policy goals: monetary independence, exchange rate stability, and free capital mobility[4] – reduces to an

[4] Also see Aizenman, et al. (2010, 2011, 2013), Obstfeld (2014), Obstfeld, et al. (2005), and Shambaugh (2004) for further discussion and references dealing with the trilemma.

"irreconcilable duo" of monetary independence and capital mobility. Consequently, restricting capital mobility maybe the only way for non-center countries to retain monetary autonomy.

Aizenman, et al. (2016, 2017) investigated whether Rey's view, the end of the trilemma hypothesis, is supported by the data. They focused on how the financial conditions of – and shocks propagated from – the CEs (i.e., the U.S., Japan, and the Eurozone) impact the economies in the PHs. They concluded that policy arrangements based on the trilemma do affect the extent of linkage between CEs' and PHs' financial conditions. In short, an obituary for the trilemma is not needed.

While the trilemma is not dead, it is true that open economies are subject to ebbs and flows of capital that are heavily affected by the state of economic and financial conditions of the CEs. That means, policy makers in the PHs need to play a balancing act; while being constrained by the trilemma, they also need to manage to prevent financial instability. As Aizenman (2017) put it, we may now live in a world of "quadrilemma" where financial stability have been added to the trilemma's original policy goals. Successful navigation of the open economy quadrilemma helps in reducing the size of the transmission of external shocks to the domestic economy, and reducing the costs of domestic shocks. These observations explain the relative resilience of emerging markets, especially in countries with more mature institutions, buffered by deeper fiscal and monetary space.

In addition to, or instead of, developing mature institutions, some countries have relied on other policies to sustain financial stability. One prime example of policies emerging market economies recently have started adopting is macroprudential policies.[5] For example, in recognition of the sources of Korea's vulnerabilities, since June 2010, South Korea has introduced a series of macroprudential measures aimed at building resilience against external financial shocks, especially against its well-known vulnerability to capital flow reversals in the banking sector and the associated disruptions to domestic financial conditions. Other emerging market economies such as Brazil, Indonesia, Russia, and Thailand also implemented macroprudential policies facing an influx of capital in the aftermath of the GFC.[6]

[5] For reviews on macroprudential policies, Bank of England (2009, 2011), Cerutti, et al. (2017), Claessens (2014), Galati and Moessner (2011, 2014), IMF (2013a,b), Lim et al. (2011), Ostry, et al. (2012), and Pasricha, et al. (2017).
[6] In fact, macroprudential policies predate those implemented in the aftermath of the GFC. An oft-cited example is Chile's unremunerated Reserve Requirement (URR) on foreign borrowing. RR was also implemented by Germany and other western European countries in the 1970s to curb capital inflows. For a historical overview of regulatory attempts to control capital flows, refer to Gosh, et al. (2018).

The recent implementations of macroprudential policies have led to a rise in the literature that investigates the efficacy of macroprudential policies such as Akinci and Olmstead-Rumsey (2017), Buch and Goldberg (2017), Cerutti, et al., (2015), Ghosh, et al. (2014, 2015), Lim, et al. (2011), Ostry, et al. (2012), and many others. This paper will be an addition to this literature. We will investigate whether and to what extent macroprudential policies affects the financial link between the CEs and the PHs.

In our previous work, we examined at the effect of trilemma policy configurations of the CEs on several CE-PH financial links. In this study, we focus on the link between the CEs and the PHs through policy interest rates. We are particularly interested in examining whether a set of macroprudential instruments can be another policy tool for the PHs to remain monetary autonomy. While developing and emerging market economies maneuver ebbs and flows of capital that are heavily influenced by the conditions and policies of the CEs, macroprudential policies may complement the traditional open macro policies such as exchange rate regimes and financial liberalization. It is important to investigate whether and to what extent developing and emerging market economies delink themselves from the sphere of influence of the CEs by implementing macroprudential instruments. Finding out the effectiveness of macroprudential policy will provide more clues on how to navigate the world of quadrilemma. [7]

More specifically, we will include a variable that represents the level of extensity of implementing macroprudential policies. While it might appear that macroprudential regulations and traditional capital controls overlap, there is a distinction. The primary goal of macroprudential policies is to ensure financial stability by implementing policies aimed at affecting the balance sheets of both financial institutions and borrowers. Moreover, macroprudential policies are often targeted at certain sectors, typically corporate and mortgage

[7] A possible interpretation of financial instability deals with the presence of multiple equilibria associated with financial fragility. Such financial fragility may reflect concerns regarding the commitment and fiscal viability of policies needed to prevent a run on the banking system in the presence of balance sheet exposure. Bocola and Lorenzoni (2017) provide an insightful model illustrating and explaining these issues in the context of EMs characterized by limited credibility of their fiscal backstop mechanisms. Their framework implies that the "state of fundamentals" (like fiscal space, growth rates, etc.) determines the existence and multiplicity of equilibria. If the fundamentals are very strong, the private sector does not have the incentive to "run on the system," and the regime is stable. If the fundamentals are very weak, the private sector attacks the system, and the regime collapses. In between the very strong and the weak equilibria, a range of multiple equilibria exist. Under certain conditions, policies like credible deposit insurance, large-enough accumulation of international reserves, macro prudential policies reducing balance sheet exposure, or the provision of hard currency swap lines may prevent the exposure to multiple equilibria by terminating the incentive to run. Earlier examples of such systems include Diamond and Dybvig (1983) and Obstfeld (1996).

sectors, in contrast to capital controls that typically affect cross-border transactions irrespective of sector. Smoothening out excessive procyclical movements in financial markets (e.g., rapid growth in credit and liquidity, procyclical capital adequacy, and excessive leverages) could help prevent accumulation of systematic risk and thereby preempt an occurrence of financial crisis and its resultant damage on the real economy.

Capital controls (which in our lexicon is inversely related to financial openness) usually pertain to the aggregate economy, or more precisely, its balance of payments. Hence, capital controls are not usually varied in response to the business cycle, even though revenues from imposing levies on cross-border capital flows can have some impacts on the fiscal conditions.[8] How open a country wants to have financial account transactions is often driven by the government's industrial policy and financial regulatory framework. However, although financial stability is not necessarily the primary target of capital controls, a country with a fixed exchange rate regime may impose capital controls when it wants to retain monetary policy autonomy with an eye to economic stability

Thus, macroprudential policies can be regarded as a set of policy tools to pursue financial stability independent from the three policies in the trilemma. In this paper, we focus on whether and to what extent implementing a set of macroprudential policies would enhance countries' open macro policy autonomy when they are exposed to shocks emanating from the center economies.

Our empirical method relies upon a two-step approach. We first investigate the extent of sensitivity of policy interest rate while controlling for global factors. The estimation is done for the sample period is 1986 through 2015, using monthly data and in a rolling fashion. Next, we examine the association of these sensitivity coefficients with the extensity of macroprudential policy implementations while controlling for country's trilemma choices, the real and financial linkages with the CE, the levels of institutional development, and the like.

In what follows, we present the framework of our main empirical analysis in Section 2. Each of the two steps for the estimation is explained in this section. In Section 3, we present empirical results for the estimations while focusing on the effect of macroprudential policies. In

[8] Capital controls might enable, either intentionally or unintentionally, financial repression whereby which the government can secure additional fiscal resources.

Section 4, we investigate the interactive effects between macroprudential policies and macroeconomic conditions and policies. We make concluding remarks in Section 5.

2 The Framework of the Main Empirical Analysis

We extend the same approach as followed in Aizenman et al. (2016, 2017), with special focus on the macroprudential policies as one of the potential determinants of the financial link between the CEs and the PHs. As the first step, we regress the policy interest rate of the PHs on those of the CEs while controlling for global factors.[9] If country *i* has its monetary policy more susceptible to the monetary policy of one (or more) of the CEs, the correlation of the policy interest rates between the CEs and PHs should be significantly positive, implying a closer linkage between the CEs and PHs, and also that the PH of concern has less of monetary autonomy.

Once we get the estimated coefficients of the CEs' policy interest rates, which we treat as the variable for the degrees of financial sensitivity, as the second step, we regress the estimated degree of sensitivity on potential determinants, including sample countries' macroeconomic conditions or policies, real or financial linkage with the CEs, the level of institutional development of the countries, and the extensity of macroprudential policies. If macroprudential policies can affect the extent of monetary independence in a way that they help economies of our concern to retain monetary independence, the estimated coefficient should be significantly negative.

2.1 The First-Step: Estimating Sensitivity Coefficients

The main objective of this first step estimation is to estimate the correlation of the policy interest rates between the CEs and peripheral economy *i*, while controlling for global factors. We regress the policy interest rate of peripheral economy *i* (Y_{it}) on the vector of the policy interest rates of the three CEs, i.e., the U.S., the Euro area, and Japan, as shown in (1). We focus on the

[9] Ideally, estimation should also control for domestic factors (as the Taylor rule estimation would suggest). In one of our earlier papers, we did control for a domestic factor by including the growth rate of industrial production. However, doing so constrained the number of observations of the estimated gammas due to data availability. Hence, in this paper, we do not include industrial production growth in the first-step estimation so as to maximize the sample size of the estimated gammas. As far as the countries for which the industrial production data exists are concerned, inclusion of industrial production growth does not significantly affect the estimated gammas.

estimated coefficient $\hat{\gamma}_{Fi}^{C}$ which represents the extent of financial sensitivity of peripheral country *i* to the three CEs: [10]

$$Y_{it} = \alpha_{Fit} + \sum_{g=1}^{G} \beta_{Fit}^{G} Z_{it}^{G} + \sum_{c=1}^{C} \gamma_{Fit}^{C} X_{it}^{C} + \varepsilon_{it}, \qquad (1)$$

where Z_i^G is a vector of global factors.

For money market rates that represent policy short-term interest rate, using official policy interest rates may not capture the actual state of monetary policy because all of the CEs have implemented extremely loose monetary policy, whether conventional or unconventional one, in the aftermath of the GFC.[11] Hence, we use the "shadow interest rates" to represent a more realistic state of liquidity availability for the three advanced economies. For the U.S. and the Euro area, we use the shadow interest rates estimated by Wu and Xia (2014). For Japan, we use the shadow rates estimated by Christensen and Rudebusch (2014).

We also have global factors (Z_i^G) as a group of control variables in the estimation. As the "real" variable, we include the first principal component of oil prices and commodity prices.[12] Z_i^G also comprises a vector of "financial" global factors, namely, the VIX index from the Chicago Board Options Exchange as a proxy for the extent of investors' risk aversion as well as the "Ted spread," which is the difference between the 3-month Eurodollar Deposit Rate in London (LIBOR) and the 3-month U.S. Treasury Bill yield. The latter measure gauges the general level of stress in the money market for financial institutions.

We apply the Ordinary Least Squares (OLS) method to do the estimation for each of the sample countries which amount to about 100 countries, including advanced economies (IDC),

[10] We do not include China as one of the CEs. Aizenman, et al. (2016) find that despite the recent impressive rise as an economic power, China's contribution in the financial sector still seems negligible in a historical context. Considering that the Shanghai stock market crash in the summer of 2015 and the winter of 2016 significantly affected financial markets in the U.S., Japan, and Europe, one expects that the role of China as a CE and connectivity with it will become substantial in the near future. The same kind of argument can be made about whether other large emerging market economies such as Brazil, Russia, and India can be the center economies that exert global influence. While their role as major economies in the world has been rising, we would still have to wait for future research to identify their increasing influence in the global economy.

[11] This is true especially after the ECB and the Bank of Japan lowered their policy rates down to zero but before they adopted negative interest rates.

[12] The use of the first principal component of oil and commodity prices is to avoid multicollinearity or redundancy.

less developed countries (LDC), and emerging market countries (EMG) the latter of which is a subset of LDC.[13] The sample period is 1986 through 2015, using monthly data, with regressions implemented over non-overlapping three year periods. That means that we obtain time-varying $\hat{\gamma}_{Fit}^{C}$ across the panels. For all the estimations, we exclude the U.S. and Japan. As for the Euro member countries, they are removed from the sample after the introduction of the euro in January 1999 or they become member countries, whichever comes first.[14]

2.2 The Second Step: Baseline Model

Once we estimate γ_{Fit}^{C}, we regress $\hat{\gamma}_{Fit}^{C}$ on a number of country-specific variables. To account for potential outliers on the dependent variable, we apply the robust regression estimation technique to the following estimation model.[15]

$$\hat{\gamma}_{Fit}^{C} = \theta_0 + \theta_1 OMP_{Fit} + \theta_2 MC_{Fit} + \theta_3 LINK_{Fit} + \theta_4 INST_{Fit} + \theta_5 MPI_{Fit} + \theta_6 CRISIS_{Fit} + u_{Fit} \quad (2)$$

Here, the choice of variables is based on a wide variety of literature pertaining to spillover effects and global synchronization of financial or macroeconomic variables. Hence, we assume that the above estimation model takes a reduced form, rather than a structural form, by which we can address various theoretical predictions at once, rather than relying on one particular theory or model.

There are four groups of explanatory variables. The first group of explanatory variables is a set of open macroeconomic policy choices (OMP_i), for which we include the indexes for exchange rate stability (*ERS*) and financial openness (*KAOPEN*) from the trilemma indexes by Aizenman, et al. (2013). As another variable potentially closely related to the trilemma framework, we include the variable for IR holding (excluding gold) as a share of GDP because we believe the level of IR holding may affect the extent of cross-country financial linkages.[16]

[13] The emerging market countries (EMG) are defined as the countries classified as either emerging or frontier during the period of 1980-1997 by the International Financial Corporation plus Hong Kong and Singapore.
[14] Endogeneity can be an issue for this type of estimation. As a robustness check, we re-estimated the first-step model by lagging the right-hand-side variables. However, it did not change the characteristics of the results (not reported). Hence, we keep the estimation method as it is.
[15] This estimation method keeps recursively down-weighting the outliers until it obtains converged estimates.
[16] Aizenman, et al. (2010, 2011) show the macroeconomic impact of trilemma policy configurations depends upon the level of IR holding.

The group of macroeconomic conditions, or MC_i includes inflation volatility, current account balance, and gross national debt (as a share of GDP).

The group of the variables that reflect the extent of linkages with the center countries (*LINK*) includes trade linkage, which we measure as: $TR\_LINK_{ip} = IMP_{ip}^{C} / GDP_{ip}$ where IMP_i^C is total imports into center economy *C* from country *i*, normalized by country *i*'s GDP. *LINK* also includes variables for financial linkage, for which we use the ratio of bank lending from center economy *C* to country *i* as a share of country *i*'s GDP.

Another variable that reflects the linkage with the major economies is the variable for the extent of trade competition (*Trade_Comp*). *Trade_Comp* measures the importance to country *i* of export competition in the third markets between country *i* and major country *C*.[17] A higher value of this measure indicates country *i* and major economy *C* exports products in similar sectors so that their exported products tend to be competitive to each other.

The fourth group is composed of the variables that characterize the nature of institutional development (*INST*), namely, variables for financial development and legal development.[18] For the measure of the level of financial development, we use Svirydzenka's (2016) "index of financial development" which is the first principal component of two sub-indexes, one that captures the development of financial markets (*FM*) and the other that reflects the development of financial institutions (*FI*). Each of *FM* and *FI* is the first principal components of three variables: "depth," "access," and "efficiency," respectively.[19]

The variables in *MC* and *INST* are included in the estimations as deviations from the U.S., Japanese, and Euro Area's counterparts. The variables in vectors *OMP*, *MC*, and *INST* are sampled from the first year of each three year panels to minimize the effect of potential

[17] Shocks to country *C*, and especially shocks to country *C* that affects country *C*'s exchange rate, could affect the relative price of country *C*'s exports and therefore affect country *i* through trade competition in third markets. See Appendix 1 for the variable construction.

[18] However, since the estimate of the legal development variable is found to be persistently insignificant, this variable is dropped from the estimation.

[19] That is, there are FM-depth, FM-access, FM-efficiency, and FI-depth, FI-access, FI-efficiency. Each of the six sub-indexes is the first principal components of the component variables. For further details, refer to Svirydzenka (2016).

endogeneity or bidirectional causality.[20] Also, in order to capture global common shocks, we also include time fixed effects.[21]

2.3 The Macroprudential Policy Index (MPI)

MPI is the variable of our focus. We assume it represents the extensity of the implementation of macroprudential policies, for which we use the macroprudential policy dataset developed by Cerutti, et al. (2015). This dataset is based on a comprehensive survey conducted by the International Monetary Fund (IMF), called Global Macroprudential Policy Instruments (GMPI). This survey sent IMF member countries' central banks questionnaires regarding the use and effectiveness of 18 macroprudential policy instruments. Cerruti, et al. (2015) focus on 12 policy instruments and compiled a panel dataset with dummy indicators on the usage of each instrument for 119 countries during the period 2000-2013.

MPI is the sum of the following 12 dummies variables, each of which takes the value of unity when the policy instrument of concern is implemented by the country.[22]

- Loan-to-value ratio cap (*LTV_CAP*);
- Debt to income ratio (*DTI*);
- Dynamic Loan-loss Provision (*DP*);
- Countercyclical capital buffer/requirement (*CTC*);
- Leverage (*LEV*);
- Capital surcharges on Systematically Important Financial Institutions (*SIFI*);
- Limits on interbank exposures (*INTER*);
- Concentration limits (*CONC*);
- Limits on foreign currency loans (*FC*);
- FX and/or countercyclical reserve requirements (*RR_REV*);

[20] Sampling data from the first year of each three-year panel could still entail bidirectional causality. As another way of mitigating endogeneity or bidirectional causality, we could lag the right-hand-side variables, but by one three-year panel. Lagging the right-hand-side variables this way could mean that we assume it takes three to five years for the right-hand-side variables to affect the dependent variable, which we do not think is plausible.
[21] Lastly, to control for economic or financial disruptions, we include a vector of currency and banking crises (*CRISIS*). For currency crisis, we use a dummy variable based on the exchange market pressure (EMP) index which is calculated using the exchange rate against the currency of the base country. The banking crisis dummy is based on the papers by Laeven and Valencia (2008, 2010, 2012).
[22] For more details on the dataset, refer to Appendix 2 as well as Cerruti, et al. (2015).

- Limits on domestic currency loans (*CG*); and
- Levy/tax on financial institutions (*TAX*).

We treat *MPI* as the measure for the *extensity* of macroprudential policy implementation. Cerruti, et al. (2015) make it clear that each of the 12 dummies does not "capture the intensity of the measures and any changes in intensity over time."[23] Although each dummy does not directly refer to the stringency of individual policy measures, MPI, as an aggregate of the 12 dummies, does reflect the *extensity* of the macroprudential measures.

Countries have adopted varying institutional arrangements to avoid the accumulation of systematic risk and the occurrence of financial crisis. Obviously, there is no "one-size-fit-all" macroprudential policy framework. Instead, a broad range and variety of macroprudential policy tools have been in use in many countries with different policy objectives. Some policy tools are intended to build up buffers against accumulating systematic risks so that boom-bust cycles can be mitigated. Other tools are meant to deal with and attenuate the influence of external factors or of interlinkages between different domestic financial markets.

Thus, as policy authorities strengthen defenses against financial instability, the set of policy tools would necessarily expand. In other words, an extensive use of macroprudential policies should be warranted to make the aggregate set of policy instruments more effective. Therefore, focusing on the extensity of macroprudential measures could capture addressing the intensity of macroprudential policies. Hence, we examine whether the level of macroprudential policy extensity affects interest rate financial linkages.

Figure 1 illustrates the development of MPI over 2000 through 2013 for different income groups (Panel (a)) and for different regional groups (Panel (b)). We can see that the use of macroprudential instruments is consistently becoming more frequent over years. Emerging market economies (EMG) are the most frequent user of macroprudential policies, which is understandable given that this group of economies are vulnerable to torrents of capital as they liberalize their financial markets while their domestic institutions are not as highly developed as advanced, industrial countries.

[23] The authors also argue that codifying the degree of intensity of the measures would involve a certain degree of subjective judgements.

According to Table 1, both the mean and the standard deviation of MPI are the highest for the EMG group. Industrialized countries, which as an aggregate have the lowest mean and standard deviation in the full sample period (Table 1), increased the use of macroprudential policies around the GFC and continued to increase the usage toward the end of the sample period. The U.S. and European industrialized countries were the epicenters of the GFC, and other, mostly European, industrialized countries surrounding these economies took defensive actions to shield themselves from the shocks emanating from the epicenters. That can be observed as rapid increases in the use of macroprudential policies by western and eastern European economies as shown in Figure 1 (b). Among different regions, economies in Latin America are the most frequent users of macroprudential policy instruments consistently throughout the sample period.

Cerruti, et al. (2015) also group these 12 dummy variables into the group of macroprudential policy tools intended to affect the behavior of borrowers (*BORROWER*) and that of those intended to affect the behavior of lenders (*FINANCIAL*). *BORROWER* is composed of loan-to-value ratio caps (*LTV_CAP*) and debt to income ratio (*DTI*) while *FINANCIAL* is of the remaining 10 tools: *LTV_CAP*, *DTI*, *DP*, *CTC*, *LEV*, *SIFI*, *INTER*, *CONC*, *FC*, *RR_REV*, *CG*, and *TAX*.

Figure 2 illustrates the development of *BORROWER* and *FINANCIAL* for the advanced economies (IDC) and developing economies (LDC).[24] Developing economies have been more likely to implement both *BORROWER* and *FINANCIAL* compared to IDCs. Many LDCs increased the number of borrower-targeted macroprudential policies in 2004 and after 2010 while they steadily increased the use of lender-targeted policies over time. Interestingly, IDCs increased the use of borrower-targeted macroprudential policies rather discretely in 2008 when the Financial Crisis broke out, and in 2010 and 2013 in response to loose monetary policy in the U.S. and the Euro area in the preceding years.

As we previously discussed, the main purpose of macroprudential policies is to contain systematic risk and increase resilience of financial system to shocks. This means that macroprudential policy tools can vary in terms of their purposes and targets. The International

[24] Because the maximal values differ between *BORROWER* (2) and *FINANCIAL* (10), Figure 2 is drawn to show the group average of the portion of the implementation of policy *x* (i.e., $\overline{x_i} = \frac{x_i}{x_{max}}$ where x is *BORROWER* or *FINANCIAL*).

Monetary Fund (IMF), the Financial Stability Board (FSB), and the Bank for International Settles (BIS) categorize macroprudential policies into (1) (broad-based) capital tools; (2) asset-side (sectorial capital) tools; and (3) liquidity-related tools (IMF-FSB-BIS, 2016).

According this categorization, we can disaggregate MPI into *CAPITAL*, which is the sum of *DP*, *CTC*, *SIFI*, and *INTER*; *ASSET*, which is the sum of *LTV_CAP*, *DTI*, *LEV*, and *CONC*; and *LIQUIDITY* which is the sum of *FC*, *RR_REV*, *CG*, and *TAX* (see Appendix 2). The policy tools included in *CAPITAL* aim at increasing resilience of the financial system while maintaining the supply of credit through adverse conditions, while those in *ASSET* seek to break the procyclical feedback between asset prices and credit in the mortgage lending market. Tools in *LIQUIDITY* are aimed at managing the build-up of liquidity and foreign exchange risks associated with lending booms.

Figure 3 shows the trajectories of the three disaggregated measures of macroprudential policies for IDCs and LDCs.[25] Among LDCs, asset-based measures are most implemented among the three types of policies, followed by liquidity-related and broad capital-based. Among IDCs, asset-based measures are still most used and their use has been increasing since the Financial Crisis of 2008. For this group of countries, broad capital-based measures are second most used while liquidity-based measures are least used, though their use has been rapidly rising after the GFC.

Using these MPI-related variables, we examine whether and to what extent the implementation of macroprudential policies affects the financial linkages between CEs and PHs. We will primarily focus on investigating the aggregate impact of macroprudential policies using MPI. We will also disaggregate the impact of macroprudential policies and examine whether and to what extent different types of disaggregated macroprudential policy variables for affect the CE-PH links. These variables are included in the estimation as three-year averages. Because MPI-related indexes are available for 2000-2013, the sample is now composed of three-year panels start in 1998-2000 and ending in 2013-14.[26].

[25] As in the case of Figure 2, the group average of the portion of the policy implementation.
[26] Data availability makes the last observation a two-year average. For the last panel, we use the MPI data as of 2013.

3 Empirical Results

3.1 First-Step Estimations – Connectivity with the CEs

As the first step, we estimate the extent of correlation of the policy interest rates between the CEs and the PHs while controlling for two kinds of global factors: "real global" and "financial global," using the three-year, non-overlapping panels in the 1986-2015 period.

To gain a birds-eye view of the empirical results and the general trend of the groups of factors that influence the financial link, we focus on the joint significance of the variables included in the real global and financial global groups, and vector X^C the latter of which includes the policy interest rates of the CEs.

Figure 4 illustrates the proportion of countries for which the joint significance tests are found to be statistically significant (with the *p*-value less than 5%) for the real global and financial global groups, and vector X^C of the CEs' policy interest rates. While we have done the estimation exercise for advanced economies (IDC), less developed economies (LDC), and emerging market countries (EMG), our discussions focus on the results of developing countries.

According to Figure 4, the CEs' policy interest rates have been dominant for developing and emerging market economies in the last two decades. That is, the policy interest rates of the CEs affect most joint-significantly those of the PHs, a consistent result with the findings reported in Aizenman et al. (2016).

Furthermore, the proportion of joint significance is also relatively high for the group of "financial global" variables during the GFC and the last three year panel for developing countries and since the GFC for developed countries and emerging market countries, suggesting global financial factors have been playing an important role in affecting the policy interest of countries regardless of income levels. This result is consistent with the Rey's (2013) thesis of "global financial cycles." Not surprisingly, economies are more exposed to global financial shocks during periods of financial turbulence while also following CEs' monetary policies.

Figure 5 disaggregates the effect of the CEs. The bars illustrate the proportion of the countries with significant $\hat{\gamma}$'s for the three CEs: the United States, the euro area, and Japan. We see the U.S. policy interest rates exerting the most significant effects on the policy interest rates of the PHs in most of the time period. We also see the euro area affecting the financial variables of the PHs especially around the time of the GFC as well.

3.2 Findings from Aizenman, Chinn, and Ito (2016, 2017)

Before moving onto discussing the results from the second-step estimations, let us summarize the findings of the second-step estimations from our previous studies.

We find the arrangement of open macro policies such as the exchange rate regime and financial openness have direct influences on the sensitivity to the CE's. As theory suggests, we find that an economy that pursues greater exchange rate stability and financial openness would face a stronger link with the CE's through policy interest rates and REER movements. In short, the trilemma matters.

We also find that the degree of exchange rate stability and financial openness do matter for the level of sensitivity when they are interacted with other variables such as current account balances, gross national debt, trade demand, and financial development. For example, if a developing country receives higher import demand from the CE's, that would strengthen the link between the peripheral and center economies through policy interest rates when the PH has a policy arrangement of pursuing both greater exchange rate stability and financial openness. Such a policy arrangement would also make the impact of having greater gross debt on the link between CE's and PH's REER. Thus, we conclude that open macro policy arrangements do have both direct and indirect impacts on the extent of sensitivity to the center economies.

In Aizenman, et al. (2017), we generally find evidence that the weights of major currencies, external debt, and currency compositions of debt affect the degree of connectivity. Having a higher weight of the dollar or the euro in the implicit currency basket would make the response of a financial variable such as REER and EMP in the PHs more sensitive to a change in key variables in the CEs such as policy interest rates and REER. Having more exposure to external debt would have similar impacts on the financial linkages between the CEs and the PHs. Lastly, we find that currency composition in international debt securities matter. Generally, those economies more reliant on the dollar for debt issuance tend to be more vulnerable to emanating from the U.S.

3.3 Results of the Second-Step Estimation: Do the Macroprudential policies matter?

We now use the estimation model based on equation (2) and investigate the determinants of the extent of linkages through the policy interest rate, $\hat{\gamma}_{Fit}^{C}$, while focusing on the impact of macroprudential policies. Table 2 reports the estimation results for the LDC and EMG samples.

Generally, compared to the results in our previous study (Aizenman, et al. 2017), the results are unaffected despite the inclusion of the MPI in the estimation.

PHs with more open financial markets tend to follow the monetary policy of the CEs, though the extent of exchange rate stability they pursue does not matter.[27] The positive coefficient on inflation volatility means that countries with highly volatile inflation cannot maintain monetary independence. Those peripheral countries that export competitive products to the CEs may be more able to delink the link of the policy interest rates with the CEs, while those with stronger trade links with the CEs tend to have a stronger connectivity through the policy interest rates with the CEs. The more developed financial markets a PH country is equipped with, the more connectivity through policy interest rates it has with the CEs. This result may reflect that countries with more developed financial markets tend to be more exposed to arbitrage opportunities so that their interest rates tend more to be equalized or synchronized with those of the CEs. The model, however, does not fit very well for the subsample of EMGs.

The effect of macroprudential policies on the financial link between the CEs and PHs is not observed. Although the estimated coefficient of the MPI variable is negative for both LDCs and EMGs, it is never statistically significant.

As previously described, the MPI index can be disaggregated into those borrower-targeted (*BORROWER*) and those targeted for financial institutions (*FINANCIAL*), or those regarded as capital tools (*CAPITAL*), asset-side tools (*ASSET*), or liquidity-related tools (*LIQUIDITY*). We now replace the MPI with *BORROWER* or *FINANCIAL* individually, or both of them together. Table 3 reports the estimation results only for the estimates of *BORROWER*, *FINANCIAL*, or both.

Again, we do not observe any significant effect of these variables – in Table 3, neither *BORROWER* nor *FINANCIAL* enters the estimation as a significant determinant whether the variables are included individually or together.

Even when we include *CAPITAL*, *ASSET*, and *LIQUIDITY* individually or all together, still, we do not observe any significant impact of these variables (results not reported).

[27] Aizenman, et al. (2017) find that the links through other financial variables are affected by the degree of exchange rate stability. Hence, unlike the "global financial cycles" argument by Rey (2013), the type of exchange rate regimes does matter.

Do these results suggest that macroprudential policies do not affect the financial connectivity between the CEs and the PHs? We cannot make such a conclusion too hastily.

The effect of macroprudential policies may differ depending on the conditions of the CEs or PHs. Macroprudential policy instruments received more attention when several important emerging market economies such as Brazil, Korea, and Indonesia, implemented these policies against the influx of capital caused by unconventionally lax monetary policy of the CEs. Given that, the effectiveness of the macroprudential policies may differ whether the CEs implement a policy that contributes to an influx of capital to the PHs or an efflux of capital from the countries.

Figure 6 illustrates the shadow policy interest rates for the three CEs. From the figure, we can see that different three-year panels (shown with vertical dotted lines) present different states of monetary policies among the three CEs. That is, the three-year panels of 2001-03, 2007-09, 2010-12 can be clearly perceived as the periods when three CEs implemented expansionary monetary policy which could have contributed to causing an influx of capital to emerging market economies. In the other panels, the state of monetary policy of the three CEs appears as contractionary or undiscernible.

From the perspective of the PHs, macroprudential policy may be more important when the CEs relax monetary policy than otherwise, because loose monetary policy by the CEs might necessitate PHs to take some actions against an influx of capital that is departing from the low-yielding advanced economies for higher yields.

Now, let us estimate the variable of financial connectivity again, but this time restricting the sample to the panels of 2001-03, 2007-09, 2010-12, i.e., the time periods when the CEs implemented lax monetary policy. The results are reported in Table 4.

Interestingly, the estimated coefficient of the MPI becomes significantly negative for LDC. That indicates that macroprudential policy help these economies to retain monetary independence. In other words, macroprudential policies may help PHs to shield the influence of the CEs' policy interest rate changes. This evidence is consistent with the fact that many emerging market countries implemented macroprudential policies when they experienced a rise in capital inflows in the aftermath of the GFC. The coefficient of the MPI is also found to be negative for the EMG subsample, but it is not statistically significant.

Figure 7 illustrates the contributions of the right-hand side variables to the estimated financial sensitivity for Israel, Korea, and Turkey, using the estimates from the regression for

LDC reported in Table 4. As previously described, we group the right-hand side variables into a group of open macroeconomic policy choices (OMP_i); macroeconomic conditions (MACRO); the variables that reflect the extent of linkages with the CEs (LINK); the variable that characterizes the nature of institutional development (*INST*); and the MPI as the measure of the extensity of macroprudential policies. We show the contributions of each of the groups along with the estimated gamma from the first step regression as well as the gamma predicted from the second step regression for the three-year panels of 2007-09 and 2010-12 – the time periods when the CEs implement expansionary monetary policy.[28]

These countries represent the case where their gamma against the U.S. policy interest rate (i.e., the estimated coefficient of the correlation between these countries' and the U.S. policy interest rates) fell while they increased the level of MPI. In other words, these country's monetary independence *rose* when they implemented more extensive macroprudential policies. For example, Turkey increased the level of MPI from 2.3 in 2007-09 to 4.7 in 2010-12. The (negative) contribution of MPI expands as the level of MPI rises while the estimated gamma against the U.S. policy interest rate goes down from 0.40 in 2007-09 to -0.53 in 2010-12 (i.e., it retained more monetary independence). The proportion of the MPI's contribution, coloured in brown, appears to be significant given the level of the gamma. Similarly, the contribution of the MPI looks significant for both Korea and Israel, both of which experienced a fall in the estimated gamma between the two time periods while their MPI levels went up.[29] Thus, the effect of the MPI is not just econometrically significant, but also economically significant.

When we disaggregate the MPI into *BORROWER* and *FINANCIAL* and include them either separately or together, the estimation results shown in Table 5 indicate that the negative effect of the MPI variable in Table 4 come from the macroprudential policy instruments that are targeted for lenders, i.e., financial institutions.

[28] For the sake of simplicity of the graph presentation, we omit showing the contributions of the time fixed effects as well as the estimated constant.

[29] As we will see in the next section, the negative correlation between the MPI and the estimated gamma is more applicable to countries running current account deficit and holding lower levels of IR. As of 2007-09 and 2010-12, Turkey ran current account deficit while Korea and Israel ran current account surplus, the latter two countries of which held relatively sizeable IR. The exercise here does not distinguish between current account surplus and deficit countries, or between high and low IR holders. Hence, we are showing the "average behavior" between these different types of economies. Economies like Korea and Israel could also implement active and preemptive macroprudential policies if they are "prudentially" afraid of the tail risk of rapid worsening of their domestic financial market conditions.

Generally, macroprudential policies targeting lenders seek to make the price of credit more expensive so that borrowers' demand for credit would fall. Authorities in charge could slow down credit growth insofar as borrowers are interest-sensitive. The finding that macroprudential policy instruments targeted at lenders are more effective in weakening the financial linkage with the CEs means that monetary authorities can retain more monetary autonomy by making the price of credit more expensive. This result might arise because it is easier for authorities in charge of macroprudential policies to target financial institutions rather borrowers because the number of lenders can be relatively limited while that of borrowers can be numerous.

What about the impacts of *CAPITAL*, *ASSET*, and *LIQUIDITY?*

We include these variables instead of the previous two variables both individually and jointly and report the results in Table 6. Among the three variables, only *LIQUIDITY* turns out to be a significant and negative contributor to the correlation of policy interest rates between the CEs and the PHs. Given that liquidity-related macroprudential measures are intended to control liquidity growth, especially when the periphery economy is experiencing an influx of capital due to expansionary monetary policy conducted by the CEs, controls on liquidity growth should be effective in allowing the country to retain control over its own monetary policy.

Lastly, we include each of the 12 dummy variables individually and jointly instead of MPI or the other disaggregated measures, and report the results in Table 7. Among the dummy variables, the policy that limits banks from exceeding a fixed minimum leverage ratio ("Leverage ratio cap") and the policy of countercyclical reserve requirements are found to have a significantly negative impact on the correlation of policy interest rates between the CEs and the PHs.[30] The countercyclical reserve requirements policy is found to be robust even when all of the dummy variables are included in the estimation. Among the 12 types of macroprudential policies, the cap on the leverage ratio and countercyclical reserve requirements are effective in controlling credit growth, which allows the monetary authorities of the PHs to retain autonomy over interest rate policy.

Interestingly, none of the above findings are observed when the estimation is conducted for the remaining three-year panels. These empirical findings suggest that the effect of

[30] The positive estimate of the variable for countercyclical capital requirements (column (2)) only reflects the policy implementation by Nepal (2010-12) and Georgia (2007-09, 2010-12).

macroprudential policy is discernible only when the CEs implement expansionary monetary policy that eventually causes a rise in capital inflows among developing countries, but not when the CEs implement contractionary monetary policy. In other words, the impact of macroprudential policies is asymmetrical. That explains why we did not find a significant impact of macroprudential policies in the baseline regression.[31]

As previously discussed, the purpose of macroprudential policies is to protect the financial system from economic and financial shocks. For small, open peripheral economies, the main purpose of macroprudential policies is to minimize systematic risk that arises from shocks emanating from the CEs. When the CEs implement expansionary monetary policy, that can shift the tide of cross-border capital flow toward higher-yielding markets in the PHs, while the PHs could experience capital outflow when the CEs implement contractionary monetary policy. However, the magnitude and the impact of capital outflow on the financial markets and the real economy often depends upon the scale of capital inflow that precedes the event of capital outflow. Monetary authorities often implement macroprudential policies as preemptive measures to mitigate an expansion of credit thereby avoiding severe bubble and bust cycles.

The estimation results we obtained from the above analysis bolster the premise that macroprudential policies are important when credit and liquidity expansion is being "exported" from the CEs.

4. Further Analyses

We saw that macroprudential policies could affect the financial link between the CEs and the PHs through the policy interest rates, especially when the CEs implement expansionary monetary policy. The effect of macroprudential policies might also depend upon several other macroeconomic or policy conditions of the PH countries that implement the policies.

Let us now examine how the effect of macroprudential policies on the financial link might change depending on the macroeconomic or policy environment of the PHs. We test how third factors could affect the effectiveness of macroprudential policies on the interest rate

[31] We cannot differentiate between the hypothesis that the asymmetry occurs post-financial crisis vs. a period of loose monetary policy in the CEs.

channel between the CEs and the PHs while continuing to restrict our sample period to the periods of CEs' "loose" monetary policy.

First, we test the impact of current account balances. Although we observed that macroprudential policies become effective only when the CEs implement expansionary monetary policy, the effectiveness of macroprudential policies should differ whether the PH country of concern is a net recipient of capital or a net lender. Historically, current account deficit countries are more receptive to external shocks than surplus countries.

To test that, we divide the sample of LCD, or EMG, into the country-years in which the PH runs current account surplus and those in which they run deficit. Table 8 reports the estimation results for the MPI variable. The negative effect of macroprudential policies on the interest rate link between CEs and PHs is observed only for current account deficit countries for both LDC and EMG subsamples. That means that macroprudential policies allow PHs to retain more monetary independence from the CEs when they are net recipients of capital, while macroprudential policies do not matter for current account surplus countries.

The level of international reserves holding might matter for the effectiveness of macroprudential policies. If a country holds a large volume of international reserves and implement macroprudential policies, those policies may be more effective because holding a large volume of IR could send a positive signal that the country is less vulnerable to external shocks. In this case, it can be argued that IR holding plays a supplemental role to macroprudential policies. At the same time, however, macroprudential policies and IR holding could have a substitutive relationship to each other. In that case, even if a country does not hold a large volume of IR, active implementations of macroprudential policies might function as an alternative buffer to external shocks.

Our estimation results suggest that macroprudential policies and IR holding have a substitutive relationship with each other. Table 9 reports the results from the estimations in which we divide the sample of LDC or EMG depending on the level of IR (as a share of GDP) is greater or lower than the sample medium. According to the estimation results, for EMG countries which do not hold high levels of IR, implementing macroprudential policies could help them mitigate the impact of a change in the CEs' policy interest rates on their own interest rates, i.e., they can retain more monetary autonomy from implementing macroprudential policies.

The impact of macroprudential policies could also depend upon the degree of openness to international financial markets of the country that implements the policies. We divide the sample into two subsamples depending on whether our measure of capital account openness (the Chinn-Ito index) is above or below the sample medium and rerun the estimations. In Table 10, we observe that macroprudential policies could be more effective when the economy of concern is relatively financially closed. This means that when a PH country tries to shield itself from capital inflows diverted from the CEs, having more closed financial markets would help for the macroprudential policies to be more effective. Conversely, for PH economies with more open financial markets, macroprudential policies would not be sufficient to manage capital inflows.

The purpose of implementing macroprudential policies is to shield the influence of policy changes made by the CEs so that the country that implements the policies could retain its own monetary autonomy. We have seen that PHs' macroprudential policies are effective when the CEs implement expansionary monetary policy. In such a situation, a lax monetary environment among the CEs would cause capital to flow into emerging market economies with higher yields, which could cause credit to expand in the latter. Monetary policy makers of the PHs might become concerned that increased credit in their economies might become out of controls, against which policy makers may implement macroprudential policies. Given this, the effect of macroprudential policies may be more discernable when the PH economy of concern is experiencing an increase in capital inflow and also an expansion of credit.

Table 11 divides the sample depending on the portfolio net inflow (as a share of GDP) is experiencing a positive or negative growth. The coefficient of the MPI is negative for the LDC sample for the economies that are experiencing growth in net portfolio inflows. The estimated coefficient of the MPI for the EMG group is also negative, but only marginally significant (p-value = 16%). Macroprudential policies are discernably effective when the PHs are experiencing an increase in portfolio net inflows.

In Table 12, we divide the sample depending on whether the country of concern is experiencing a growth of credit higher than its own median or not.[32] The MPI variable enters the estimation for both the LDC and EMG subsample with a significantly negative coefficient only for the sample of countries with higher-than-median credit growth. Taken together with the results of Table 11, we can conclude that macroprudential policies can become effective when

[32] We measure credit growth as a percentage growth of liquid liabilities as a share of GDP.

the CEs implement expansionary monetary policy, that causes a rise in portfolio net inflows and credit expansion in the PHs.

5. Concluding Remarks

The implementation of unconventional monetary policies by the advanced economies in the aftermath of the GFC significantly affected capital flows globally. Encountering a surge of capital flows, many emerging market economies faced the need to maneuver macroeconomic policy so as to alleviate the impacts of spillovers from the advanced economies. One such example is macroprudential policies, which were put in place by many emerging market economies as an attempt to mitigate the impact of changes in cross-border capital flows on domestic financial markets and to prevent financial instability. In this paper, we empirically investigated how the financial link through policy interest rates between the CEs and PHs can be affected by the implementation of macroprudential policies by the PHs.

We utilized the investigation framework we used in our previous works to examine the determinants of the financial link (Aizenman, et al. 2016, 2017) and examined whether and to what extent a set of macroprudential policies affect the extent of sensitivity through policy interest rates between the center, advanced economies (i.e., the U.S. the euro area, and Japan) and developing and emerging market countries in the peripheries.

From the baseline estimation exercise, at a first glance, we found that the extensity of macroprudential policies (measured by the macroprudential policy index, MPI) does not affect the degree of connectivity through the policy interest rates between the CEs and the PHs. When we investigated the impact of the disaggregated macroprudential policies, still, its impact on the BE-PH link through the policy interest rates was not evidenced.

However, when we focused on the time periods when the CEs implement expansionary monetary policy, we found that macroprudential policies do matter and negatively affect the interest rate connectivity between the CEs and the PHs. This finding suggests that macroprudential policies have an asymmetrical effect; that is, only when CEs implement expansionary monetary policy, the effect of macroprudential policies is detected. That makes sense considering that CEs' lax monetary policy causes massive capital to flow to the PHs, the

latter of which try to mitigate any negative impact on the real economy of credit expansion caused by capital influx from the CEs.[33]

When we disaggregated the index for macroprudential policies into the group of borrower-targeted macroprudential policy tools and that of lender-targeted macroprudential policy tools, we found that the above negative impact of MPI is mainly driven by lender-targeted macroprudential policies.

Furthermore, when we disaggregated the MPI into (broad-based) capital tools; asset-side (sectorial capital) tools; and liquidity-related tools, only *LIQUIDITY* turn out to be a significant and negative contributor to the correlation of policy interest rates between the CEs and the PHs.

The effectiveness of macroprudential policies can vary depending on the macroeconomic conditions or policies of the PH economies that implement them. Hence, we examined whether and how macroeconomic conditions and policies could affect the effectiveness of macroprudential policies.

We found that PH countries' policy interest rates could become more independent of CEs' when macroprudential policies are implemented by the countries with current account deficit. In other words, macroprudential policies could work more effectively for countries that import capital from overseas.

When we compare high IR holding countries with low IR holding ones, the estimated coefficient of the variable for macroprudential policies was found to be significantly negative, i.e., weakening the policy interest rate link between the CEs and the PHs, only for low IR holders. This suggests that countries with low levels of IR holding may use macroprudential policies as a substitute to holding high levels of IR.

When we compare the PH countries that are experiencing a rise in net portfolio inflows with those which are not, we detected the effect of macroprudential policies only among those with increasing net portfolio inflows. We also compared the PH countries that are experiencing credit growth with those which are not and found that only those which are experiencing credit growth have a significantly effect on their macroprudential policies.

Thus, we have been able to show the effect of macroprudential policies as the "fourth" factor in the quadrilemma. It must be noted that macroprudential policies are not the same as

[33] Similarly, Han and Wei (2018) find asymmetrical effects of capital controls, depending on whether core country monetary policy is tightening or loosening.

conventional capital controls policies. What makes macroprudential policies different from conventional capital controls is that macroprudential policies are aimed at mitigating the balance sheet exposure associated with short term debt flows while typical capital controls are blunt instruments that focus more on affecting capital flows and less on mitigating the balance sheet exposures. That may explain our findings that the effect of macroprudential policies are detected only when the CEs implement expansionary policy and when the PHs' domestic credit conditions are affected.

Clearly, it is better to use more nuanced or detailed cross-country data on macroprudential policies, rather than relying on crude dummy variables, so that we can identify which types of macroprudential policies are effective or ineffective under what kind of policy or macroeconomic conditions. However, such an exercise is outside the scope of this paper. We will tackle on this issue as one of the future research agendas.

References:

Aizenman, Joshua and Hiro Ito. 2014. "Living with the Trilemma Constraint: Relative Trilemma Policy Divergence, Crises, and Output Losses for Developing Countries" *Journal of International Money and Finance* 49 p.28-51, (May). Also available as NBER Working Paper #19448 (September 2013).

Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito. 2017. "Balance Sheet Effects on Monetary and Financial Spillovers: The East Asian Crisis Plus 20*." Journal of International Money and Finance*, vol. 74, pages 258-282.

Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito. 2016. "Monetary Policy Spillovers and the Trilemma in the New Normal: Periphery Country Sensitivity to Core Country Conditions," *Journal of International Money and Finance*, Volume 68, November 2016, Pages 298–330. Also available as NBER Working Paper #21128 (May 2015).

Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito. 2013. "The 'Impossible Trinity' Hypothesis in an Era of Global Imbalances: Measurement and Testing," *Review of International Economics*, 21(3), 447–458 (August).

Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito. 2011. "Surfing the Waves of Globalization: Asia and Financial Globalization in the Context of the Trilemma," *Journal of the Japanese and International Economies*, vol. 25(3), p. 290 – 320 (September).

Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito. 2010. "The Emerging Global Financial Architecture: Tracing and Evaluating New Patterns of the Trilemma Configuration," *Journal of International Money and Finance* 29 (2010) 615–641.

Akinci, O. and J. Olmstead-Rumsey. 2017. "How Effective Are Macroprudential Policies? An Empirical Investigation." *Journal of Financial* Intermediation. Available online.

Bank of England. 2011. "Instruments of Macroprudential Policy," Bank of England Discussion Paper (December).

Bank of England. 2009. "The Role of Macroprudential Policy," Bank of England Discussion Paper (November).

Buch, C. and L. Goldberg. 2017. Cross-Border Prudential Policy Spillovers: How Much? How Important? Evidence from the International Banking Research Network, *International Journal of Central Banking*, March Issue, p. 505 – 558.

Bocola, L. and Lorenzoni, G., 2017. Financial crises and lending of last resort in open economies (No. w23984). National Bureau of Economic Research.

Cerutti, E, S Claessens, and L Laeven. 2017. "The Use and Effectiveness of Macroprudential Policies: New Evidence," *Journal of Financial Stability*, vol. 28(C), pages 203-224.

Cerutti, E, S Claessens, and L Laeven. 2017. "Changes in Prudential Policy Instruments – A New Cros-country Database," *International Journal of Central Banking*, vol. 13 (1), pp. 477-503, 2017.

Christensen, J. H. E., and Glenn D. Rudebusch. 2014. "Estimating Shadow-rate Term Structure Models with Near-zero Yields," *Journal of Financial Econometrics* 0, 1-34.

Claessens, Stijn. 2014. "An Overview of Macroprudential Policy Tools," IMF WP 14/214.

Diamond, D.W. and Dybvig, P.H., 1983. Bank runs, deposit insurance, and liquidity. Journal of political economy, 91(3), pp.401-419.

Forbes, Kristin J. and Menzie D. Chinn. 2004. "A Decomposition of Global Linkages in Financial Markets over Time," *The Review of Economics and Statistics*, August, 86(3): 705–722.

Frankel, J. and S. J. Wei. 1996. "Yen Bloc or Dollar Bloc? Exchange Rate Policies in East Asian Economies." In T. Ito and A Krueger, eds., *Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows*, Chicago: University of Chicago Press, pp 295–329.

Galati, G. and R. Moessner. 2014. "What do we know about the effects of macroprudential policy?" DNB Working Paper, No. 440/September 2014.

Galati, G. and R. Moessner. 2011. "Macroprudential policy – a literature review," BIS Working Papers No 337.

Ghosh, Atish R., Mahvash S. Qureshi, and Naotaka Sugawara. 2014. "Regulating Capital Flows at Both Ends: Does it Work?" IMF Working Paper WP/14/188. Washington, D.C.: International Monetary Fund.

Ghosh, Atish R., Jonathan D. Ostry, and Mahvash S. Qureshi. 2015. "Exchange Rate Management and Crisis Susceptibility: A Reassessment." IMF Economic Review 63 (1): 238–276.

Ghosh, Atish, Mahvash Qureshi, Jonathan Ostry, and Chifundo Moya. 2018. *Managing Capital Market Flows*. Cambridge: MIT Press.

Haldane, A. and S. Hall. 1991. "Sterling's Relationship with the Dollar and the Deutschemark: 1976–89." *Economic Journal*, 101:406 (May).

Han, X. and Wei, S.J., 2018. International transmissions of monetary shocks: Between a trilemma and a dilemma. *Journal of International Economics*, 110, pp.205-219.

Hausmann, R. and Panizza, U., 2011. "Redemption or abstinence? original sin, currency mismatches and counter cyclical policies in the new millennium," *Journal of Globalization and Development*, 2(1).

International Monetary Fund. 2013a. "Key Aspects of Macroprudential Policy," IMF Policy Paper (June).

International Monetary Fund. 2013b. "Key Aspects of Macroprudential Policy – Background Paper," IMF Policy Paper (June).

International Monetary Fund, Financial Stability Board, and Bank for International Settlements. 2016. "Elements of Effective Macroprudential Policies – Lessons from International Experience."

Ito, H. and M. Kawai. 2016. "|Trade invoicing in major currencies in the 1970s-1990s: lessons for renminbi internationalization," *Journal of the Japanese and International Economies*, vol 42, December, pp 123–145.

Ito, H. and C. Rodriguez. 2015. "Clamoring for Greenbacks: Explaining the Resurgence of the US Dollar in International Debt." RIETI Working Paper 15-E-119 (October).

Ito, H, R. McCauley and T. Chan. 2015. "Emerging market currency composition of reserves, denomination of trade and currency movements", Emerging Markets Review, December, pp 16-19.

Laeven, L. and F. Valencia. 2012. "Systematic Banking Crises: A New Database," IMF Working Paper WP/12/163, Washington, D.C.: International Monetary Fund.

Laeven, L. and F. Valencia. 2010. "Resolution of Banking Crises: The Good, the Bad, and the Ugly," IMF Working Paper No. 10/44. Washington, D.C.: International Monetary Fund.

Laeven, L. and F. Valencia. 2008. "Systematic Banking Crises: A New Database," IMF Working Paper WP/08/224, Washington, D.C.: International Monetary Fund.

McCauley, R. and T. Chan 2014. "Currency movements drive reserve composition", BIS Quarterly Review, December, pp 23-36.

Obstfeld, M., 1996. Models of currency crises with self-fulfilling features. European economic review, 40(3-5), pp.1037-1047.

Ostry, J., A. Ghosh, M. Chamon, and M. Qureshi. 2012. “Tools for Managing Financial-Stability Risks from Capital Inflows,” *Journal of International Economics,* 88(2): p. 407 – 421.

Pasricha, G., M. Falagiarda, M. Bijsterbosch, and J. Aizenman. 2017. Domestic and Multilateral Effects of Capital Controls in Emerging Markets, NBER Working Paper Series 20822. Cambridge: National Bureau of Economic Research.

Rey, H. 2013. “Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence,” prepared for the 2013 Jackson Hole Meeting.

Shambaugh, J. C., 2004. The Effects of Fixed Exchange Rates on Monetary Policy. *Quarterly Journal of Economics* 119 (1), 301-52.

Wu, Jing Cynthia and Fan Dora Xia. 2014. “Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound”, NBER Working Paper No. 20117.

Appendix 1: Data Descriptions and Sources

Policy short-term interest rate – money market rates. Extracted from the IMF's *International Financial Statistics (IFS)*.

Commodity prices – the first principal component of oil prices and commodity prices, both from the *IFS*.

VIX index – It measures the implied volatility of S&P 500 index options and is available in http://www.cboe.com/micro/VIX/vixintro.aspx.

"Ted spread" – It is the difference between the 3-month Eurodollar Deposit Rate in London (LIBOR) and the 3-month U.S. Treasury Bill yield.

Exchange rate stability (ERS) and financial openness (KAOPEN) indexes – From the trilemma indexes by Aizenman, et al. (2013).

International reserves – international reserves minus gold divided by nominal GDP. The data are extracted from the IFS.

Gross national debt – It is included as a share of GDP and obtained from the World Economic Outlook (WEO) database.

Trade demand by the CEs – $TR\_LINK_{ip} = IMP_{ip}^{C} \big/ GDP_{ip}$ where IMP_i^C is total imports into center economy *C* from country *i*, that is normalized by country *i*'s GDP and based on the data from the IMF *Direction of Trade* database.

FDI provided by the CEs – It is the ratio of the total stock of foreign direct investment from country *C* in country *i* as a share of country *i*'s GDP. We use the *OECD International Direct Investment* database.

Bank lending provided by the CEs – It is the ratio of the total bank lending provided by each of the CEs to country *i* shown as a share of country *i*'s GDP. We use the BIS database.

Trade competition – It is constructed as follows.

$$Trade\_Comp_i^C = \frac{100}{Max(Trade\_Comp)} \sum_k \left[\frac{Exp_{W,k}^C}{Exp_{W,k}^W} * \frac{Exp_{W,k}^i}{GDP_i} \right]$$

$Exp_{W,k}^C$ is exports from large-country *C* to every other country in the world *(W)* in industrial sector *k* whereas $Exp_{W,k}^W$ is exports from every country in the world to every other country in the world (i.e. total global exports) in industrial sector *k*. $Exp_{W,k}^i$ is exports from country *i* to every other country in the world in industrial sector *k*, and GDP_i is GDP for country *i*. We assume merchandise exports are composed of five industrial sectors (*K*), that is, manufacturing, agricultural products, metals, fuel, and food.

This index is normalized using the maximum value of the product in parentheses for every country pair in the sample. Thus, it ranges between zero and one.[34] A higher value of this variable means that country *i*'s has more comparable trade structure to the center economies.

[34] This variable is an aggregated version of the trade competitiveness variable in Forbes and Chinn (2004). Their index is based on more disaggregated 14 industrial sectors.

Financial development – It is the first principal component of private credit creation, stock market capitalization, stock market total value, and private bond market capitalization all as shares of GDP.[35]

Currency crisis – It is from Aizenman and Ito (2014) who use the exchange market pressure (EMP) index using the exchange rate against the currency of the base country. We use two standard deviations of the EMP as the threshold to identify a currency crisis. To construct the crisis dummies in three-year panels, we assign the value of one if a crisis occurs in any year within the three-year period.

Banking crisis – It is from Aizenman and Ito (2014) who follow the methodology of Laeven and Valencia (2008, 2010, 2012). For more details, see Appendix 1 of Aizenman and Ito (2014).

Share of export/import – The share of country *i*'s export to, or import from, a major currency country (e.g., Japan) in country *i*'s total export or import. The data are taken from the IMF's *Direction of Trade.*

Commodity export/import as a percentage of total export/import – Data are taken from the World Bank's *World Development Indicators* and the IMF's *International Financial Statistics*.

[35] Because the private bond market capitalization data go back only to 1990, the FD series before 1990 are extrapolated using the principal component of private credit creation, stock market capitalization, and stock market total values, which goes back to 1976. These two FD measures are highly correlated with each other.

Appendix 2: Macroprudential Policy Index

Variable	Variable Name	Definition
Broad-based capital tools (CAPITAL)		
DP	Time-Varying/Dynamic Loan-Loss Provisioning	Dummy for the use of a policy that requires banks to hold more loan-loss provisions during upturns
CTC	General Countercyclical Capital Buffer/Requirement	Dummy for the use of a policy that requires banks to hold more capital during upturns
SIFI	Capital Surcharges on Systematically Important Financial Institutions	Dummy for the use of a policy that requires Systematically Important Financial Institutions to hold a higher capital level than other financial institutions
INTER	Limits on Interbank Exposures	Dummy for the use of a policy that limits the fraction of liabilities held by the banking sector
Sectoral capital and asset-side tools (ASSET)		
LTV_CAP	Loan-to-Value Ratio	Dummy for the use of LTV measures used as a strict cap on new loans as opposed to a loose guideline or merely an announcement of risk weights
DTI	Debt-to-Income Ratio	Dummy for the use of a policy that constrains household indebtedness by enforcing or encouraging a limit
LEV	Leverage Ratio	Dummy for the use of a policy that limits banks from exceeding a fixed minimum leverage ratio
CONC	Concentration Limits	Dummy for the use of a policy that limits the fraction of assets held by a limited number of borrowers
Liquidity-related tools (LIQUIDITY)		
FC	Limits on Foreign Currency Loans	Dummy for the use of a policy that reduces vulnerability to foreign-currency risks
RR_REV	FX and/or Countercyclical Reserve Requirements	RR is a policy that limits credit growth. It can also be targeted to limit foreign-currency credit growth. RR_REV is a subset of RR that restricts to reserve requirements which i) imposes a specific wedge on foreign currency deposits or are adjusted countercyclically
CG	Limits on Domestic Currency Loans	Dummy for a policy that limits credit growth
TAX	Levy/Tax on Financial Institution	Dummy for taxes on the revenue of financial institutions
MPI	Macroprudential Policy Index (0 – 12)	LTV_CAP+DTI+DP+CTC+LEV+SIFI+INTER+CONC+FC+RR_REV+CG+TAX
BORROWER	Borrower-targeted instruments (0 – 2)	LTV_CAP+DTI
FINANCIAL	Financial Institution-targeted instruments (0 – 10)	DP+CTC+LEV+SIFI+INTER+CONC+FC+RR_REV+CG+TAX

Source: Table 1 of Cerutti, et al. (2015), IMF-FSB-BIS (2016).

Table 1: Summary Statistics of MPI

	Minimum	Mean	Median	Maximum	Standard Deviation
Full Sample	0	1.76	1.00	8.00	1.54
Industrialized Countries (IDC)	0	1.21	1.00	5.00	1.29
Developing Countries (LDC)	0	1.87	2.00	8.00	1.57
Emerging Markets (EMG)	0	2.23	2.00	8.00	2.23

Table 2: Factors Affecting the Estimated Financial Sensitivity, 1998-2014

	LDC	EMG
	(1)	(2)
Exch. Rate Stability	-0.016	-0.070
	(0.263)	(0.335)
Financial Openness	0.386	0.493
	(0.212)*	(0.239)**
IR Holding	0.167	0.135
	(0.611)	(0.846)
CA balance (%)	-0.318	-1.140
	(0.829)	(1.348)
Gross debt (%)	0.107	0.182
	(0.121)	(0.138)
Inflation Vol.	2.443	0.938
	(1.431)*	(1.594)
Trade Comp.	-1.897	-1.318
	(0.896)**	(1.048)
Trade demand	2.365	1.265
	(1.093)**	(1.080)
Bank Lending	0.324	0.347
	(0.619)	(0.582)
Fin. Dev.	0.755	0.638
	(0.447)*	(0.526)
Currency crisis	1.091	0.075
	(0.275)***	(0.284)
Banking crisis	-0.208	-0.024
	(0.229)	(0.253)
Macro-prudential	**-0.039**	**-0.029**
	(0.044)	**(0.044)**
N	851	532
Adj. R2	0.05	0.01
# of countries	61	35

Notes: The estimations are conducted with the robust regression method due to the existence of outliers. * $p<0.1$; ** $p<0.05$; *** $p<0.01$. The second estimation is conducted for the estimates $\hat{\gamma}_{Fi}^{C}$ from the first-step estimation that does not include China as one of the center economies. Time fixed effects for the three-year panels and the constant are also included, though their estimates are not reported.

Table 3: The Effects of Disaggregated MPI, LDC vs. EMG

Dependent Variable: Estimated Measure of Financial Sensitivity through Policy Interest Rates between CEs and PHs						
	LDC	LDC	LDC	EMG	EMG	EMG
	(1)	(2)	(3)	(4)	(5)	(6)
Borrower-targeted	-0.084		-0.063	-0.077		-0.069
MPI	(0.119)		(0.124)	(0.108)		(0.121)
Financial Institution- targeted		-0.041	-0.031		-0.027	-0.012
MPI		(0.053)	(0.056)		(0.059)	(0.065)

Table 4: Factors Affecting the Estimated Financial Sensitivity, 1998-2014 When CEs' Monetary Policy Is Loose

	LDC	EMG
	(1)	(2)
Exch. Rate Stability	0.080	-0.247
	(0.361)	(0.475)
Financial Openness	0.097	-0.009
	(0.280)	(0.324)
IR Holding	-0.107	0.216
	(0.741)	(1.056)
CA balance (%)	0.031	-0.989
	(1.046)	(1.736)
Gross debt (%)	0.067	-0.007
	(0.157)	(0.187)
Inflation Vol.	5.976	6.094
	(2.450)**	(4.242)
Trade Comp.	-0.639	-0.234
	(1.191)	(1.407)
Trade demand	0.863	0.056
	(1.463)	(1.530)
Bank Lending	0.565	0.819
	(0.690)	(0.662)
Fin. Dev.	0.219	-0.487
	(0.570)	(0.712)
Currency crisis	0.792	0.318
	(0.384)**	(0.375)
Banking crisis	-0.085	-0.081
	(0.289)	(0.342)
Macro-prudential	**-0.104**	**-0.055**
	(0.057)*	**(0.060)**
N	471	288
Adj. R2	0.04	0.01
# of countries	61	35

Notes: The estimations are conducted with the robust regression method due to the existence of outliers. * $p<0.1$; ** $p<0.05$; *** $p<0.01$. The second estimation is conducted for the estimates $\hat{\gamma}_{Fi}^{C}$ from the first-step estimation that does not include China as one of the center economies. Time fixed effects for the three-year panels and the constant are also included, though their estimates are not reported.

Table 5: The Effects of Disaggregated MPI, Borrower-targeted vs. Financial Institution (Lender)-targeted, "Loose Time"

Dependent Variable: Estimated Measure of Financial Sensitivity through Policy Interest Rates between CEs and PHs						
	LDC	LDC	LDC	EMG	EMG	EMG
	(1)	(2)	(3)	(4)	(5)	(6)
Borrower-targeted	-0.111		-0.017	-0.184		-0.180
MPI	(0.158)		(0.167)	(0.151)		(0.171)
Financial Institution- targeted		-0.136	-0.134		-0.041	-0.004
MPI		(0.070)*	(0.073)*		(0.079)	(0.090)

Table 6: The Effects of Disaggregated MPI, Capital-, Asset-, and Liquidity-based, "Loose Time"

Dependent Variable: Estimated Measure of Financial Sensitivity through Policy Interest Rates between CEs and PHs				
	(1)	(2)	(3)	(4)
Capital-based MPI	-0.082			-0.094
	(0.391)			(0.168)
Asset-based MPI		-0.085		0.043
		(0.111)		(0.125)
Liquidity-based MPI			-0.323	-0.322
			(0.127)**	(0.138)**

Table 7: The Effects of Disaggregated MPI Tools

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Loan loss provisioning	-0.243												-0.191
	(0.282)												(0.304)
Countercyclical		3.980											3.918
Capital requirement		(0.642)***											(0.678)***
K-surcharge on SIFI			-0.436										-0.282
			(0.665)										(0.691)
Limits on interbank				-0.173									-0.013
Exposure				(0.204)									(0.230)
Loan to value					-0.251								-0.170
ratio cap					(0.239)								(0.285)
Debt to income ratio cap						0.018							0.260
						(0.263)							(0.332)
Leverage ratio cap							-0.480						-0.330
							(0.275)*						(0.298)
Concentration limits								0.156					0.227
								(0.195)					(0.215)
Limits on foreign currency									-0.192				-0.211
loans									(0.246)				(0.292)
Reserve requirements										-0.411			-0.606
										(0.242)*			(0.261)**
Limits on domestic											-0.313		-0.192
Currency loan											(0.315)		(0.329)
Tax on financial												-0.256	-0.317
Institutions												(0.264)	(0.306)

Table 8: Current Account Surplus Countries vs. Current Account Deficit Countries

	LDC		EMG	
	CA Surplus	CA Deficit	CA Surplus	CA Deficit
	(1)	(2)	(3)	(4)
Macroprudential Policy Index	-0.051	-0.220	0.009	-0.264
	(0.071)	(0.110)**	(0.072)	(0.113)**
N	181	289	132	156
Adj. R2	0.07	0.36	0.20	0.06
# of countries	48	54	32	30

Table 9: Countries with High IR vs. Those with Low IR

	LDC		EMG	
	High IR	Low IR	High IR	Low IR
	(1)	(2)	(3)	(4)
Macroprudential Policy Index	-0.060	-0.168	0.036	-0.272
	(0.072)	(0.109)	(0.074)	(0.129)**
N	268	203	154	135
Adj. R2	0.00	0.13	-0.01	0.06
# of countries	43	38	23	22

Table 10: Financially Open Countries vs. Financially Closed Countries

	LDC		EMG	
	Open	Close	Open	Close
	(1)	(2)	(3)	(4)
Macroprudential Policy Index	-0.111	-0.146	-0.104	-0.044
	(0.082)	(0.089)*	(0.106)	(0.083)
N	237	234	144	143
Adj. R2	-0.01	0.12	-0.05	0.04
# of countries	33	34	19	20

Table 11: Portfolio Inflow Growing vs. Capital Inflow Contracting

	LDC		EMG	
	K-inflow Expanding (1)	K-inflow Contracting (2)	K-inflow Expanding (3)	K-inflow Contracting (4)
Macroprudential Policy Index	-0.214	0.092	-0.145	0.090
	(0.091)**	(0.116)	(0.102)	(0.106)
N	230	198	150	130
Adj. R2	0.06	0.45	-0.02	0.03
# of countries	47	46	28	28

Table 12: Credit Growing vs. Credit Contracting

	LDC		EMG	
	High Credit Expansion (1)	Low Credit Expansion (2)	High Credit Expansion (3)	Low Credit Expansion (4)
Macroprudential Policy Index	-0.259	-0.027	-0.155	-0.044
	(0.087)***	(0.089)	(0.092)*	(0.109)
N	210	261	122	167
Adj. R2	0.19	-0.02	0.12	-0.01
# of countries	51	57	29	33

Figure 1 (a): MPI by Income Groups

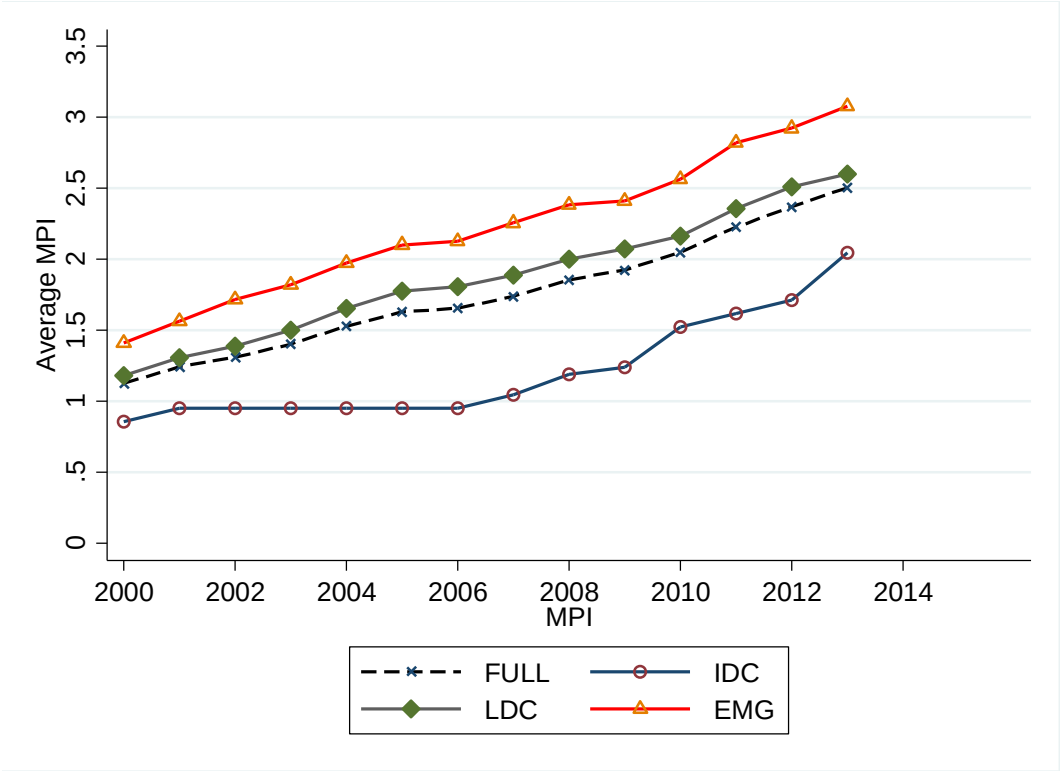


Figure 1 (b): MPI by Regions

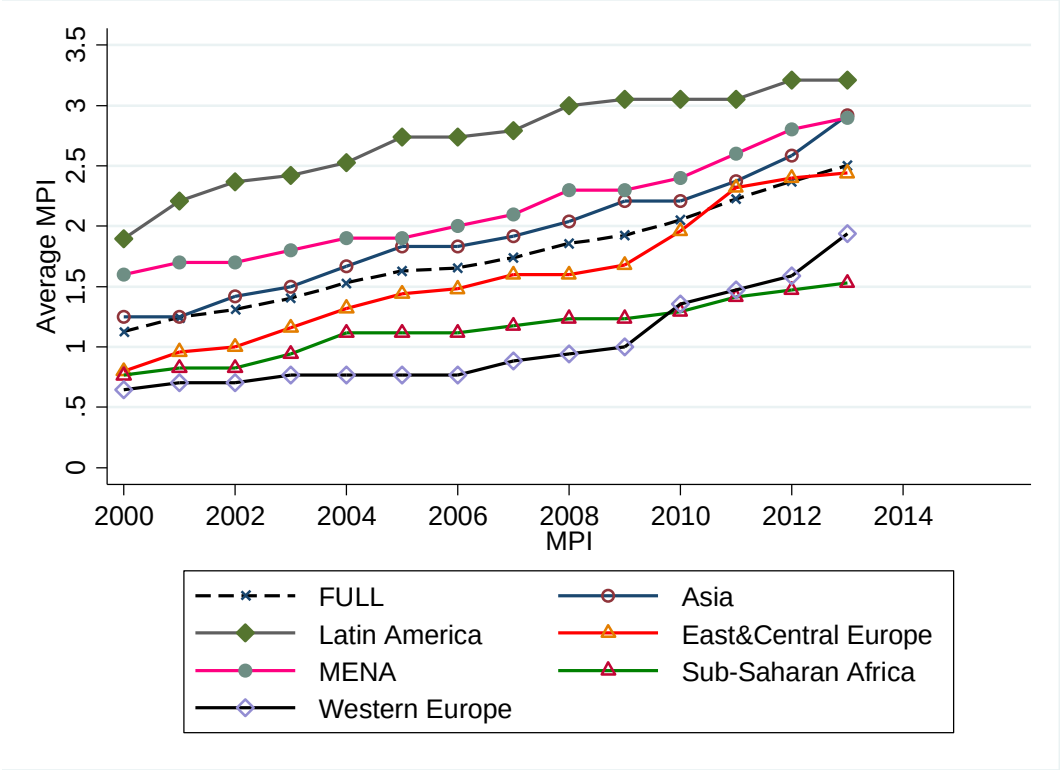


Figure 2: *BORROWER* and *FINANCIAL* by Income Groups

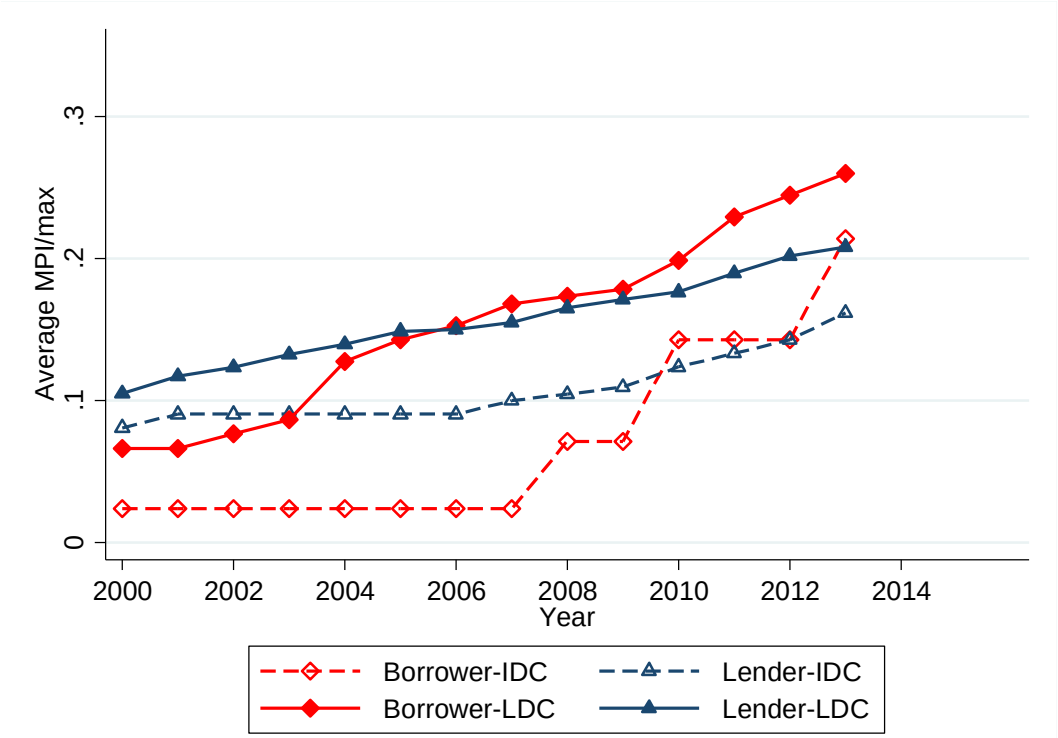


Figure 3: *CAPITAL*, *ASSET*, and *LIQUIDITY* by Income Groups

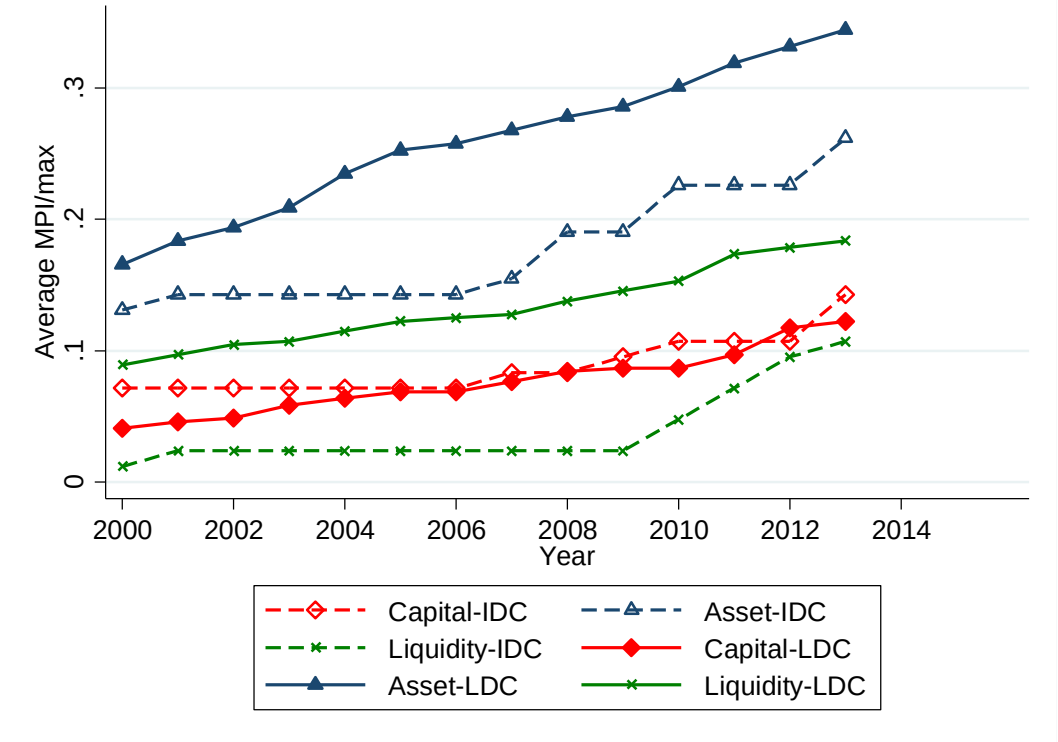


Figure 4: Proportion of Significant F-Tests

CE: Policy Interest Rate → PH: Policy Interest Rate

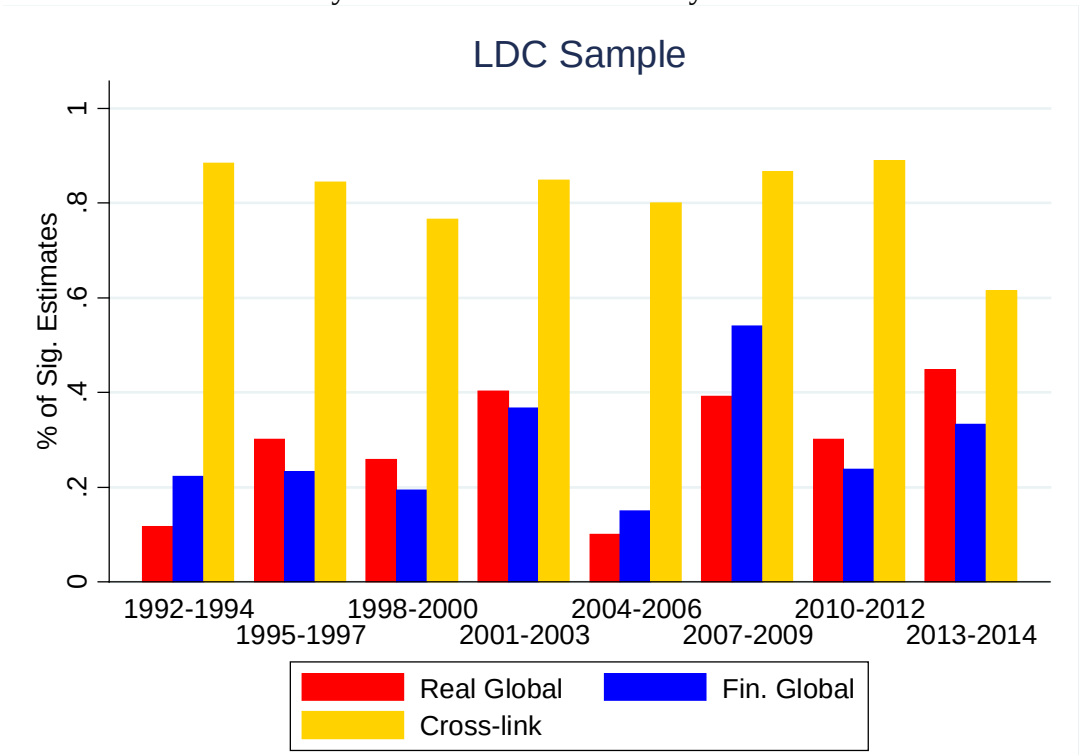


Figure 5: Proportion of Significant $\hat{\gamma}$'s

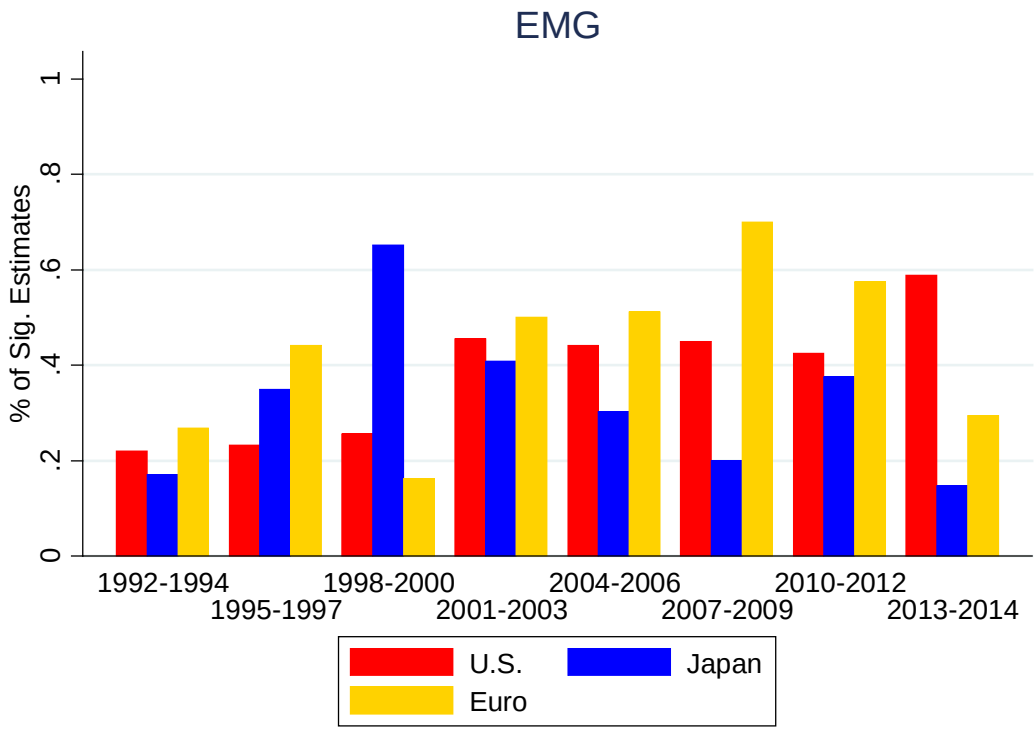


Figure 6: Shadow Policy Interest Rates of the CEs

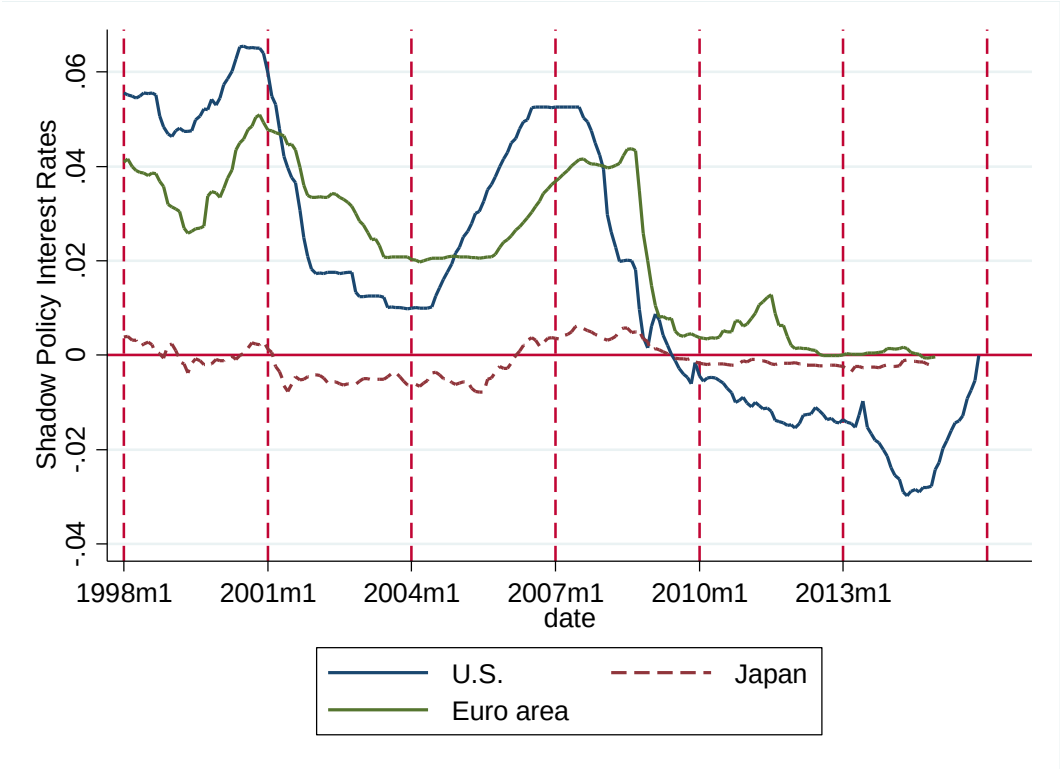
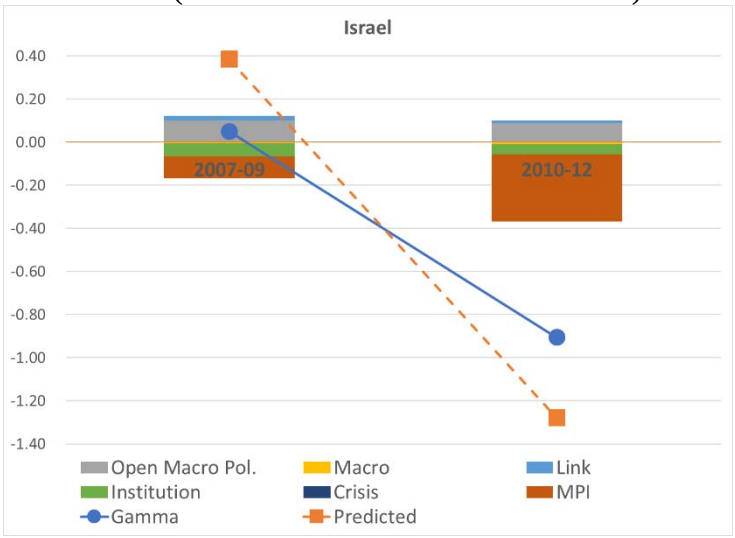
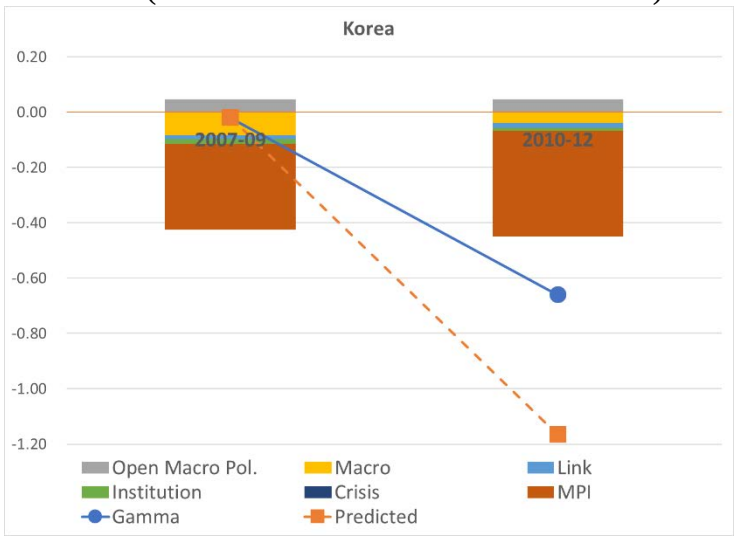


Figure 7: Estimated Contributions to the Gamma

Israel (MPI: 1 in 2007-09 → 3 in 2010-12)



Korea (MPI: 1.7 in 2007-09 → 3.0 in 2010-12)



Turkey (MPI: 2.3 in 2007-09 → 4.7 in 2010-12)