The Cost of Breaking an Exchange Rate Peg: Synthetic Control Estimation*

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This paper uses synthetic control estimation to measure the impact of switching exchange rate regimes from fixed to floating on sovereign credit risk. The study confirms the statistically significant short-term cost of breaking a peg. The results demonstrate that breaking the exchange rate peg incurs an increase in the average risk premium by 0.22–0.34 standard deviations for two to five months. The study also investigates peg-formation episodes and finds that switching the regime from floating to fixed and switching the regime from fixed to floating have asymmetric impacts on the country risk spread, and it confirms the hypothesis that investors consider breaking an exchange rate peg as breaking central bank's commitment to monetary stability.

JEL Codes: F3, F31, F41.

1. Introduction

In recent years, more developing countries have switched their exchange rate regimes from the fixed to the more flexible ones to motivate economic growth (Batini et al. 2006; Klein and Shambaugh 2008). Since the choice of exchange rate regime is one of the major

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international monetary policies constrained by the "trilemma" (Mundell 1963; Aizenman 2013; Popper, Mandilaras, and Bird 2013), it is crucial for central bankers to understand the benefits and costs of their exchange regime choice.

The current perspectives provided by the literature on the relationship between exchange rate regimes and economic welfare are contradictory. Levy-Yeyati and Sturzenegger (2003) find that fixed exchange rates are correlated with slower output growth rates and higher output volatility for the non-industrial countries. Jahjah, Wei, and Yue (2013) study how the choice of exchange rate regime affects the level of risk premium, and their study finds that the average country spread is 88 basis points lower in the countries under floating regimes than under fixed regimes. On the contrary, Alesina and Wagner (2006) find that switching exchange rate regimes from fixed to floating brings external costs into the economy. They investigate why countries employ different exchange rate regimes from their de jure regimes by studying the countries whose de jure and de facto exchange rate regimes do not match. The study concludes that breaking pegs may signal economic instability and that the financial market considers a wide exchange rate fluctuation as an indication of poor economic management. Their results show that switching exchange rate regimes from fixed to floating limits the effectiveness of interest rate or capital control policies. In addition, Aghion et al. (2009) find that exchange rate fluctuation may reduce firms' investment capacity and therefore lower the growth of the economy. On the other hand, while Ghosh, Gulde, and Wolf (2002) suggest a weak link between exchange rate regimes and real gross domestic product (GDP) growth, Harms and Kretschmann (2009) find that industrial countries benefit from flexible exchange rate fluctuations, and non-industrial countries may benefit more from implicit exchange rate stabilization.

Despite the vast literature on this subject, it is still challenging to quantify the trade-offs between regime choices because of the difficulty decoupling macroeconomic variables from the policy decisions of exchange rate intervention. The literature may benefit from a different approach to this subject. This paper investigates the impact of breaking the exchange rate peg on the country's risk premium using synthetic control estimation. More specifically, we investigate whether switching the exchange rate regime from fixed to floating in month T_0 leads to a higher country risk premium in the months T_i ($i > 0$), compared with similar countries which keep the exchange rates pegged. In order to construct the synthetic control unit, comparison countries are selected and weighted by an algorithm based on their similarity to the treated country before the treatment with respect to both the outcome variable (country risk premium) and other covariates (macroeconomic indicators, such as consumer price index (CPI), trade volumes, and foreign reserves). Following Alesina and Wagner (2006), we hypothesize that foreign investors interpret the breaking of exchange rate pegs as the central banks' loss in the ability to keep their commitment to stabilizing their markets. As suggested in Billmeier and Nannicini (2013), the benefit of the synthetic control approach is that a linear combination of untreated countries allows a "transparent" estimation of the counterfactual outcome of the treated country. The "transparent" estimation of the costs of breaking a peg should show a clearer picture of international monetary policy decisions.

The results of this study suggest that abandoning the fixed exchange rate regime incurs increases in the country's risk premium. The increase in the risk premium can be interpreted as the additional cost of abandoning the fixed exchange rate regime because it implies that the price of foreign loans becomes more expensive for local entrepreneurs, and as entrepreneurs become more financially constrained, the growth of the economy lingers. However, we also find that such impacts may be short-lived because the statistical significance of the estimates of impacts do not last longer than two to five months.

The remainder of this paper is organized as follows. Section 2 describes the empirical strategy; Section 2.1 offers a brief description of the synthetic control analysis; Section 2.2 illustrates the basis of coding of de facto exchange rate regime that is adopted in this study, and Section 2.3 provides a summary description of the data set. Section 3 provides and discusses the results of synthetic control estimation and the statistical inferences using placebo tests in Section 3.1 and average treatment effect estimation results in Section 3.2. Sections 3.3, 3.4, and 3.5 present the extended analyses that check the robustness of the results. Section 3.6 discusses a potential extension of the study, and Section 4 concludes.

2. Empirical Strategy

2.1 Synthetic Control Method

Standard cross-country estimators on macro data tend to suffer multiple endogeneity issues, especially when one uses those models to estimate the effect of macroeconomic policies or government interventions (Billmeier and Nannicini 2013). The difference-in-differences method provides a quasi-experimental design to obtain a counterfactual to estimate a causal effect of an intervention. However, the difference-in-differences method avoids the critique of the endogeneity issues only under the parallel trend assumption, which is rarely plausible in international panel data. The synthetic control method, developed in Abadie and Gardeazabal (2003) and extended in Abadie, Diamond, and Hainmueller (2010, 2015), provides an alternative approach in comparative event studies to alleviate such potential concerns. This method applies a vector of weights to a subset of the total pool of candidate control countries, which keep their exchange rate fixed, creating a synthetic (counterfactual) country whose characteristics closely match the treated country's before the treatment. It then compares the risk premium index trajectory of the treated country, which abandons the peg, with the estimated risk premium index of the synthetic control, which keeps the peg. It, therefore, captures the treatment effect of abandoning the policy of stable currency prices on the risk premium index.

We provide a description of the synthetic control method used in this study, following the notation of Abadie, Diamond, and Hainmueller (2010, 2015).[1] Of the $J + 1$ units (countries), the first unit switches its exchange rate regime from fixed to floating, while the J others (the units $j = 2$ to $j = J + 1$) keep their exchange rate fixed and are referred to as the control country candidates. For countries $j = 1, \ldots, J + 1$ and months $t = 1, \ldots, T$, let $T_0 - 1$ be the number of pre-breaking-peg months, with $1 < T_0 < T$, and we assume that the sample is a balanced panel. This study constructs a synthetic control using the 10 months of data before the month that

[1]For technical details of the methodology, see Appendix B of Abadie, Diamond, and Hainmueller (2010) and footnote 5 of Abadie, Diamond, and Hainmueller (2015).

the country abandons the exchange rate peg.[2] Then, we investigate the synthetic control's risk premium and its difference from the peg-breaking country's risk premium for 10 months after the peg breaks. That is, we set $T_0 = 11$ and $T = 21$.

We define a synthetic control as a weighted average of the units in the control candidates (the "donor pool"); a synthetic control can be represented by a $(J \times 1)$ vector of weights $W = (w_2, \ldots, w_{J+1})'$, with $0 \leq w_j \leq 1$ for $j = 2, \ldots, J+1$ and $\sum_{j=2}^{J+1} w_j = 1$. Let X_1 be a $(k \times 1)$ vector containing the values of treated country's characteristics before it breaks the peg, and let X_0 be the $k \times J$ matrix with the values of the same variables for the control country candidates.[3] The elements in X_1 and X_0 in this study are the monthly indicators from the Global Economic Monitor (GEM, the World Bank) to capture the conditions and characteristics of each country.[4] Then, the gap between values of characteristics variables of the treated country and the synthetic control is expressed as $X_1 - X_0 W$, and we select W^*, which minimizes this gap for each episode of abandoning exchange rate peg. In terms of weight selection, Abadie, Diamond, and Hainmueller (2015) suggest the following process. For $m = 1, \ldots, k$, let X_{1m} be the value of the m-th variable for the peg-breaking country and X_{0m} be a $1 \times J$ vector containing the values of the m-th variable for the control country candidates. Then, we choose W^* as the value of W that minimizes the root mean square prediction error (RMSPE),

$$\sum_{m=1}^{k} \left(X_{1m} - X_{0m} W\right)^2 . \qquad (1)$$

Then, let Y_{jt} be the outcome variable (the standardized country risk spread in this study) of country j at time t, and let Y_1 be a $(T_1 \times 1)$ vector of the post-breaking-peg values of the outcome

[2]De facto fixed exchange rate regime periods are identified using 10 months of consecutive low volatility in exchange rates; a detailed description is presented in Section 2.2.

[3]The pre-intervention characteristics in X_1 and X_0 may include pre-intervention values of the outcome variable (Abadie, Diamond, and Hainmueller 2010, 2015).

[4]A detailed description of the characteristics variables used in this study is presented in Section 2.3.

for the treated country: $Y_1 = (Y_{1\,T_0}, \ldots, Y_{1\,T})'$. Similarly, let Y_0 be a $(T_1 \times J)$ matrix, where column j contains the post-breaking-peg values of the outcome variable for unit $j + 1$. Then, the effect of switching regime (α_{1t}) for months $t \geq T_0$ is estimated as the difference between the predicted outcome of the synthetic control country and what is actually observed,

$$\hat{\alpha}_{1t} = Y_{1\,t} - \sum_{j=2}^{J+1} w_j^* Y_{j\,t}. \tag{2}$$

This study examines the 19 episodes of abandoning exchange rate pegs, which provide 19 series of $\hat{\alpha}_{1t}$ for $t \in [T_0,\ T]$. Then, we provide the average treatment effect estimates with statistical inferences whether the treatment effect is statistically different from zero for each t.

2.2 Identification of Regime-Switching Events

We identify monthly foreign exchange rate regime switches using a modified methodology of Klein and Shambaugh (2008). We classify a nominal exchange rate as “managed” if the month-end official bilateral exchange rate stays within a 2 percent band for 10 months, while pegs that last less than 10 months are classified as floating. Then, we confirm that these events align with the same regime switches specified in Klein and Shambaugh (2008);[5] our study uses this modified coding for identification at a monthly frequency, while Klein and Shambaugh (2008) provide regime classification at an annual frequency.

In order to check the robustness of results, our study also presents the results of investigating the episodes identified with a wider (2.5 percent) band in Section 3.3. This alternative method secures a larger number of control country candidates, while maintaining the statistical significance of de facto regimes. The quality of synthetic controls in terms of imitating the treated countries may depend on the size of the pool of control country candidates; a larger number of control candidates potentially raises the likelihood of finding a

[5] An updated exchange rate regime specification for 1960–2018 is provided by the author at https://iiep.gwu.edu/jay-c-shambaugh/data/.

better combination of control countries to construct the synthetic country that represents the treated country. Therefore, with a slight increase in the size of the band, we secure more control countries whose exchange rate regimes are fixed/managed during each study period and test whether the results are robust. One may argue that a country/period may be misclassified as fixed/managed simply due to a lack of shocks. However, according to Calvo and Reinhart (2002), the probability of having exchange rate volatility less than 2.5 percent within a month while having flexible exchange rates is between 60 percent and 70 percent. Therefore, the probability of having 10 consecutive months of exchange rate growth within a 2.5 percent band is estimated between 0.6 percent and 3 percent, which is still statistically insignificant.

2.3 Data

For the measure of sovereign credit risk, we use the J.P. Morgan Emerging Market Bond Index Global (EMBIG), a major index of emerging market economy sovereign bond spreads. The index is created as a benchmark reflecting returns from price gains and interest income on a "passive" portfolio of traded emerging markets debt. It is constructed as a composite of four markets: Brady bonds, Eurobonds, U.S. dollar local markets, and loans.

The index reflects country risk but is independent of exchange risk because the index presents the spread between the dollar-denominated bonds and the U.S. Treasury bill. For this reason, the index is often used in the sovereign risk literature (Kaminsky and Schmukler 2002; Gapen et al. 2008; Remolona, Scatigna, and Wu 2008; Hilscher and Nosbusch 2010), and it fits well for the purpose of this study; we intend to extract investors' sentiment from a country's exchange rate policy change on its sovereign risk, and it requires a measure that is highly correlated with sovereign risk and independent of (or less correlated with) exchange risk.[6] In other words, when central banks break exchange rate pegs by loosening (or

[6]In Section 3.5, we extend the study to investigate the episodes of peg formation and confirm the validity of the index for this study; the risk premium index does not show a systemic change during the period of more stable exchange rates, and the results imply that the EMBIG index is essentially independent of exchange risks.

losing) control over local-currency prices, unless investors consider volatile exchange rates a signal of economic instability, the index of synthetic controls will show the same trend as the index of the treated.

The data include 42 countries, of which J.P. Morgan reports the monthly risk premium index (EMBIG) from January 1998 to December 2015. Table 1 reports the list of countries and the summary statistics of EMBIG by country. The summary statistics indicate that the difference in level and variance of EMBIG among countries in the sample can be considerable. See, for example, two Latin American countries, Argentina and Chile. Argentina's average EMBIG is 1,518, while Chile's is 149.4. The standard deviation of EMBIG of Argentina is 1,811.1, while for Chile, the standard deviation is 56.6. Such difference may not be negligible because it causes potential estimation biases towards the countries with higher levels and variance of EMBIG. Due to this potential bias, we standardize EMBIG as follows:

$$\text{Std.EMBIG}_{c,t} = \frac{\text{EMBIG}_{c,t} - \hat{\mu}(\text{EMBIG})_c}{\hat{\sigma}(\text{EMBIG})_c}, \tag{3}$$

where $\text{EMBIG}_{c,t}$ is the EMBIG observation of country c at time t, $\hat{\mu}(\text{EMBIG})_c$ is the sample average of EMBIG of country c, and $\hat{\sigma}(\text{EMBIG})_c$ is the sample standard deviation of EMBIG of country c. Standardizing the units allows the construction of the synthetic control without losing much explanatory power to unit adjustments. The standardized measure is also useful for statistical inference; in Section 3.2, we combine the estimated treatment effects for statistical analysis, and it is essential to match the first and second moments of data to avoid estimation biases.

To set up a synthetic control framework, the following information is required for the country of interest as well as the control countries to construct its synthetic control: (i) a full set of EMBIG and (ii) a full set of predictor variables during the study period (10 months before and after the events). In addition, we exclude cases of economic (financial and currency) crisis; for example, we exclude the peg-breaking episodes during global crises, such as the 2007–09 subprime mortgage crisis, as well as during local crises, such as the

Table 1. Summary Statistics of EMBIG from January 1998 to December 2015

Country	Mean	SD	Min.	Max.
Algeria	826	424	304.4	2,306
Argentina	1,518	1,811.1	202.5	6,847
Belarus	717.3	284.8	266.7	1,582.3
Belize	1,028.3	454	383.4	2,427.7
Brazil	478.1	371.7	143.3	2,057.4
Bulgaria	341.9	276.7	43.1	1,365.9
Chile	149.4	56.6	54.9	383.1
Colombia	337.2	199.6	108.4	986
Côte d'Ivoire	1,551.7	1,050.3	297	3,407.8
Croatia	303.8	161.2	97.9	881.8
Dominican Rep.	492.4	299.6	138.9	1,709
Ecuador	1,146.7	844.9	354.4	4,416.2
Egypt	297.9	173.9	29.1	678.7
El Salvador	374	140.8	115.5	888.9
Gabon	461.3	213	225.7	1,215.3
Georgia	487.7	336.6	167.6	1,883.3
Ghana	591.6	249.2	321.1	1,572
Greece	103.3	22	57.3	152.6
Hungary	177.7	142.5	13.9	650.2
Indonesia	271.1	126.1	21.2	890.8
Iraq	582.1	202.1	20.2	1,239.4
Jamaica	522.3	175.1	276.6	1,120.8
Jordan	371	62.2	182.3	519.1
Kazakhstan	385.4	228.3	176.3	1,302.4
Korea	221.8	144.3	77.3	800.7
Malaysia	182.9	120	67.8	1,033.2
Mexico	268.3	138.7	97.6	944.1
Morocco	317.6	193.5	54.1	1,140.1
Nigeria	726.3	551.4	23.1	2,562.6
Pakistan	633.2	416.1	137.5	2,136.6
Panama	272	124.6	102.2	603.7
Peru	312.1	195.4	104	935.8
Philippines	298	169.7	82.8	937.3
Poland	145.4	78.7	39.5	344.9
Senegal	466.8	106.6	267.6	720.2
Sri Lanka	515.3	355.1	256.4	2,092.6
Thailand	153.5	120.3	41.9	722.8
Turkey	393.1	208.7	162.4	1,048.3
Ukraine	825.2	708.4	140.3	3,863
Uruguay	351.3	278.2	121.4	1,501.8
Venezuela	1,244.1	926.2	186.6	4,892.9
Vietnam	282.1	139.7	9.1	999.8

1998–2002 Argentine great depression, the Venezuelan banking crisis of 2009–10, etc.[7] During financial and currency crises, it is likely that the country's risk premium index fluctuates not just because of an exchange rate regime switch but because of other factors.[8] Since financial crises often lead to currency crises and vice versa (Mishkin 1999), including these cases may result in an overestimation of the effect of switching regimes (or, rather, of being "forced" to abandon the fixed regime), although the predictor variables of the synthetic controls may be able to control for such crises to some extent.

As a robustness check, we also present the estimation results excluding political upheavals in Section 3.4; political instability, which raises the country risk premium, may accompany a loss of control over exchange rates, resulting in an overestimation of the impact of breaking a peg.

Based on the criteria described above, 19 peg-breaking cases are identified and studied in the synthetic control framework. Each peg-breaking episode is listed in Table 2 with the following information: the treated country, the peg-breaking year and month, and the control country candidates, which are the countries that keep their exchange rate pegs during the study period of each case and are used to construct the synthetic control of the treated country. One may question if it is necessary to consider geological proximity or cultural/political similarity between the treated country and its control country candidates; however, such requirements are unnecessary in synthetic control studies. First, the synthetic control method finds the best combination out of the pool of candidates using their covariates to construct the synthetic control country. If, for example, one of the control country candidates is in a different continent from the one where the treated country is located and if such geological distance is the factor that makes the risk premium of the control country candidate behave differently from one of the treated countries, the control country candidate will not be used (given zero or

[7] Table A.1 in Appendix A lists the peg-breaking episodes that are excluded from estimation due to coincidence with economic crises.

[8] For example, a country may undergo a corruption scandal which may increase uncertainty (or any other event which may trigger capital outflow), contributing to an increase in the risk premium. We control for these events by assuming that these types of crises almost always go hand in hand with financial/currency crises.

Table 2. Nineteen Peg-Breaking Episodes and Corresponding Donor Pools

Country	Year	Month	Control Country Candidates
Peru	2001	July	Malaysia, Panama
Egypt	2005	February	Ecuador, El Salvador, Malaysia, Pakistan, Panama
Peru	2005	November	Ecuador, El Salvador, Malaysia, Pakistan, Panama, Philippines
Mexico	2006	April	Argentina, Ecuador, El Salvador, Pakistan, Panama, Philippines
Ecuador	2010	May	Belize, Dominican Republic, Egypt, El Salvador, Iraq, Panama, Sri Lanka, Vietnam
Ghana	2011	February	Argentina, Belize, Dominican Republic, Egypt, El Salvador, Iraq, Kazakhstan, Pakistan, Panama, Peru, Sri Lanka, Vietnam
Indonesia	2011	October	Argentina, Belize, Dominican Republic, Egypt, El Salvador, Iraq, Kazakhstan, Sri Lanka, Panama, Peru, Ukraine, Vietnam
Pakistan	2012	January	Argentina, Belize, Dominican Republic, Egypt, El Salvador, Iraq, Kazakhstan, Sri Lanka, Panama, Peru, Ukraine, Vietnam
Egypt	2013	February	Belize, Dominican Republic, Ecuador, El Salvador, Georgia, Iraq, Kazakhstan, Sri Lanka, Vietnam, Panama, Ukraine
Jamaica	2013	April	Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Kazakhstan, Jordan, Peru, Ukraine, Uruguay
Argentina	2013	August	Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Jordan, Panama, Sri Lanka, Vietnam
Indonesia	2013	September	Belarus, Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Jordan, Panama, Sri Lanka, Vietnam
Georgia	2014	January	Belarus, Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Panama, Sri Lanka, Vietnam
Kazakhstan	2014	March	Belarus, Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Panama, Sri Lanka, Vietnam
Pakistan	2014	April	Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Panama, Sri Lanka, Vietnam
Belarus	2015	February	Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Panama, Sri Lanka, Venezuela, Vietnam
Egypt	2015	March	Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Panama, Sri Lanka, Venezuela, Vietnam
Peru	2015	March	Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Panama, Sri Lanka, Venezuela, Vietnam
Philippines	2015	September	Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Panama, Sri Lanka, Vietnam

low weight) in synthetic control construction. Secondly, such filtering will limit the effectiveness of the method because it quickly lowers the number of control country candidates. For example, although there are 10 control country candidates in the case of Indonesia in September 2013, only 2 countries (Sri Lanka and Vietnam) are Asian countries.

The monthly indicators from the Global Economic Monitor (World Bank 2021a) are used as predictor variables to match and forecast the risk premium index. The indicators[9] include (i) consumer price index, (ii) import merchandise, (iii) export merchandise, (iv) stock market index, (v) months import cover of foreign reserves, (vi) industrial production, (vii) total reserves, and (viii) unemployment rate. Except for the unemployment rate, we use logged values for all variables.[10]

3. Results

In this section, we present and discuss the results of the experiments, highlighting specific cases. The results provide numerical

[9]The following data definition/description is from the Global Economic Monitor data set (World Bank 2021a): (i) Consumer price index: Data are in nominal terms and seasonally adjusted. (ii) Import merchandise: Merchandise (goods) imports, cost, insurance, and freight basis (c.i.f.), in constant US$ millions, seasonally adjusted. The base year is 2005. (iii) Export merchandise: Merchandise (goods) exports, free on board (f.o.b.), in constant US$ millions, seasonally adjusted. The base year is 2005. (iv) Stock market index: local equity market index in US$. (v) Months import cover of foreign reserves: The stock of international reserves is expressed as the number of months of financing coverage it represents for the given country's imports of merchandise goods. (vi) Industrial production: The output for the industrial sector of the economy. The industrial sector includes manufacturing, mining, and utilities. Data are in constant US$, seasonally adjusted. The base year is 2005. (vii) Total reserves: Total reserves comprise holdings of monetary gold, special drawing rights, reserves of International Monetary Fund members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. Data are in constant US$ millions. The base year is 2005. (viii) Unemployment rate: Data are in percent.

[10]One may notice that the imports, exports, industrial production, and total reserves are not scaled with the country's GDP or monetary base, which are not available for all countries at monthly frequency. Scaling the variables is not necessary for the prediction process in the synthetic control methodology because the synthetic control algorithm solves for a set of optimal country-specific weights using the combination of as well as controlling for available indicators that are highly correlated with GDP.

and graphical evidence that breaking a peg, in general, increases the country's risk premium and eventually induces additional costs that monetary authorities should consider.

We first present, in Table 3, the weights of the control countries selected to construct the synthetic control country in each case. As explained in Section 2.1, the control countries are weighted based on their similarity (by minimizing RMSPE) to the treated country before the treatment; the weighting algorithm uses both the outcome variable (country risk premium) and other covariates (macroeconomic indicators of GEM). For example, in the case of Ecuador in May 2010, the trend of the risk premium in Ecuador, before switching the exchange regime from fixed to floating, is best reproduced by a combination of the risk premium trends and covariates of the Dominican Republic (13.2 percent), Egypt (2.8 percent), Pakistan (17.9 percent), Panama (18.1 percent), and Vietnam (65.8 percent). Other control candidates (Belize, El Salvador, and Sri Lanka) are assigned zero weights.[11]

In Table 4, we present the numerical comparison of covariates between each treated country and the constructed synthetic control; the table reports the average values of predictors of the treated unit and the synthetic control unit. They show how closely the synthetic control country captures the characteristics of the treated country. Except for one case[12] of an unbalanced predictor, the average values of predictors of treated units and synthetic control units are overall balanced, and it indicates that the weights are well calibrated to construct the synthetic units that imitate the treated units.

Figure 1 reports the trends of standardized EMBIG of treated units (navy solid line) and synthetic control units (red dashed line) for all cases. The trends of the synthetic EMBIG (the counterfactual) closely track the trajectories of the trend of the "actual" EMBIG until the regime switches; during the period prior to the regime switch, the weights for the predictors from GEM of control candidates are calibrated to best match the trajectory of the treated

[11]The weights are selected through the permutation process of the synthetic control methodology. Therefore, the number of control countries receiving non-zero weights differs by case; for example, all nine control country candidates get non-zero weights in the case of Georgia (2014), while only one (of nine) control country candidate gets non-zero weights in the case of the Philippines (2015).

[12]1 of 65 predictors: Months Import Cover of Mexico (April 2006).

Table 3. Country Weights in Synthetic Countries

Case	Controls	Weight	Case	Controls	Weight	Case	Controls	Weight	Case	Controls	Weight
PER	MYS	100%	**GHA**	ARG	0%	**ARG**	BLZ	0%	**BLR**	BLZ	0%
Feb. 2005	PAN	0%	Feb. 2011	BLZ	0%	Aug. 2013	DOM	0%	Feb. 2015	DOM	0%
				DOM	15.3%		ECU	27.8%		ECU	49.7%
				EGY	12.1%		IRQ	6.9%		IRQ	0%
				SLV	0%		JOR	16.8%		LKA	0%
				IRQ	0%		LKA	0%		PAN	0%
				KAZ	0%		PAN	0%		SLV	0%
				LKA	72.7%		SLV	48.5%		VEN	50.3%
				PAK	0%		VNM	0%		VNM	0%
				PAN	0%						
				PER	0%						
				VNM	0%						
EGY	ECU	0%	**IDN**	ARG	85.8%	**IDN**	BLR	1.3%	**EGY**	BLZ	0%
Feb. 2005	SLV	0%	Oct. 2011	BLZ	0%	Sep. 2013	DOM	0%	Mar. 2015	DOM	0%
	MYS	0%		DOM	0%		ECU	0%		ECU	0%
	PAK	100%		EGY	0%		IRQ	80.6%		IRQ	41.1%
	PAN	0%		IRQ	0%		JOR	0%		LKA	0%
				KAZ	0%		LKA	17.2%		PAN	14.2%
				LKA	0%		PAN	0.9%		SLV	44.7%
				PAN	0%		SLV	0%		VEN	0%
				PER	0%		VNM	0%		VNM	0%
				SLV	0%						
				UKR	0%						
				VNM	14.2%						
PER	ECU	0%	**PAK**	ARG	0%	**GEO**	BLR	0.1%	**PER**	BLZ	0%
Nov. 2005	SLV	23.8%	Jan. 2012	BLZ	1.0%	Jan. 2014	BLZ	35.9%	Mar. 2015	DOM	0%
	MYS	0%		DOM	0%		DOM	0.9%		ECU	10.3%
	PAK	47.0%		EGY	49.6%		ECU	3.8%		IRQ	0%
	PAN	0%		IRQ	0%		IRQ	24.1%		LKA	0%
	PHL	29.2%		KAZ	0%		LKA	33.7%		PAN	0%
				LKA	0%		PAN	0.3%		SYL	0%
				PAN	0%		SYL	0.6%		VEN	89.7%
				PER	0%		VNM	0.6%		VNM	0%
				SLV	0%						
				UKR	49.4%						
				VNM	0%						

(*continued*)

Table 3. (Continued)

Case	Controls	Weight	Case	Controls	Weight	Case	Controls	Weight	Case	Controls	Weight
MEX	ARG	0%	**EGY**	BLZ	12.9%	**KAZ**	BLR	7.7%	**PHL**	BLZ	0%
Apr. 2006	ECU	0%	Feb. 2013	DOM	0%	Mar. 2014	BLZ	0%	Sep. 2015	DOM	0%
	SLV	0%		ECU	0%		DOM	17.5%		ECU	0%
	PAK	82.1%		GEO	0%		ECU	55.9%		IRQ	0%
	PAN	17.9%		IRQ	0%		IRQ	18.8%		LKA	100%
	PHL	0%		KAZ	0%		LKA	0%		PAK	0%
				LKA	0%		PAN	0%		PAN	0%
				PAN	0%		SLV	0%		SLV	0%
				SLV	0%		VNM	0%		VNM	0%
				UKR	87.1%						
				VNM	0%						
ECU	BLZ	0%	**JAM**	BLZ	8.8%	**PAK**	BLZ	2.3%			
May 2010	DOM	13.2%	Apr. 2013	DOM	0%	Apr. 2014	DOM	51.8%			
	EGY	2.8%		ECU	0%		ECU	0%			
	SLV	0%		IRQ	0%		IRQ	0%			
	PAK	17.9%		KAZ	87.8%		LKA	0%			
	PAN	18.1%		JOR	0%		PAN	39.0%			
	LKA	0%		LKA	0%		SLV	0%			
	VNM	65.8%		PAN	0%		VNM	6.9%			
				SLV	0%						
				UKR	3.4%						
				VNM	0%						

Note: ISO Alpha-3 country codes are used to indicate country names in this table: Algeria (DZA), Argentina (ARG), Belarus (BLR), Belize (BLZ), Brazil (BRA), Bulgaria (BGR), Chile (CHL), Colombia (COL), Côte d'Ivoire (CIV), Croatia (HRV), Dominican Republic (DOM), Ecuador (ECU), Egypt (EGY), El Salvador (SLV), Gabon (GAB), Georgia (GEO), Ghana (GHA), Greece (GRC), Hungary (HUN), Indonesia (IDN), Iraq (IRQ), Jamaica (JAM), Jordan (JOR), Kazakhstan (KAZ), Korea (KOR), Malaysia (MYS), Mexico (MEX), Morocco (MAR), Nigeria (NGA), Pakistan (PAK), Panama (PAN), Peru (PER), Philippines (PHL), Poland (POL), Senegal (SEN), Sri Lanka (LKA), Thailand (THA), Turkey (TUR), Ukraine (UKR), Uruguay (URY), Venezuela (VEN), Vietnam (VNM).

Table 4. Predictor Balance in Synthetic Country Construction

	Treated	Synthetic		Treated	Synthetic		Treated	Synthetic
Peru, Jul. 2001			**Pakistan, Jan. 2012**			**Pakistan, Apr. 2014**		
Imports Merchandise	6.929	5.859	Exports Merchandise	7.624	8.392	Consumer Price Index	4.972	4.867
Exports Merchandise	6.367	7.320	Months Import Cover	1.589	0.993	Exports Merchandise	7.666	7.666
Months Import Cover	2.654	1.225	Total Reserves	9.805	9.795	Total Reserves	9.013	9.013
Total Reserves	9.085	6.829	**RMSPE**		0.112	**RMSPE**		0.079
RMSPE		0.265						
Egypt, Feb. 2005			**Egypt, Feb. 2013**			**Belarus, Feb. 2015**		
Consumer Price Index	4.066	4.027	Consumer Price Index	4.822	4.873	Consumer Price Index	5.906	5.425
Imports Merchandise	7.258	7.564	Months Import Cover	0.907	0.801	Exports Merchandise	7.941	6.551
Exports Merchandise	6.499	7.002	Total Reserves	9.617	9.439	Total Reserves	8.323	9.345
Months Import Cover	2.561	2.047	**RMSPE**		0.297	**RMSPE**		0.374
Total Reserves	9.609	9.399						
RMSPE		0.238						
Peru, Nov. 2005			**Jamaica, Apr. 2013**			**Egypt, Mar. 2015**		
Consumer Price Index	4.474	4.247	Consumer Price Index	4.822	4.725	Consumer Price Index	5.025	4.773
Imports Merchandise	7.169	7.651	Exports Merchandise	4.995	6.360	Exports Merchandise	7.636	7.638
Exports Merchandise	7.218	7.084	Months Import Cover	0.763	1.701	Total Reserves	9.702	9.619
Months Import Cover	2.635	1.551	Total Reserves	7.063	8.992	**RMSPE**		0.228
Total Reserves	9.523	9.037	**RMSPE**		0.094			
RMSPE		0.162						

(*continued*)

Table 4. (Continued)

	Treated	Synthetic		Treated	Synthetic		Treated	Synthetic
Mexico, Apr. 2006			**Argentina, Aug. 2013**			**Peru, Mar. 2015**		
Imports Merchandise	10.022	8.000	Exports Merchandise	8.810	8.129	Consumer Price Index	4.750	4.799
Exports Merchandise	9.858	7.392	Months Import Cover	1.897	1.739	Exports Merchandise	8.058	7.344
Months Import Cover	−1.169	1.585	Total Reserves	10.620	9.637	Total Reserves	11.293	8.308
Total Reserves	8.708	9.430	**RMSPE**		0.064	**RMSPE**		0.062
RMSPE		0.048						
Ecuador, May 2010			**Indonesia, Sept. 2013**			**Philippines, Sept.**		
Consumer Price Index	4.596	4.592	Consumer Price Index	4.763	4.763	**2015**	4.778	4.801
Exports Merchandise	7.221	7.365	Imports Merchandise	9.669	8.123	Consumer Price Index	8.514	7.216
Months Import Cover	1.068	1.241	Exports Merchandise	9.628	8.642	Exports Merchandise	9.628	8.777
Total Reserves	8.314	8.305	Months Import Cover	1.891	2.363	Total Reserves		0.426
RMSPE		0.126	Total Reserves	11.559	10.506	**RMSPE**		
			RMSPE		0.250			
Ghana, Feb. 2011			**Georgia, Jan. 2014**					
Exports Merchandise	6.574	7.138	Consumer Price Index	4.722	4.722			
Months Import Cover	1.255	1.277	Total Reserves	8.010	8.009			
Total Reserves	8.220	8.229	**RMSPE**		0.128			
RMSPE		0.068						
Indonesia, Oct. 2011			**Kazakhstan, Mar.**					
Exports Merchandise	9.723	8.825	**2014**	4.833	4.828			
Months Import Cover	2.038	1.916	Consumer Price Index	8.867	7.715			
Total Reserves	11.592	10.665	Exports Merchandise	10.137	8.871			
RMSPE		0.071	Total Reserves		0.058			
			RMSPE					

Figure 1. Trends of Standardized EMBIG of Treated Country (solid line) vs. Synthetic Control (dashed line)

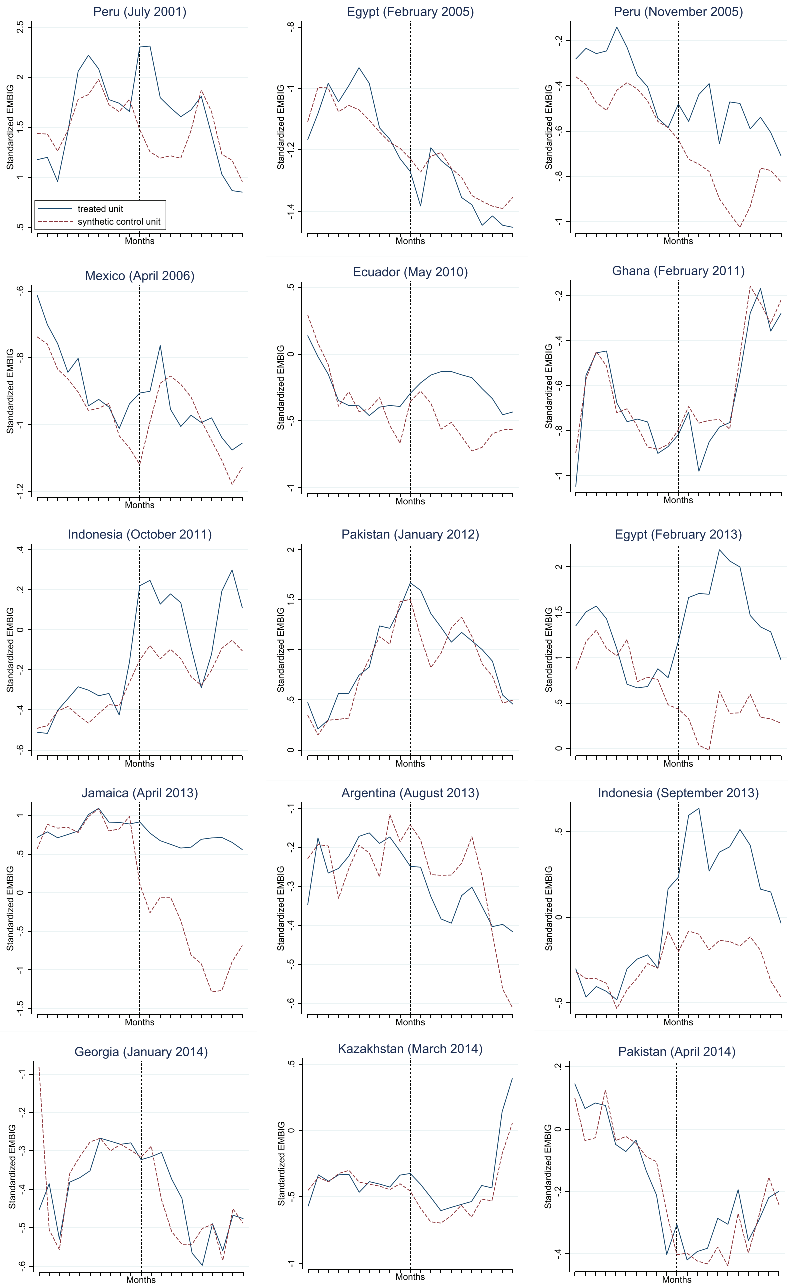

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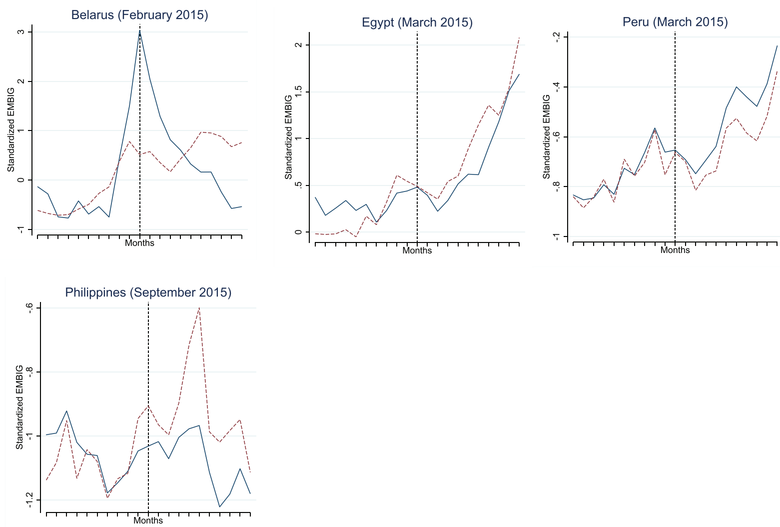
Figure 1. (Continued)



country's risk premium by minimizing RMSPE. The estimated cost of abandoning stable exchange rates ($\hat{\alpha}_t$) is represented by the difference between the standardized EMBIG of the treated unit and the synthetic control unit after switching its exchange rate regime from fixed to floating.

Overall, the results support the hypothesis that abandoning a regime of stable exchange rates increases the country's risk premium; in other words, the cost of breaking a peg exists and is estimated to be positive. In most cases, the standardized EMBIG of the treated countries (the solid lines) start deviating positively from the synthetic controls (the dashed lines) around the times when exchange rates start floating: Peru (2001), Peru (2005), Mexico (2006), Ecuador (2010), Indonesia (2011), Pakistan (2012), Egypt (2013), Jamaica (2013), Indonesia (2013), Georgia (2014), Kazakhstan (2014), Pakistan (2014), Belarus (2015), and Peru (2015). These cases suggest that if the country kept its exchange rate fixed, it would have maintained a lower risk premium compared with the actual risk premium. In two cases, Egypt (2015) and the Philippines (2015), the treated country's risk premium decreases more than the synthetic control country's risk premium. In three cases—Egypt

(2005), Ghana (2011), and Argentina (2013)—switching regimes does not seem to affect sovereign risk because the trajectories of solid and dashed lines do not deviate from each other in the sample periods.

In some cases, the deviation between a treated unit and a synthetic control unit seems to start before (one to two months) the regime switch occurs: for example, Ecuador (2010), Egypt (2013), Indonesia (2013), and Belarus (2015). This can be explained by the limitation of investigating monthly averages of higher-frequency observations. Exchange rates are updated every second of every day, and their monthly average is the average of these values within a month. If the central bank switches its regime from fixed to floating in the second half of January, the exchange rates in January are averaged out, and currency price volatility may show up only in February, even though the regime was switched in January. Therefore, the risk premium index seems to deviate earlier than expected because the market reacts to higher-frequency information.

3.1 Inference from Placebo Tests

Following the literature (Abadie and Gardeazabal 2003; Abadie, Diamond, and Hainmueller 2010), we evaluate the statistical significance of our estimates through placebo tests. The placebo test demonstrates that the treatment effect is statistically not different from zero when it "should not" exist. The placebo studies are performed by applying the synthetic control method to the control countries. Since the countries in the control group did not switch their regimes, we "should not" observe any systematic change in the trends of their risk premium index. We expect the following if the synthetic control method successfully captures the effect of switching regimes in the treated countries: (i) the estimated α_{1t} of both the treated and control country stay at zero before switching regimes, and (ii) after the exchange rate regime is switched in the treated country, the estimated α_{1t} of the treated country shows a sudden increase, while the estimated α_{1t} of the control countries should remain statistically equivalent to zero or follow a random walk.

Figure 2 provides the placebo test results, and they support our hypothesis. We present the trajectory of the estimated α_{1t} for the treated country which switched its regime from fixed to floating

Figure 2. Trends of Estimated Treatment Effect (orange line) vs. Placebo Effect (gray line)

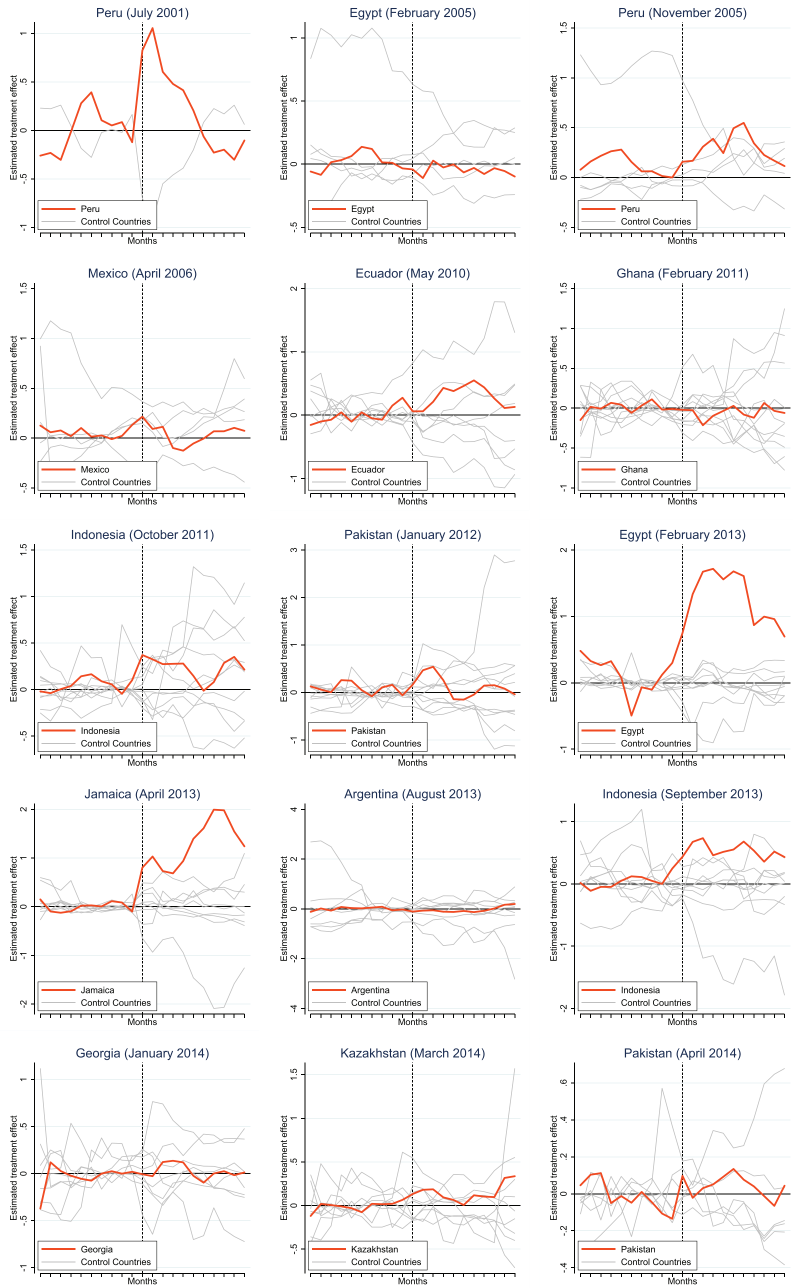


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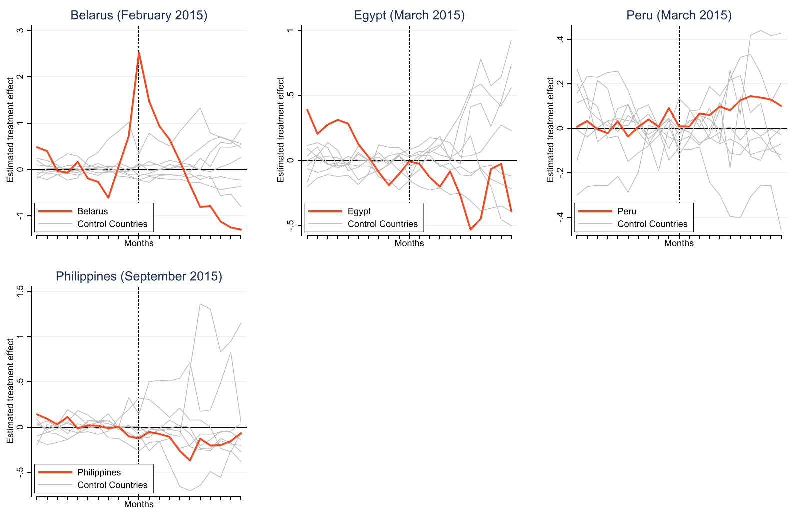
Figure 2. (Continued)



(orange/darker line) and the trajectories of the control countries which maintained their fixed regimes (gray/lighter line). Most of them show that the treated countries' estimated α_{1t} start deviating from zero or follow a hump-shaped pattern after the events, while the ones for control countries do not follow this stylized pattern. These patternless gray lines indicate that the synthetic control estimation in this study does not systematically create or capture a false treatment effect. However, it is also worth noting that the placebo test does not directly infer that the treatment effect on the treated country is statistically different from zero, either. In the following section, we address this issue using a classical statistical inference method.

3.2 Inference from Average Treatment Effect Estimates

Despite its clear intuition, questions have been raised on the reliability of statistical inference in placebo tests. Most synthetic control studies, including Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010), examine the treatment effect on one treated unit. Since it creates an estimated trend of time series for only one unit, there are not enough samples to provide statistical significance. Therefore, the best way to show this effect in such studies is through permutation exercises, which demonstrate that this effect is not observable in control units, that is, placebo tests. However, several studies argue that placebo tests in synthetic control analyses may be misleading. For example, Hahn and Shi (2017) show by using a data-generating process (DGP) that placebo tests may fail to provide proper statistical inference when a pre-estimation is made on the observations with size distortions. On the other hand, Ferman and Pinto (2017) present examples that placebo tests can have size distortions even when they consider an infeasible synthetic control estimator that correctly reconstructs the factor loadings of the treated unit.

Therefore, in order to avoid the potential issues in placebo tests discussed above and complement our findings, we present "classical" estimates of the treatment effect as well. Specifically, we find the mean of treatment effect estimates for a given t of all cases:

$$\hat{\hat{\alpha}}_{1t} = \frac{1}{n} \sum_{i=1}^{n} \hat{\alpha}_{1it}, \qquad (4)$$

where $\hat{\alpha}_{1it}$ denotes the treatment effect estimate of country i at time t and n denotes the number of cases. Since we examine multiple cases ($n = 19$) of treatment effect and also use a standardized measure of EMBIG—as shown in Equation (3)—for all treated and control countries, combining these results allows us to estimate the average treatment effect and obtain the standard errors of the estimates without estimation bias from the significant differences in the first and second moments of the index among countries. The average effect of switching regimes is summarized in Figure 3 and Table 5. The estimates show that the effect of breaking an exchange rate peg on a country's risk premium is positive and statistically significant. Figure 3 shows that the treatment effect estimates are statistically significant for two to five months after switching its exchange rate regime (two months with 99 percent confidence intervals and five months with 95 percent confidence intervals); in magnitude, EMBIG rises by 0.3203–0.3439 standard deviations with 99 percent confidence intervals (0.2164–0.3439 standard deviations with 95 percent confidence intervals).

Figure 3. Average Treatment Effect Estimates $\hat{\hat{\alpha}}_{1t}$ and Statistical Significance Over Time

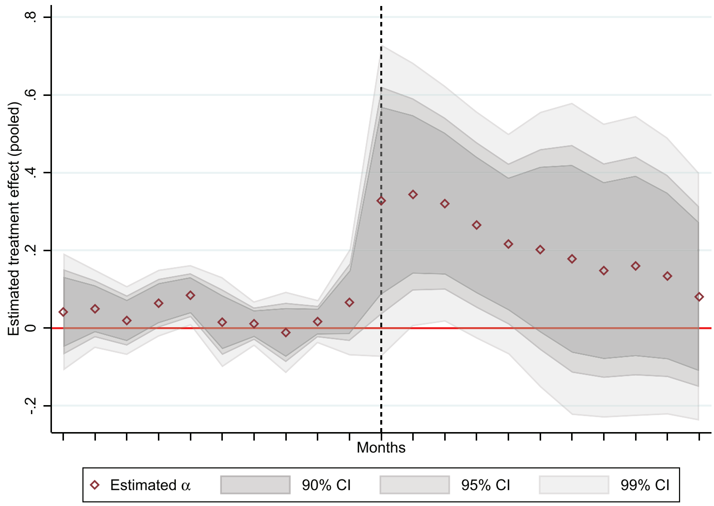


Table 5. Estimated Treatment Effect and Statistical Significance Over Time (p-values are calculated for the hypotheses set of $H_0 : \alpha_{1t} = 0$ and $H_1 : \alpha_{1t} \neq 0$)

Before Switching			After Switching		
t	$\hat{\hat{\alpha}}_{1t}$	p-value	t	$\hat{\hat{\alpha}}_{1t}$	p-value
1	0.0415	0.4403	T_0	0.3278**	0.0307
2	0.0497	0.1746	T_1	0.3439***	0.0092
3	0.0196	0.5355	T_2	0.3203***	0.0072
4	0.0641**	0.0471	T_3	0.2654**	0.0178
5	0.0845***	0.0060	T_4	0.2164**	0.0419
6	0.0152	0.7107	T_5	0.2020	0.1186
7	0.0113	0.5811	T_6	0.1782	0.2180
8	−0.0113	0.7602	T_7	0.1480	0.2755
9	0.0168	0.4007	T_8	0.1599	0.2490
10	0.0662	0.1808	T_9	0.1340	0.2940
			T	0.0806	0.4764

Note: *** indicates 99 percent significance level; ** indicates 95 percent significance level; * indicates 90 percent significance level.

3.3 Robustness Check: Alternative de facto Fixed Regime Specification

In this section, we use a slightly wider band (2.5 percent) than the one used in Klein and Shambaugh (2008) to identify the events and treated/control countries. As explained in Section 2.2, the 2.5 percent bands potentially secure a larger pool of control units while keeping the validity of the band, so the probability of having 10 consecutive months of spurious pegs within the band becomes statistically insignificant.

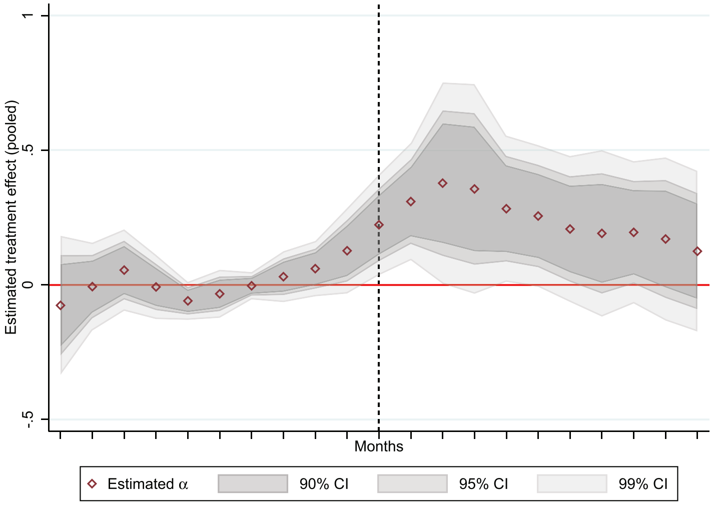
Table 6 lists the 16 identified cases and corresponding control country candidates. 2.5 percent bands identify fewer peg-breaking cases but allow more control country candidates per case. This is because while 2 percent bands identify more periods as de facto floating regime periods, they identify more periods as de facto fixed regime periods. This also explains why different peg-breaking events are identified under different sizes of bands, except for the cases of Mexico (2006), Pakistan (2012), and Indonesia (2013). For example, the case of Peru (2001) is considered a regime-switching case under a 2 percent band but not with a 2.5 percent band, and the case of Korea (2003) is identified with a 2.5 percent band but not with a 2 percent band; the Peru (2001) case is not identified as a regime-switching episode under a 2.5 percent band because the entire study period (September 2000–May 2002) is identified as a period of fixed regime due to the wider band, and the Korea (2003) case is not identified as a peg-breaking episode under a 2 percent band because the entire period (April 2002–December 2003) is classified as floating regime months due to the narrower band. Tables 14 and 15 in Appendix B report the weights of control countries to construct the synthetic control countries and the balance of covariates.

The analysis results using these episodes identified with the alternative de facto regime specification do not deviate much from the previous results and reconfirm the hypothesis that breaking the exchange rate peg has statistically significant impacts on the risk premium. The standardized EMBIG of the treated countries deviate positively from the synthetic controls after the exchange rate pegs are broken: Philippines (2000), Korea (2003), Argentina (2003), Bulgaria (2003), Hungary (2005), Poland (2005), Mexico (2006), Belarus (2011), Uruguay (2011), Mexico (2011), Pakistan (2012),

Table 6. Sixteen Peg-Breaking Episodes Identified with 2.5 Percent Bands

Country	Year	Month	Control Country Candidates
Mexico	1999	September	Argentina, Malaysia, Morocco, Panama, Peru, Venezuela
Philippines	2000	August	Argentina, Colombia, Ecuador, Malaysia, Panama, Peru
Korea	2003	February	Bulgaria, Côte d'Ivoire, Croatia, Ecuador, El Salvador, Hungary, Malaysia, Morocco, Philippines, Panama, Peru, Thailand, Ukraine, Poland
Argentina	2003	August	Colombia, Chile, Côte d'Ivoire, Croatia, Ecuador, El Salvador, Indonesia, Malaysia, Morocco, Philippines, Panama, Peru, Thailand, Ukraine
Bulgaria	2003	August	Côte d'Ivoire, Croatia, Ecuador, El Salvador, Malaysia, Morocco, Philippines, Panama, Peru, Thailand, Ukraine
Chile	2004	May	Côte d'Ivoire, Ecuador, Egypt, El Salvador, Hungary, Malaysia, Morocco, Philippines, Peru, Ukraine
Hungary	2005	February	Ecuador, Egypt, El Salvador, Malaysia, Mexico, Nigeria, Philippines, Peru, Ukraine, Uruguay
Poland	2005	May	Argentina, Colombia, Ecuador, Egypt, El Salvador, Indonesia, Malaysia, Mexico, Nigeria, Pakistan, Philippines, Peru, Ukraine, Uruguay
Mexico	2006	April	Argentina, Bulgaria, Côte d'Ivoire, Ecuador, Egypt, El Salvador, Malaysia, Morocco, Nigeria, Pakistan, Philippines, Peru, Ukraine, Uruguay, Venezuela
Belarus	2011	July	Argentina, Belize, Dominican Republic, Ecuador, Egypt, El Salvador, Iraq, Jamaica, Kazakhstan, Sri Lanka, Philippines, Peru, Ukraine
Uruguay	2011	September	Argentina, Belize, Dominican Republic, Ecuador, Egypt, El Salvador, Georgia, Iraq, Jamaica, Kazakhstan, Jordan, Nigeria, Philippines, Peru, Ukraine, Venezuela
Malaysia	2011	September	Argentina, Belize, Dominican Republic, Ecuador, Egypt, El Salvador, Georgia, Iraq, Jamaica, Kazakhstan, Jordan, Nigeria, Philippines, Peru, Ukraine, Venezuela
Mexico	2011	September	Argentina, Belize, Dominican Republic, Ecuador, Egypt, El Salvador, Georgia, Iraq, Jamaica, Kazakhstan, Jordan, Nigeria, Philippines, Peru, Ukraine, Venezuela
Pakistan	2012	January	Argentina, Belize, Dominican Republic, Ecuador, Egypt, El Salvador, Georgia, Iraq, Jamaica, Kazakhstan, Jordan, Nigeria, Philippines, Peru, Ukraine, Venezuela
Turkey	2013	June	Dominican Republic, Ecuador, El Salvador, Iraq, Kazakhstan, Jordan, Nigeria, Pakistan, Sri Lanka, Ukraine, Vietnam
Indonesia	2013	September	Belarus, Belize, Dominican Republic, Ecuador, El Salvador, Iraq, Jordan, Nigeria, Pakistan, Panama, Sri Lanka, Vietnam

Figure 4. Average Treatment Effect Estimates $\hat{\hat{\alpha}}_{1t}$ and Statistical Significance Over Time: Peg-Breaking Episodes Identified with 2.5 Percent Bands



Turkey (2013), and Indonesia (2013). In one case, Chile (2004), the treated country's risk premium decreases more than the synthetic control country's risk premium. In two cases, Mexico (1999) and Malaysia (2011), it does not show either positive or negative treatment effects of breaking pegs.

Figure 4 and Table 7 report the average treatment effect estimates and statistical significance over time.[13] The results mirror those in Section 3.2. The magnitude of the increase in risk premium due to peg abandonment is estimated to be 0.2129–0.3246 standard deviations with a significance level of 99 percent and 0.2010–0.3518

[13]Figure C.1 and Table C.1 in Appendix C present the combined treatment effect estimates using 32 cases (19 cases identified using 2 percent bands and 13 cases (16 cases netting the 3 overlapping cases) identified with 2.5 percent bands). Due to the larger size of treatment effect estimates, the widths of confidence intervals are generally narrower. Therefore, the results indicate that the treatment effect estimates are statistically significant in relatively longer periods after abandoning the exchange rate pegs: four to six months with 95–99 percent significance levels.

Table 7. Average Treatment Effect Estimates $\hat{\hat{\alpha}}_{1t}$ and Statistical Significance Over Time: Peg-Breaking Episodes Identified with 2.5 Percent Bands

Before Switching			After Switching		
t	$\hat{\hat{\alpha}}_{1t}$	p-value	t	$\hat{\hat{\alpha}}_{1t}$	p-value
1	−0.0838	0.3873	T_0	0.2129***	0.0002
2	−0.0123	0.8326	T_1	0.3134***	0.0003
3	0.0456	0.3900	T_2	0.3246***	0.0005
4	0.0024	0.9527	T_3	0.3518**	0.0155
5	−0.0274	0.2625	T_4	0.3104**	0.0266
6	−0.0325	0.3099	T_5	0.2789**	0.0180
7	−0.0299	0.3747	T_6	0.2054**	0.0402
8	0.0090	0.7031	T_7	0.2010*	0.0599
9	0.0635**	0.0464	T_8	0.1523	0.1595
10	0.1066***	0.0054	T_9	0.1417	0.2094
			T	0.1191	0.2585

Note: p-values are calculated for the hypotheses set of $H_0 : \alpha_{1t} = 0$ and $H_1 : \alpha_{1t} \neq 0$. *** indicates 99 percent significance level; ** indicates 95 percent significance level; * indicates 90 percent significance level.

standard deviations with a significance level of 95 percent. The duration of impact is estimated to be from three (99 percent significance level) to seven (95 percent significance level) months.

3.4 Robustness Check: Political Instability

In the previous sections, the peg-breaking episodes that coincide with economic crises were excluded in the estimation of treatment effects because including such cases in the study would have exaggerated the movement of the risk premium index and would result in estimation bias. Political crises may result in similar estimation bias because political instability deters foreign investment in those countries and consequently raises (or amplifies the increase in) the risk premium. If the exchange rate pegs were broken during a period of political turmoil, including such cases in the study potentially results in overestimation of the impact of abandoning the exchange rate peg. In this section, we identify the peg-breaking cases that coincided with political upheavals and provide estimation results excluding those cases.

In order to identify political upheavals, we use the annual political stability index from the Worldwide Governance Indicators (WGI)[14] by the World Bank (2021b). The index measures the perception of the likelihood of political instability in each country. Therefore, the index is well suited to reflect the (local and foreign) investors' sentiment on a country's political stability. As we did with the EMBIG index in (3), we standardize the political stability index to account for country heterogeneity as follows:

$$\text{Std.WGI}_{c,t} = \frac{\text{WGI}_{c,t} - \hat{\mu}(\text{WGI})_c}{\hat{\sigma}(\text{WGI})_c}, \tag{5}$$

where $\text{WGI}_{c,t}$ is the WGI political stability index observation of country c in year t, $\hat{\mu}(\text{WGI})_c$ is the sample average of index of country c, and $\hat{\sigma}(\text{EMBIG})_c$ is the sample standard deviation of index of country c. This standardized index indicates how many standard deviations the country is away from its average level of political stability in year t.

Table 8 presents the standardized political stability index of the year when each country broke their pegs. If the political stability index shows a significant (over one standard deviation[15]) decrease from its average, we assume that the country experienced an extreme political upheaval, which can potentially bias the estimation of risk premium changes during the period; we indicate these cases with the asterisk sign ($*$) in Table 8.

The estimation results excluding these cases show that the main thesis of the study persists. Figures 5 and 6 and Tables 9 and 10 show that the treatment effect remains statistically significant; breaking the exchange rate pegs incurs an increase of 0.2172 to 0.3280

[14] WGI reports six indices to measure aggregate and individual governance for over 200 countries and territories over the period 1996–2019: (i) Voice and Accountability, (ii) Regulatory Quality, (iii) Political Stability and Absence of Violence, (iv) Rule of Law, (v) Government Effectiveness, and (vi) Control of Corruption. In this study, we use (iii) Political Stability and Absence of Violence.

[15] Pakistan's (2012) case is sorted as a political upheaval because the index is almost one standard deviation (0.98 standard deviation) lower than the average.

Table 8. Standardized Political Stability Index in Years of All Cases

Country	Year	Std. WGI
A. Episodes Identified with 2 Percent Bands		
Peru	2001	−0.70
Egypt	2005	0.55
Peru	2005	−0.70
Mexico	2006	−0.21
Ecuador	2010	−0.26
Ghana	2011	1.41
Indonesia	2011	0.49
Pakistan	2012	−0.98*
Egypt	2013	−1.42*
Jamaica	2013	0.76
Argentina	2013	0.53
Indonesia	2013	0.93
Georgia	2014	1.20
Kazakhstan	2014	−0.23
Pakistan	2014	−0.49
Belarus	2015	−0.45
Egypt	2015	−1.14*
Peru	2015	1.06
Philippines	2015	0.85
B. Episodes Identified with 2.5 Percent Bands		
Mexico	1999	0.66
Philippines	2000	−0.40
Korea	2003	−0.88
Argentina	2003	−1.16*
Bulgaria	2003	−0.56
Chile	2004	0.77
Hungary	2005	0.84
Poland	2005	−1.23*
Mexico	2006	−0.21
Belarus	2011	−1.42*
Uruguay	2011	0.67
Malaysia	2011	−0.72
Mexico	2011	−0.33
Pakistan	2012	−0.98*
Turkey	2013	−0.43
Indonesia	2013	0.93

Note: The cases that are considered to coincide with political upheavals are indicated with *.

Figure 5. Average Treatment Effect Estimates $\hat{\hat{\alpha}}_{1t}$ and Statistical Significance Over Time: Excluding Political Crises Cases

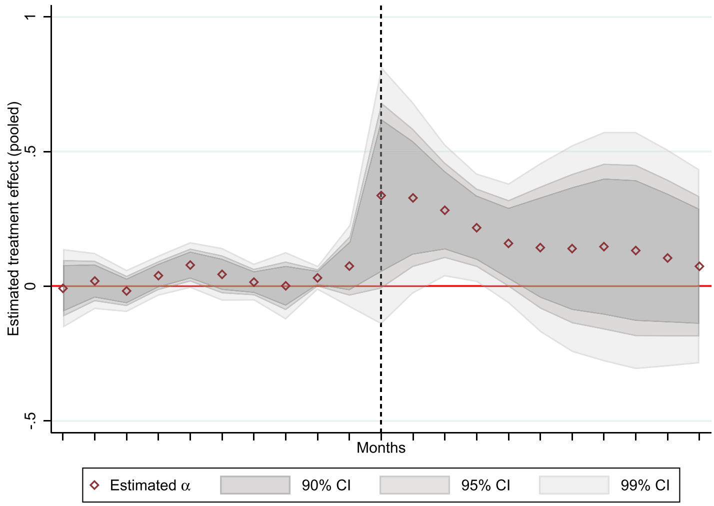


Figure 6. Average Treatment Effect Estimates $\hat{\hat{\alpha}}_{1t}$ and Statistical Significance Over Time: Peg-Breaking Episodes Identified with 2.5 Percent Bands, Excluding Political Crises Cases

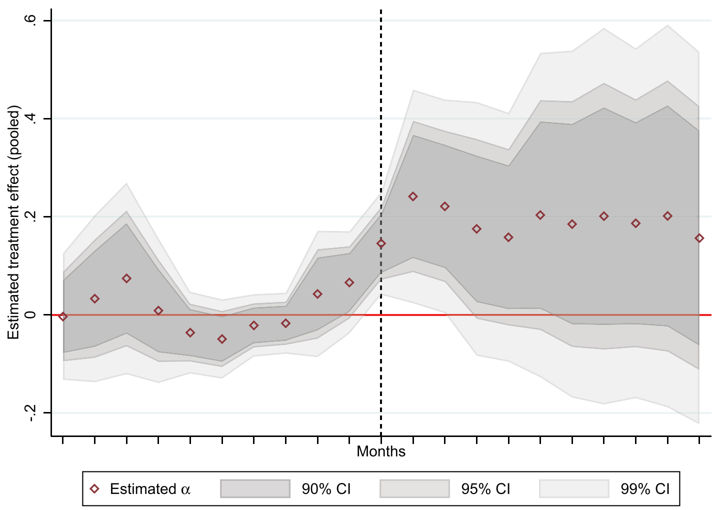


Table 9. Estimated Treatment Effect and Statistical Significance Over Time: Excluding Political Crises Cases

Before Switching			After Switching		
t	$\hat{\hat{\alpha}}_{1t}$	p-value	t	$\hat{\hat{\alpha}}_{1t}$	p-value
1	−0.0079	0.8760	T_0	0.3369*	0.0558
2	0.0193	0.5954	T_1	0.3280**	0.0159
3	−0.0175	0.5226	T_2	0.2820***	0.0042
4	0.0394	0.1437	T_3	0.2172***	0.0064
5	0.0786**	0.0164	T_4	0.1591*	0.0531
6	0.0441	0.2075	T_5	0.1434	0.1988
7	0.0153	0.5235	T_6	0.1397	0.3011
8	0.0014	0.9735	T_7	0.1470	0.3259
9	0.0310*	0.0628	T_8	0.1326	0.3894
10	0.0748	0.1701	T_9	0.1049	0.4553
			T	0.0739	0.5550

Note: *** indicates 99 percent significance level; ** indicates 95 percent significance level; * indicates 90 percent significance level.

Table 10. Estimated Treatment Effect and Statistical Significance Over Time: Peg-Breaking Episodes Identified with 2.5 Percent Bands, Excluding Political Crises Cases

Before Switching			After Switching		
t	$\hat{\hat{\alpha}}_{1t}$	p-value	t	$\hat{\hat{\alpha}}_{1t}$	p-value
1	−0.0035	0.9339	T_0	0.1456***	0.0013
2	0.0330	0.5606	T_1	0.2414***	0.0055
3	0.0743	0.2635	T_2	0.2212***	0.0092
4	0.0086	0.8595	T_3	0.1753*	0.0594
5	−0.0363	0.2048	T_4	0.1581*	0.0794
6	−0.0493*	0.0850	T_5	0.2034*	0.0827
7	−0.0216	0.3158	T_6	0.1850	0.1329
8	−0.0172	0.4109	T_7	0.2012	0.1321
9	0.0426	0.3278	T_8	0.1867	0.1326
10	0.0659*	0.0760	T_9	0.2017	0.1370
			T	0.1564	0.2274

Note: *** indicates 99 percent significance level; ** indicates 95 percent significance level; * indicates 90 percent significance level.

standard deviations[16] in the country risk spread (95–99 percent significance levels), and the estimated treatment effects are statistically positive for two to three months.[17] Although the duration of treatment effect may seem to decrease, the decrease is potentially due to the widened confidence intervals from the decrease in number of samples by excluding three to four cases; Figures 5 and 6 show that the estimated treatment effects still “jump” and stay positive after the exchange rate pegs are broken, as we have seen in Figure 3.

3.5 Robustness Check: Peg Formation

The study hypothesizes that investors may interpret breaking exchange rate pegs as the central banks’ loss in the ability to keep their commitment to monetary stability. In order to bolster the hypothesis, this section investigates episodes of exchange rate peg formation. Based on the hypothesis, switching regime from fixed to floating and floating to fixed should have an asymmetric impact on risk premium. Investor confidence may falter, resulting in a decrease in investment in the country immediately after a breaking of the peg, which can be interpreted as the central bank breaking a commitment. On the other hand, central banks gaining investors’ trust after the formation of a peg may take some time. This exercise will therefore confirm the hypothesis if the treatment effect (of switching the regime from floating to peg) does not drop below zero or show any systemic changes after peg formation.

We use the same basis of coding used in Section 2.2 to identify de facto regime periods; we classify a country as intervening in the foreign exchange market if the exchange rates stay within a 2 percent band for 10 consecutive months. We isolate episodes where a country floats its exchange rates for at least 10 months before the de facto fixed regime begins. The control country candidates are the countries which keep de facto floating regimes during the study period. We identify 33 peg-formation episodes, listed with the control country candidates for each episode in Table 11.

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[16]These results are derived from using the events and countries identified with 2 percent bands; 0.1456–0.2414 standard deviation increases are estimated using 2.5 percent bands.

[17]Similar results can be found in combined placebo tests, as shown in Figure E.2 in Appendix E.

Table 11. Thirty-Three Cases of Peg Formation and Control Country Candidates to Construct Synthetic Controls

Country	Year	Month	Control Country Candidates
Korea	2000	January	Algeria, Brazil, Bulgaria, Colombia, Côte d'Ivoire, Croatia, Hungary, Mexico, Morocco, Nigeria, Poland, Thailand, Turkey
Ecuador	2000	February	Algeria, Brazil, Bulgaria, Colombia, Côte d'Ivoire, Croatia, Hungary, Mexico, Morocco, Nigeria, Poland, Thailand, Turkey
Colombia	2001	February	Brazil, Bulgaria, Chile, Côte d'Ivoire, Croatia, Hungary, Mexico, Morocco, Nigeria, Philippines, Poland, Turkey
Thailand	2001	May	Brazil, Bulgaria, Chile, Côte d'Ivoire, Croatia, Hungary, Mexico, Morocco, Nigeria, Philippines, Poland, Turkey
Algeria	2001	September	Brazil, Bulgaria, Chile, Côte d'Ivoire, Croatia, Hungary, Mexico, Morocco, Nigeria, Philippines, Poland, Turkey
Venezuela	2003	April	Argentina, Brazil, Chile, Côte d'Ivoire, Croatia, Dominican Republic, Hungary, Morocco, Poland, Turkey, Uruguay
Colombia	2003	June	Argentina, Brazil, Chile, Côte d'Ivoire, Croatia, Dominican Republic, Hungary, Morocco, Poland, Turkey, Uruguay
Philippines	2003	September	Brazil, Bulgaria, Chile, Côte d'Ivoire, Dominican Republic, Hungary, Morocco, Poland, Turkey, Uruguay
Nigeria	2003	December	Brazil, Bulgaria, Chile, Côte d'Ivoire, Dominican Republic, Hungary, Morocco, Poland, Turkey, Uruguay
Argentina	2004	June	Brazil, Bulgaria, Chile, Côte d'Ivoire, Dominican Republic, Hungary, Morocco, Poland, Turkey, Uruguay
Mexico	2004	June	Brazil, Bulgaria, Chile, Côte d'Ivoire, Dominican Republic, Hungary, Morocco, Poland, Turkey, Uruguay
Turkey	2005	May	Brazil, Bulgaria, Chile, Côte d'Ivoire, Dominican Republic, Hungary, Indonesia, Poland
Morocco	2005	July	Brazil, Bulgaria, Chile, Côte d'Ivoire, Hungary, Indonesia, Poland
Uruguay	2006	February	Brazil, Bulgaria, Chile, Côte d'Ivoire, Hungary, Indonesia, Poland
Dominican Rep.	2006	April	Brazil, Bulgaria, Chile, Côte d'Ivoire, Hungary, Indonesia, Poland
Ghana	2009	June	Brazil, Bulgaria, Colombia, Chile, Gabon, Hungary, Malaysia, Mexico, Philippines, Poland, Turkey, Uruguay

(*continued*)

Table 11. (Continued)

Country	Year	Month	Control Country Candidates
Peru	2009	June	Brazil, Bulgaria, Colombia, Chile, Gabon, Hungary, Malaysia, Mexico, Philippines, Poland, Turkey, Uruguay
Indonesia	2009	November	Brazil, Bulgaria, Colombia, Chile, Gabon, Hungary, Malaysia, Mexico, Philippines, Poland, Turkey
Ukraine	2009	November	Brazil, Bulgaria, Colombia, Chile, Gabon, Hungary, Malaysia, Mexico, Philippines, Poland, Turkey
Uruguay	2010	August	Brazil, Bulgaria, Colombia, Chile, Gabon, Hungary, Malaysia, Mexico, Poland, Turkey
Philippines	2010	October	Brazil, Bulgaria, Colombia, Chile, Croatia, Gabon, Hungary, Malaysia, Mexico, Poland, Turkey
Georgia	2011	May	Brazil, Bulgaria, Chile, Côte d'Ivoire, Croatia, Gabon, Hungary, Malaysia, Mexico, Poland
Colombia	2012	March	Brazil, Bulgaria, Chile, Côte d'Ivoire, Croatia, Gabon, Hungary, Mexico, Poland, Senegal
Turkey	2012	March	Brazil, Bulgaria, Chile, Côte d'Ivoire, Croatia, Gabon, Hungary, Mexico, Poland, Senegal
Ghana	2012	June	Brazil, Bulgaria, Chile, Côte d'Ivoire, Croatia, Gabon, Hungary, Mexico, Poland, Senegal
Malaysia	2012	July	Brazil, Bulgaria, Chile, Côte d'Ivoire, Croatia, Gabon, Hungary, Mexico, Poland, Senegal
Croatia	2013	July	Brazil, Chile, Hungary, Poland, Uruguay
Mexico	2013	July	Brazil, Chile, Hungary, Poland, Uruguay
Côte d'Ivoire	2013	November	Brazil, Chile, Hungary, Poland, Uruguay
Gabon	2013	November	Brazil, Chile, Hungary, Poland, Uruguay
Senegal	2013	November	Brazil, Chile, Hungary, Poland, Uruguay
Jamaica	2014	February	Brazil, Chile, Hungary, Poland, Uruguay
Nigeria	2015	March	Brazil, Colombia, Chile, Ghana, Hungary, Indonesia, Poland, Turkey, Ukraine, Uruguay

Figure 7 and Table 12 show the average treatment effect estimates of peg formation and their statistical significance over time.[18] The estimation results confirm the hypothesis that the "benefit" of peg formation and the "cost" of breaking a peg are asymmetric. That is, while the previous results confirm that positive and significant costs of breaking an exchange rate peg exist, the results

[18]The individual synthetic control analysis results and placebo tests are presented in Figures D.1 and D.2 in Appendix D.

Figure 7. Estimated Treatment Effect of Foreign Exchange Regime Switching on Country's Risk Premium Over Time: Peg-Formation Episodes

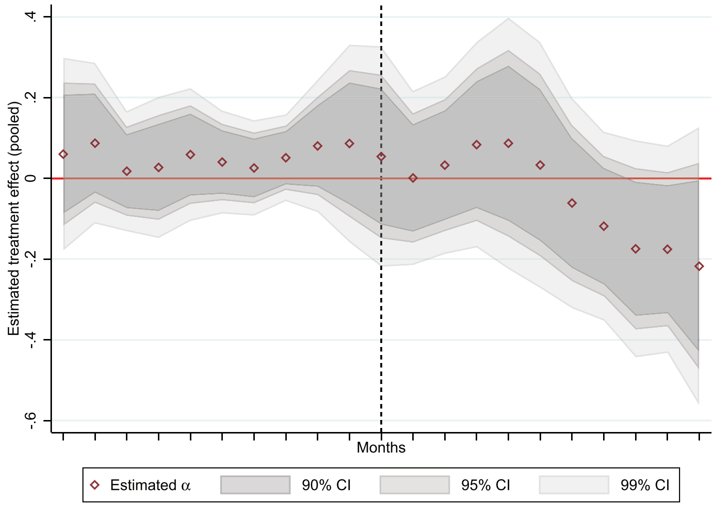


Table 12. Estimated Treatment Effect of Peg Formation and Statistical Significance Over Time

Before Switching			After Switching		
t	$\hat{\hat{\alpha}}_{1t}$	p-value	t	$\hat{\hat{\alpha}}_{1t}$	p-value
1	0.0599	0.4973	T_0	0.0539	0.5924
2	0.0870	0.2405	T_1	0.0009	0.9905
3	0.0177	0.7475	T_2	0.0326	0.6880
4	0.0270	0.6756	T_3	0.0834	0.3766
5	0.0588	0.3357	T_4	0.0868	0.4511
6	0.0403	0.3941	T_5	0.0329	0.7693
7	0.0257	0.5568	T_6	−0.0612	0.5251
8	0.0509	0.2038	T_7	−0.1185	0.1752
9	0.0802	0.1905	T_8	−0.1745*	0.0851
10	0.0863	0.3419	T_9	−0.1756*	0.0704
			T	−0.2177*	0.0936

Note: *** indicates 99 percent significance level; ** indicates 95 percent significance level; * indicates 90 percent significance level.

in this section suggest that peg formation does not have a statistical impact on sovereign risk spreads. The average treatment effect estimates do not deviate much from zero, and they stay statistically insignificant for the entire study period with 95–99 percent significance levels (for eight months with 90 percent level). It is also noteworthy that the downward trend seems to begin at the end of the study period; that is, stable exchange rates do not lower the risk premium unless they last longer than nine months (with 90 percent significance level). In other words, the results imply that while breaking a peg is interpreted as breaking the central bank's commitment, which is reflected as an immediate increase (or "jump") in the country risk spread, it may take time to gain investors' trust in the central bank's commitment to stabilize the market and the economy.

3.6 Further Discussion of the Results

Although the results in the study confirm the existence of statistically significant short-term costs of breaking a peg, the study also suggests that the effect is potentially short-lived. After its spike from the exchange rate regime switch, the statistical significance of the average treatment effect tends to dissipate within a few months. The estimated short-term effect has two potential explanations. One explanation is that the average treatment effect decreases over time, as seen in Figure 3 and Table 5. However, they also show that the average treatment effect is still above zero for the entire study period of 10 months. Another potential explanation is that the variance in the estimated risk premium increases after the peg breaking. In other words, the change in the exchange rate regime may affect different countries differently, and the magnitude and the duration of impacts differ by country. The difference in impacts creates rather large standard errors and thus wide confidence intervals. Therefore, even if the average treatment effect remains positive, the estimated treatment effect becomes statistically zero after four to seven months, due to the large standard errors.

While this study focuses on the identification of the costs of breaking a peg in the short run, a further investigation of the treatment effect in the long run can be beneficial. A potential extension of the study is to examine the determinants of the impact of peg breaking on risk premium. The treatment effects vary among peg-breaking episodes, and such variation in the magnitude and the duration of impacts exists even within a country between different peg-breaking episodes; for example, while the risk premium increase is estimated to be around one standard deviation in the case of Peru in 2001, a much smaller increase (0.1 standard deviation) is estimated when the peg was broken in 2015. Identifying the determinants of such variation in treatment effects potentially leads us to understand why it may cost more for specific countries (or at certain times) to abandon their exchange rate pegs. The results of research projects such as these would contribute to our understanding of the rationality for central banks to fear to float in the long run. We leave these extensions for future work.

4. Conclusion

This paper studies the short-term cost of switching the exchange rate regime from fixed to floating by investigating the country spread through the synthetic control method. We use J.P. Morgan's risk premium index to measure the country spread that is independent of exchange risks to capture the foreign investor's sentiment on the sovereign risk during exchange rate peg abandonment. Overall, the results provide clear empirical evidence that switching exchange rate regimes from fixed to floating incurs an increase in the risk premium. When the exchange rate peg is broken, the average risk premium shows a statistically significant increase of 0.2129–0.3246 standard deviations. The results support the hypothesis that breaking exchange rate pegs may bring negative sentiment to the market, increasing the price of foreign loans, which is reflected in the statistically significant increase in sovereign risk.

In order to check the robustness of the results, we repeat the analysis on peg-breaking episodes identified with an alternative specification used to classify exchange rate regimes; the treatment effect is estimated to be an increase of 0.2010–0.3518 standard deviations in the country risk spread for three to seven months. In addition, we present the estimation results excluding the cases that coincided with political crises, which may incur overestimation of treatment effects, and the estimation without these cases provides similar results: an increase of 0.2172–0.3280 standard deviations in the risk premium. In both robustness check exercises, statistically significant country risk premium increases are estimated after countries abandon their exchange rate pegs. We also investigate episodes of peg formation. The results confirm the hypothesis of Alesina and Wagner (2006) and suggest that breaking a peg implies breaking the central bank's commitment and that it may take a long time for the central bank to regain investors' trust in its commitment to monetary stability.

Appendix A. List of Peg-Breaking Episodes that Coincide with Economic Crises

Table A.1. Peg-Breaking Cases that are Excluded in Estimation Due to the Coincidence with Economic Crises

Exchange Rate Peg-Breaking Cases			
Country	**Year**	**Month**	**Economic Crises**
Argentina	2002	February	Argentine Great Depression (1998–2002)
Venezuela	2002	March	Venezuelan General Strike (2002–03)
Iraq	2007	January	Subprime Mortgage Crisis (2007–09)
Malaysia	2007	January	
Philippines	2007	June	
Uruguay	2007	November	
Peru	2007	November	
Pakistan	2008	June	
Argentina	2008	July	
Jamaica	2008	November	
Venezuela	2010	February	Venezuelan Banking Crisis (2009–10)
Venezuela	2013	March	Crisis in Venezuela (2012–)
Ukraine	2014	March	Ukrainian Crisis (2013–14)

Appendix B. Synthetic Control Analyses on Peg-Breaking Episodes Identified with 2.5 Percent Bands de facto Regime Specification

Table B.1. Predictor Balance in Synthetic Country Construction: Peg-Breaking Episodes Identified with 2.5% Bands

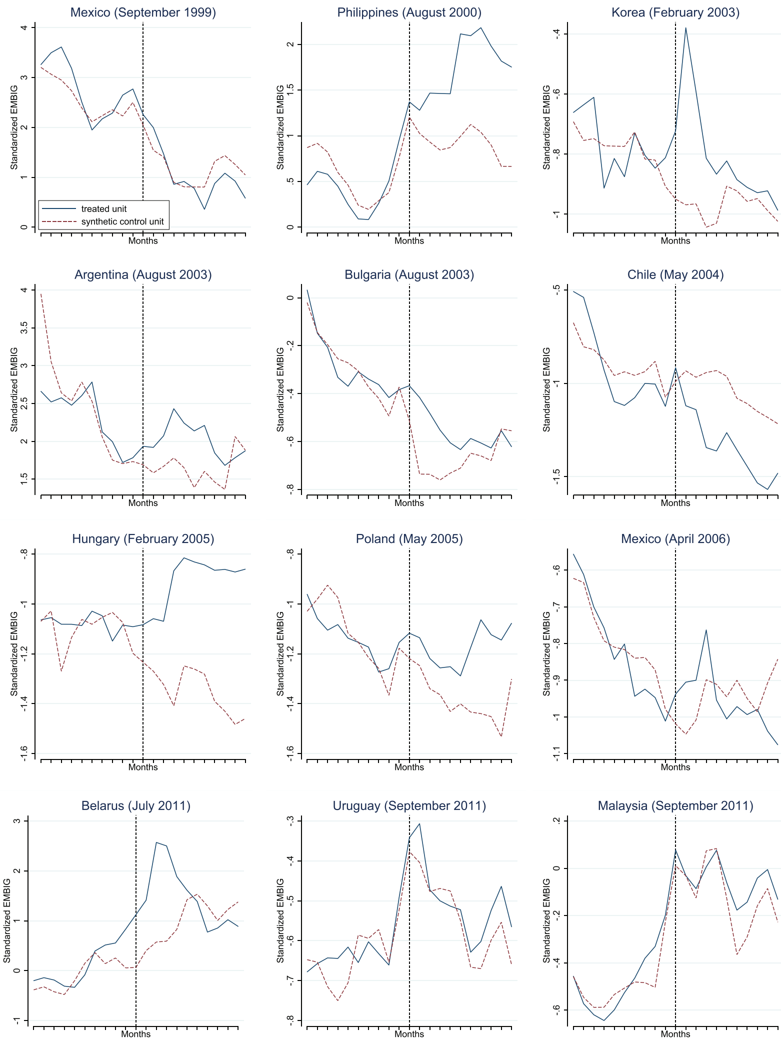
	Treated	Synthetic		Treated	Synthetic		Treated	Synthetic
Mexico, Sept. 1999			**Hungary, Feb. 2005**			**Mexico, Sept. 2011**		
Consumer Price Index	4.072	4.413	Consumer Price Index	4.331	4.174	Consumer Price Index	4.648	4.640
Imports Merchandise	9.690	7.473	Imports Merchandise	8.657	7.464	Imports Merchandise	10.184	7.883
Exports Merchandise	9.332	6.915	Exports Merchandise	8.462	6.755	Exports Merchandise	10.260	8.265
Months Import Cover	−1.284	1.703	Months Import Cover	0.978	1.789	Months Import Cover	−1.022	2.723
Total Reserves	8.085	8.854	Industrial Production	21.635	22.001	Industrial Production	24.126	22.349
RMSPE		0.757	Total Reserves	9.526	9.047	Total Reserves	9.244	10.722
			RMSPE		0.177	**RMSPE**		0.085
Philippines, Aug. 2000			**Poland, Feb. 2005**			**Pakistan, Jan. 2012**		
Imports Merchandise	7.972	7.395	Consumer Price Index	4.469	4.086	Consumer Price Index	4.769	4.769
Exports Merchandise	8.030	7.217	Imports Merchandise	9.251	7.448	Imports Merchandise	8.061	8.057
Months Import Cover	1.712	2.344	Exports Merchandise	8.846	6.617	Exports Merchandise	7.672	7.438
Industrial Production	22.552	22.443	Months Import Cover	1.555	2.401	Months Import Cover	1.627	1.627
Total Reserves	9.626	9.482	Industrial Production	22.899	22.306	Total Reserves	9.811	9.811
RMSPE		0.256	Total Reserves	10.548	9.646	**RMSPE**		0.098
			RMSPE		0.083			
Korea, Feb. 2003			**Mexico, Apr. 2006**			**Turkey, Jun. 2013**		
Consumer Price Index	4.377	4.242	Consumer Price Index	4.415	4.259	Consumer Price Index	4.816	4.816
Imports Merchandise	10.049	8.424	Imports Merchandise	10.009	7.479	Imports Merchandise	9.925	8.403
Exports Merchandise	9.549	8.077	Exports Merchandise	9.842	7.073	Exports Merchandise	9.457	8.943
Months Import Cover	2.165	1.262	Months Import Cover	1.165	1.725	Months Import Cover	1.778	2.529
Total Reserves	11.659	9.417	Industrial Production	24.113	21.951	Total Reserves	11.704	10.933
RMSPE		0.087	Total Reserves	8.695	9.054	**RMSPE**		0.654
			RMSPE		0.031			

(*continued*)

Table B.1. (Continued)

	Treated	Synthetic		Treated	Synthetic		Treated	Synthetic
Argentina, Aug. 2003			**Belarus, Jul. 2011**			**Indonesia, Sept. 2013**		
Imports Merchandise	7.175	7.207	Consumer Price Index	4.768	4.722	Consumer Price Index	4.763	4.763
Exports Merchandise	7.797	6.907	Imports Merchandise	8.190	8.428	Imports Merchandise	9.669	8.354
Months Import Cover	2.424	2.242	Exports Merchandise	7.944	7.627	Exports Merchandise	9.628	8.777
Total Reserves	9.287	9.155	Months Import Cover	–0.138	1.940	Months Import Cover	1.891	2.457
RMSPE		1.027	Industrial Production	21.651	22.651	Total Reserves	11.559	10.811
			Total Reserves	8.052	10.368	**RMSPE**		0.403
			RMSPE		0.325			
Bulgaria, Aug. 2003			**Uruguay, Sept. 2011**					
Imports Merchandise	6.760	7.818	Consumer Price Index	4.694	4.639			
Exports Merchandise	6.453	5.789	Imports Merchandise	6.730	7.763			
Months Import Cover	1.890	1.897	Exports Merchandise	–0.450	8.012			
Industrial Production	20.607	21.902	Months Import Cover	9.146	2.101			
Total Reserves	8.659	9.715	Industrial Production	20.608	22.091			
RMSPE		0.054	Total Reserves	9.052	9.973			
			RMSPE		0.058			
Chile, May 2004			**Malaysia, Sept. 2011**					
Imports Merchandise	7.623	7.625	Consumer Price Index	4.635	4.671			
Exports Merchandise	7.665	7.004	Imports Merchandise	9.494	7.920			
Months Import Cover	2.754	2.330	Exports Merchandise	9.844	8.385			
Industrial Production	22.475	22.160	Months Import Cover	2.054	2.472			
Total Reserves	10.127	9.702	Industrial Production	22.879	22.391			
RMSPE		0.140	Total Reserves	11.700	10.529			
			RMSPE		0.076			

Figure B.1. Trends of Standardized EMBIG of Treated Country (solid line) vs. Synthetic Control (dashed line): Peg-Breaking Episodes Identified with 2.5 Percent Bands



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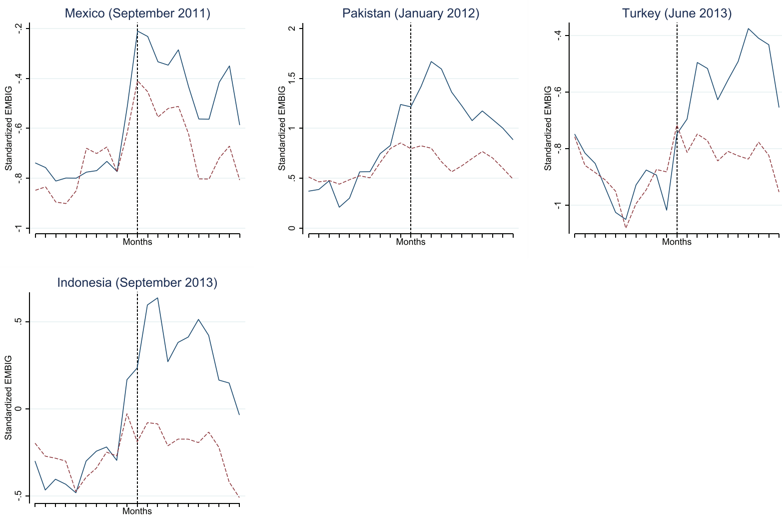
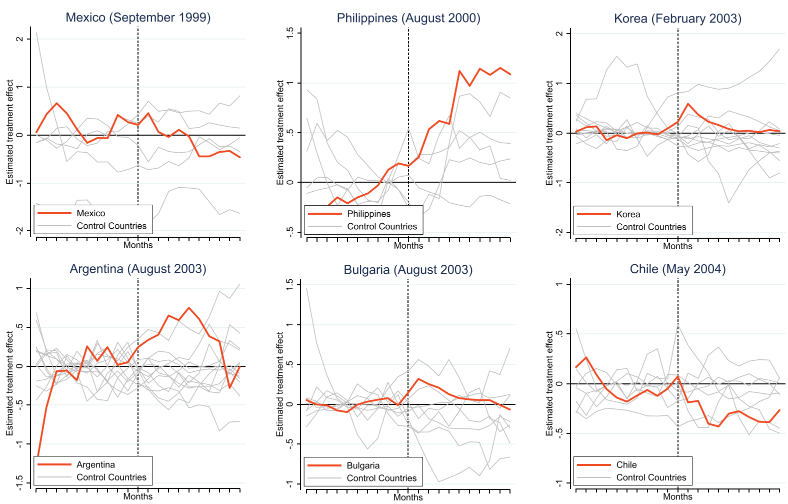


Figure B.2. Trends of Estimated Treatment Effect (orange line) vs. Placebo Effect (gray line): Peg-Breaking Episodes Identified with 2.5 Percent Bands



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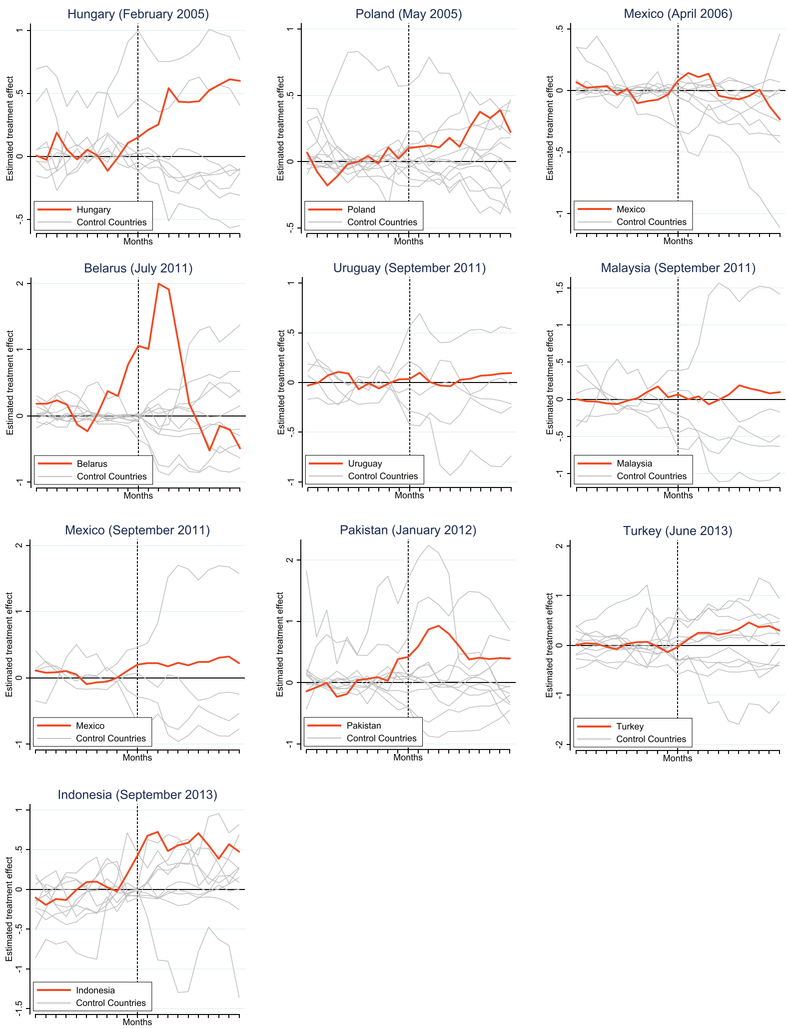
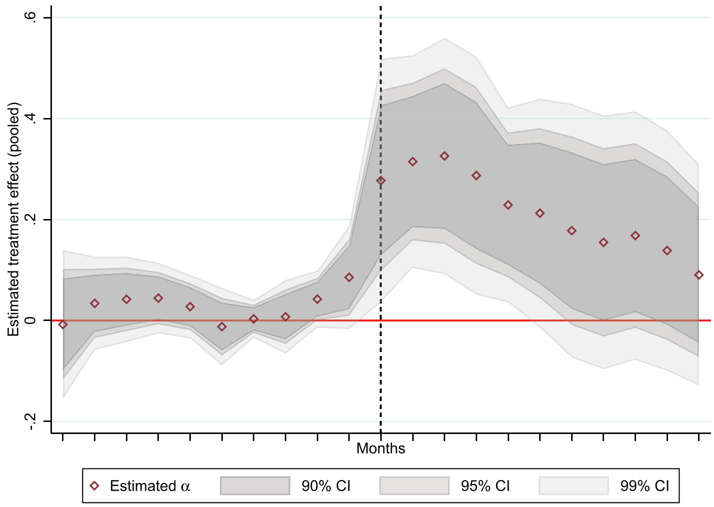


Appendix C. The Estimated Treatment Effect: Using 32 Peg-Breaking Cases Identified with Both 2 Percent and 2.5 Percent Bands

Figure C.1. Estimated Treatment Effect and Statistical Significance Over Time



Note: The figure shows 32 episodes identified with 2 percent (19 cases) and 2.5 percent bands (13 cases, excluding the overlapping cases of Mexico (2006), Pakistan (2013), and Indonesia (2013)).

Table C.1. Estimated Treatment Effect and Statistical Significance Over Time: Using the 32 Episodes Identified with 2 Percent (19 cases) and 2.5 Percent (13 cases: excluding the overlapping cases of Mexico (2006), Pakistan (2013), and Indonesia (2013))

Before Switching			After Switching		
t	$\hat{\hat{\alpha}}_{1t}$	p-value	t	$\hat{\hat{\alpha}}_{1t}$	p-value
1	−0.0079	0.8853	T_0	0.2773**	0.0036
2	0.0339621	0.3215	T_1	0.3148***	0.0003
3	0.0419931	0.1837	T_2	0.3259***	0.0006
4	0.0444137	0.0923	T_3	0.2873***	0.0022
5	0.0274539	0.2413	T_4	0.2289***	0.0028
6	−0.0122	0.6686	T_5	0.2126**	0.0152
7	0.0032	0.8170	T_6	0.1778*	0.0615
8	0.0074	0.7833	T_7	0.1548	0.1012
9	0.0423**	0.0493	T_8	0.1682	0.0704
10	0.0855**	0.0294	T_9	0.1385	0.1211
			T	0.0904	0.2670

Note: *** indicates 99 percent significance level; ** indicates 95 percent significance level; * indicates 90 percent significance level.

Appendix D. Synthetic Control Analyses on the Episodes of Peg Formation

Figure D.1. Trends of Standardized EMBIG of Treated Country (solid line) vs. Synthetic Control (dashed line): Peg-Formation Episodes

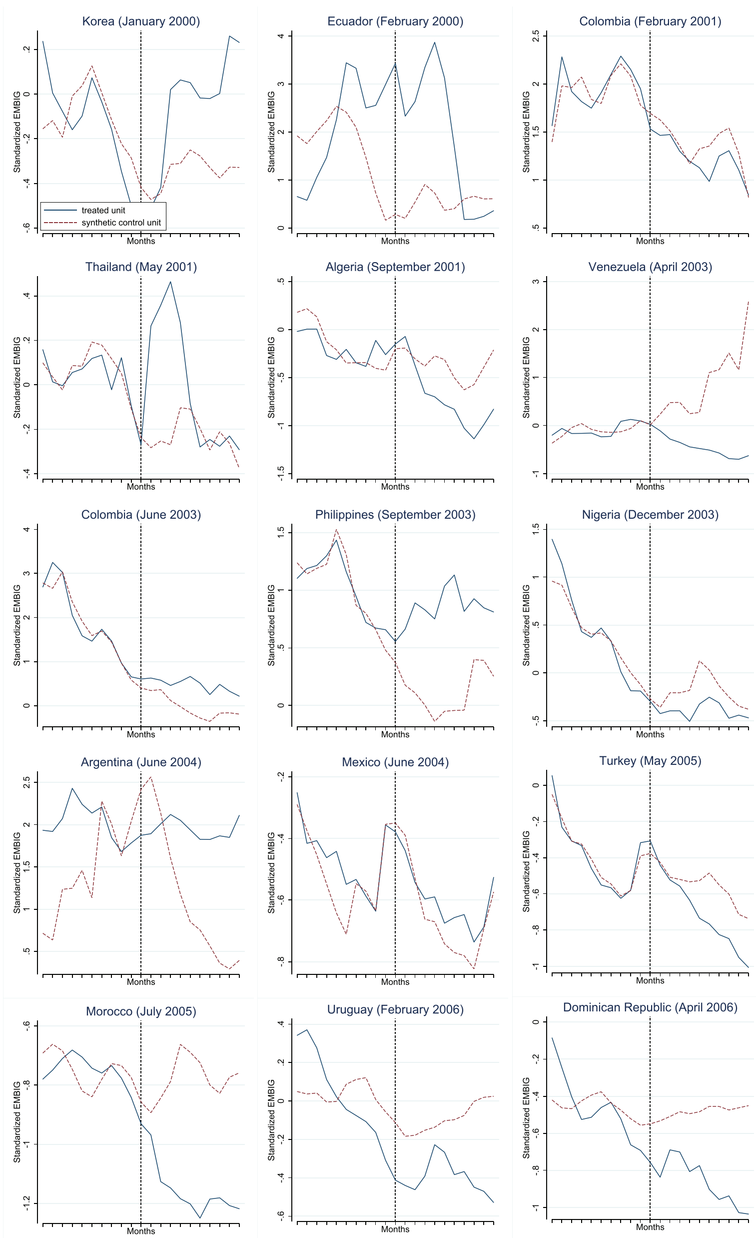


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Figure D.1. (Continued)

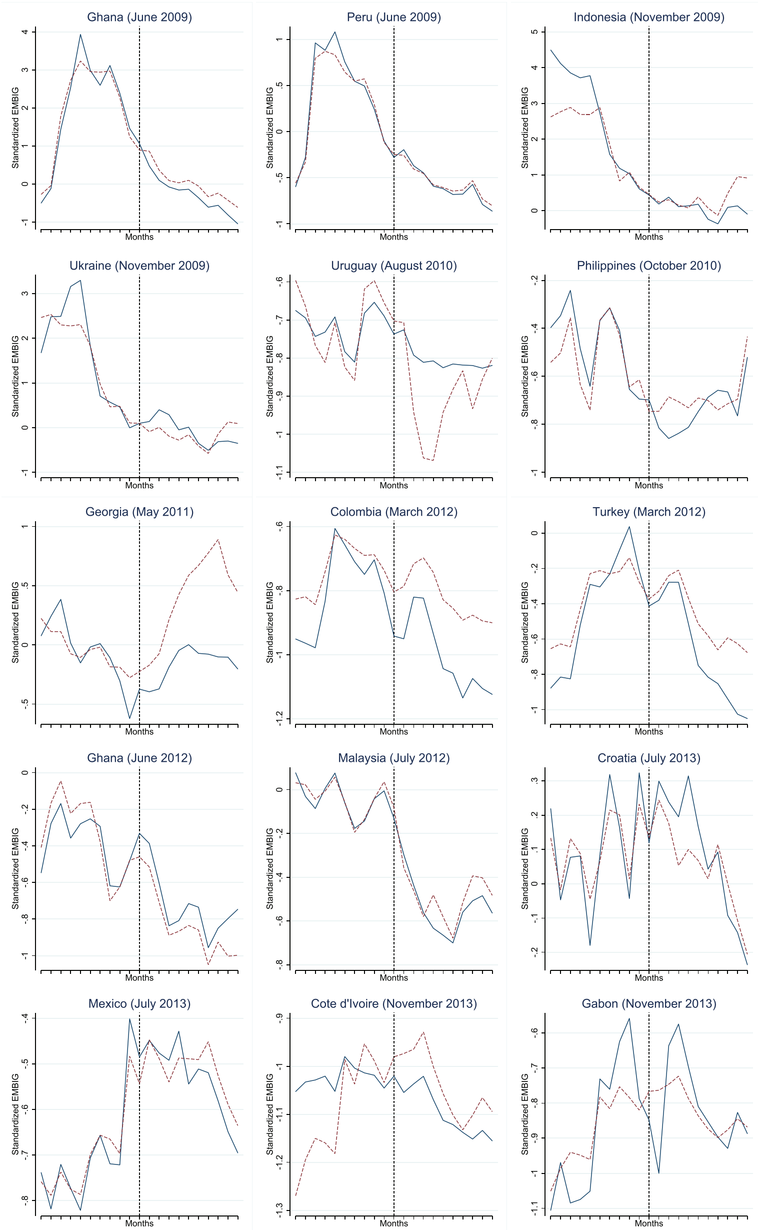

Figure D.2. Trends of Estimated Treatment Effect (orange line) vs. Placebo Effect (gray line): Peg-Formation Episodes

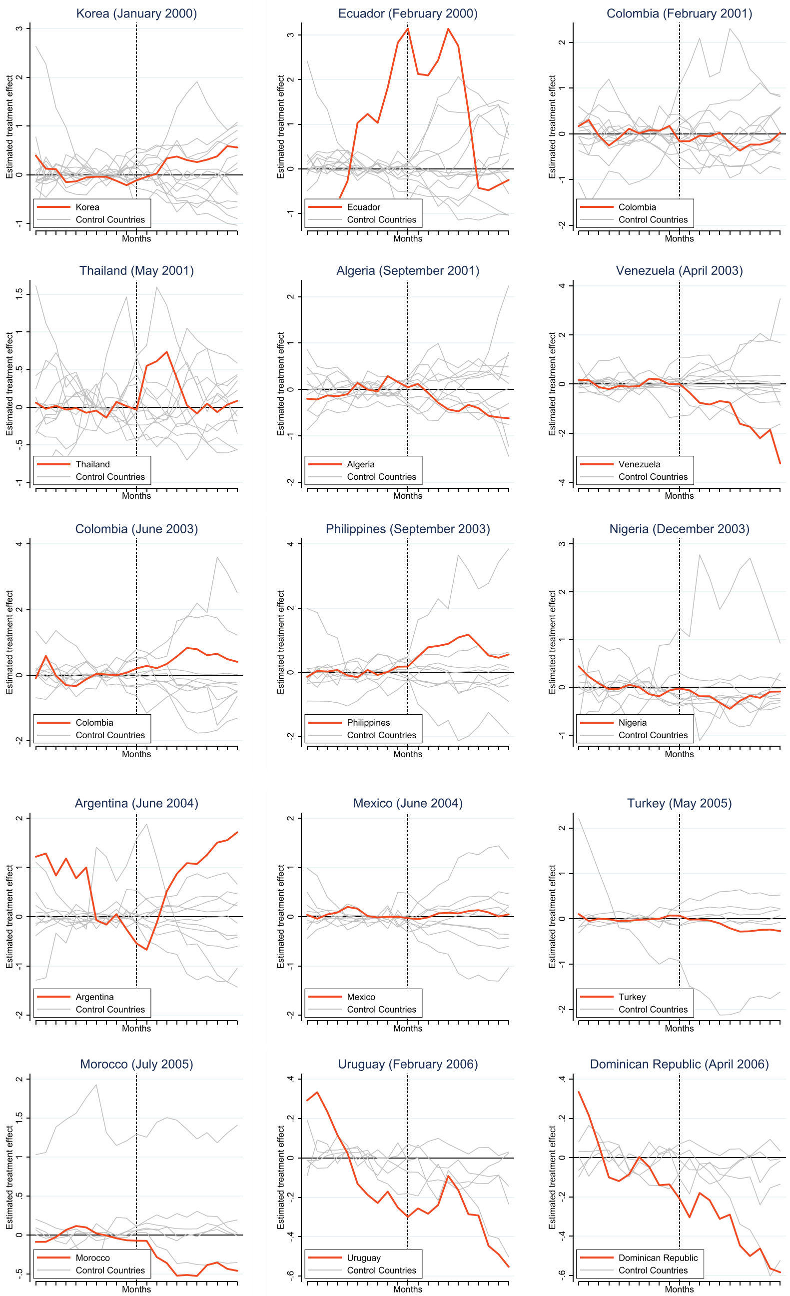

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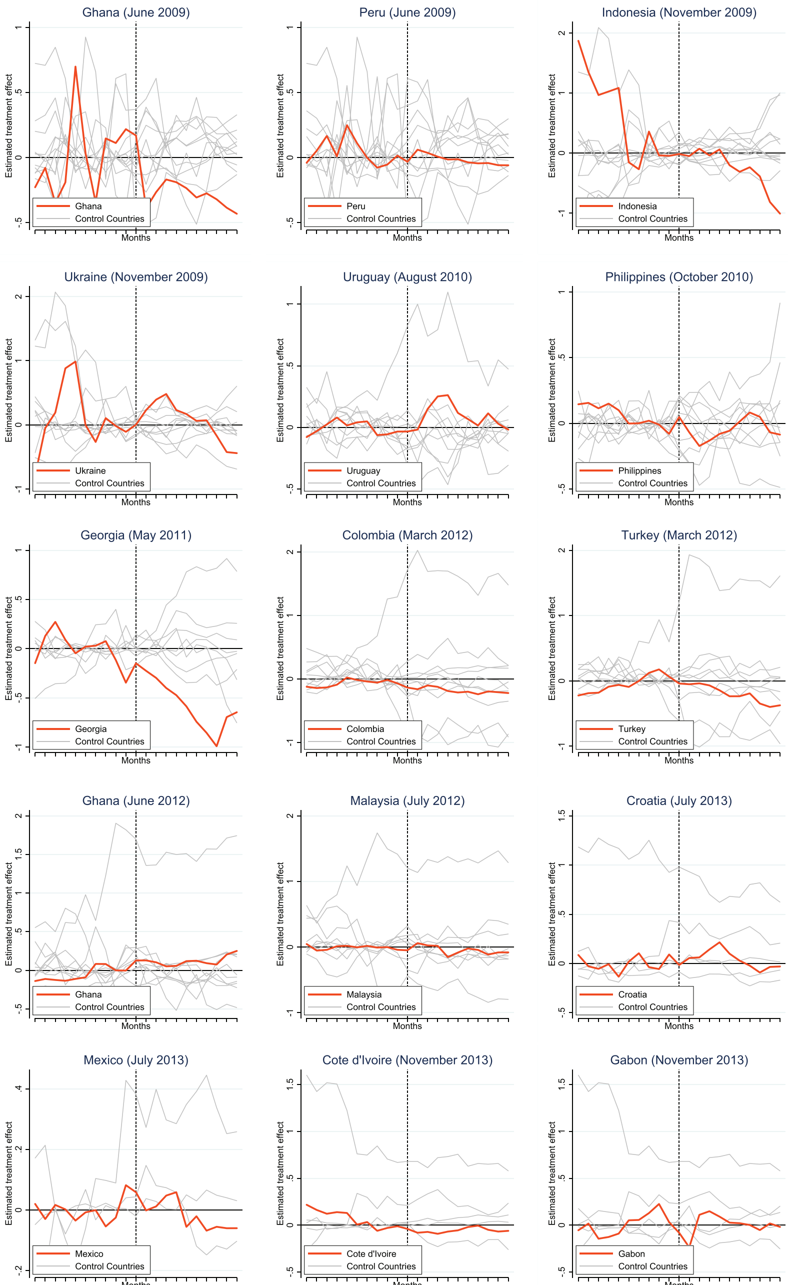
Figure D.2. (Continued)



Appendix E. Combined Placebo Tests

Figure E.1. Combined Placebo Tests on Control Countries

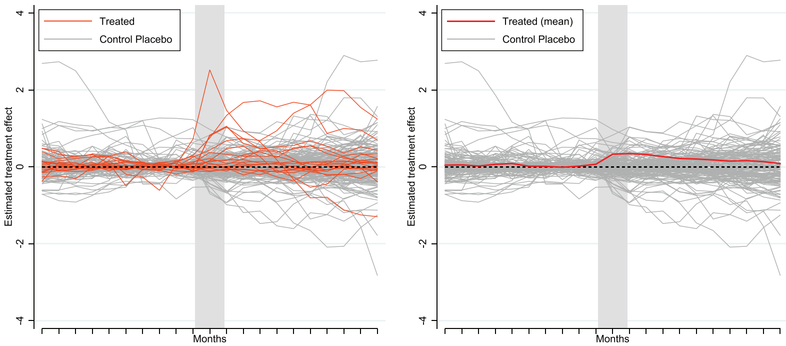
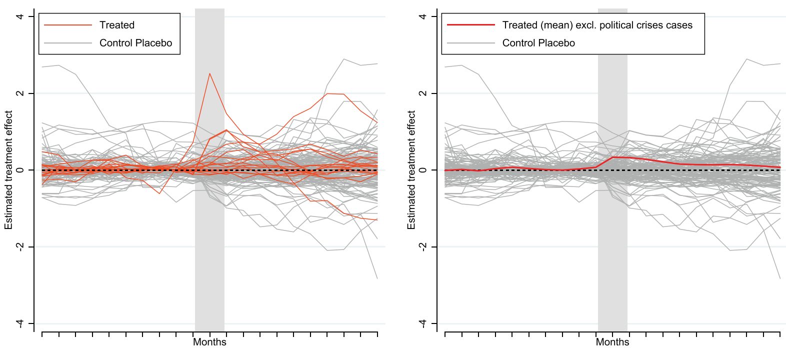


Figure E.2. Combined Placebo Tests (excluding the results of political crises cases) on Control Countries



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