DEPARTMENT OF THE TREASURY

WASHINGTON, D.C.

Public Document

August 24, 2020

James Maeder
Deputy Assistant Secretary for Antidumping and Countervailing Duty Operations
Department of Commerce

Dear Deputy Assistant Secretary Maeder:

Pursuant to 19 C.F.R 351.528(c) and your letter dated July 8, 2020, please find below the evaluation and conclusion of the Department of the Treasury (Treasury) regarding 19 C.F.R. 351.528(a) and (b)(1) in relation to Commerce's countervailing duty (CVD) investigation of an alleged subsidy pertaining to currency undervaluation in C-552-829 on passenger vehicle and light truck tires from the Socialist Republic of Vietnam (Vietnam).

In order to make our evaluation and conclusion as to the determinations requested by Commerce, Treasury has conducted an analysis using its Global Exchange Rate Assessment Framework (GERAF). GERAF provides a multilaterally consistent method for assessing the extent of any currency misalignment and the specific economic fundamentals and government policies that contribute to the misalignment. For further detail on GERAF, please see the enclosed methodology paper and a non-technical summary of how GERAF is applied for purposes of submissions for Commerce's countervailing duty proceedings, which will also be published on the Treasury website concurrent with this letter.

Regarding the determination under 19 C.F.R. 351.528(a)(1), Treasury assesses that the Vietnamese dong was undervalued during the relevant period. Specifically, Treasury's evaluation leads us to assess that in 2019 there was a gap between Vietnam's real effective exchange rate (REER) and the real effective exchange rate that achieves an external balance over the medium term that reflects appropriate policies (equilibrium REER). Treasury's assessment that the dong was undervalued in 2019 is independent of its finding of undervaluation as a result of government action on the exchange rate, as laid out in 19 C.F.R. 351.528(a)(2).

Regarding the determination under 19 C.F.R. 351.528(a)(2), Treasury has determined that Vietnam in 2019 undertook "government action on the exchange rate" that contributed to the undervaluation of the dong. Specifically, consistent with the data available on countries' holdings of official foreign exchange reserves through the International Monetary Fund (IMF)'s International Financial Statistics Database, and the data construction employed in the GERAF methodology (*see* Section III of the GERAF methodology paper), we conclude that the Vietnamese government—through the State Bank of Vietnam—undertook net purchases of foreign exchange in 2019 totaling about $22 billion. Treasury concludes that these net purchases

of foreign exchange had the effect of undervaluing Vietnam's REER by 4.2%. The uncertainty range around this assessment, based on one standard error, spans from REER undervaluation of 3.5% to 4.8%.

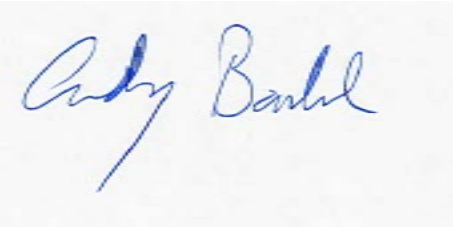
On a bilateral basis, Treasury assesses that the Government of Vietnam's actions on the exchange rate had the effect of undervaluing the dong vis-à-vis the U.S. dollar by 4.7%. The uncertainty range around this assessment, based on one standard error, spans from bilateral undervaluation of 4.2% to 5.2%.

Therefore, Treasury assesses that the difference between the nominal, bilateral dong exchange rate against the U.S. dollar consistent with the equilibrium REER and the actual nominal, bilateral dong exchange rate against the U.S. dollar in 2019, taking into account the impact of government action on the exchange rate, was 1,090 dong per U.S. dollar. The uncertainty range around this assessment, based on one standard error, spans from 967 to 1,213 dong per U.S. dollar. Specifically, Treasury assesses that, taking into account the impact of government action on the exchange rate, the actual, nominal bilateral dong exchange rate against the U.S. dollar in 2019 was 23,224 dong per U.S. dollar, whereas the nominal, bilateral dong exchange rate against the U.S. dollar consistent with the equilibrium REER was 22,134 dong per U.S. dollar (with the uncertainty range around this assessment, based on one standard error, spanning from 22,011 to 22,257 dong per U.S. dollar).

Calculations supporting Treasury's conclusions are enclosed.

If you have any questions regarding this analysis, please contact Treasury at CurrencyCVD@treasury.gov.

Sincerely,



Andy Baukol
Principal Deputy Assistant Secretary, International Monetary Policy

Enclosure

		Effect of FX intervention	Effect of capital controls*	Combined effect (i.e., "government action on the exchange rate")	± 1 Standard Error Range
		Contribution to excess current account imbalances (in percent of GDP)			
[A = See GERAF methodology]	Domestic gap	2.0	0.0	2.0	1.7 — 2.3
[B = See GERAF methodology]	Multilateral gap	1.9	0.0	1.9	n.a.
[C = See GERAF methodology]	Adjustments to ensure global consistency	0.0	0.0	0.0	n.a.
[D = B + C]	Final multilateral gap	1.9	0.0	1.9	1.6 — 2.2
[E = See GERAF methodology]	CA-REER semi-elasticity	-0.48	-0.48	-0.48	n.a.
		Contribution to REER valuation (in percent)			
[F = A / E]	Domestic gap	-4.2	0.0	-4.2	-4.8 — -3.5
[G = D / E]	Multilateral gap	-4.0	0.1	-3.9	-4.6 — -3.3
		Contribution to bilateral USD exchange rate valuation (in percent)			
[H = See GERAF methodology**]	Bilateral gap	-4.7	-0.2	-4.9	-5.4 — -4.5
[I = H if F ≠ 0]	Bilateral gap adjusted for domestic actions	-4.7	0.0	**-4.7**	**-5.2 — -4.2**
		Bilateral exchange rate vis-à-vis the USD (Local currency per U.S. dollar)			
[J]	Average VND/USD spot rate in 2019			**23,224**	
[K = 1/((1 / J) / (1 + (I/100)))]	VND/USD rate consistent with 2019 equilibrium REER w/o government action on the exchange rate			**22,134**	**22,011 — 22,257**
[L = J - K]	Difference			**1,090**	**967 — 1,213**

* Capital controls are not expressed relative to an annual GDP-weighted world average in GERAF. Thus, the effect of the domestic gap of capital controls on excess current account imbalances [A] is identical to the that of mulitlateral gap [B].

** Bilateral gaps are derived using the vector of GERAF-estimated multilateral REER misalignments due to government actions on the exchange rate.

Sources: National authorities; Haver Analytics; and U.S. Treasury staff estimates.

TREASURY FRAMEWORK FOR ASSESSING CURRENCY UNDERVALUATION
SUMMARY

This summary explains how Treasury uses its Global Exchange Rate Assessment Framework (GERAF) to evaluate currency valuations in the context of countervailing duty proceedings.

GERAF assesses exchange rate valuations on a real-trade-weighted basis for more than 50 major economies that account for more than 90% of global economic activity. GERAF's exchange rate valuations are derived from its estimates of the medium-term current account balances for all these economies that are consistent with economic fundamentals and appropriate policies. This approach is widely accepted and often employed in the economic literature on global external imbalances and has been employed in applied practices for assessing currency valuations. GERAF uses an econometric framework to assess historical statistical relationships between current accounts, cyclical factors, macroeconomic and structural fundamentals, and macroeconomic policies in a globally consistent manner. This approach can then translate findings of globally consistent current account misalignments into corresponding real effective exchange rate (REER) misalignments. These REER misalignments can then be translated into corresponding (and multilaterally consistent) bilateral exchange rate misalignments vis-à-vis the U.S. dollar.

GERAF's assessment provides a detailed framework for assessing, among other factors, the impact of specific government policies—including those that could be considered "government action on the exchange rate" in 19 CFR 351.528—on currency undervaluation. Moreover, GERAF can quantify the impact of a particular domestic policy on a given currency's valuation *as well as* the collective impact of all other countries' policies on that given currency's valuation. These features allow Treasury to make a granular assessment of the extent to which a country's government action on the exchange rate contributed, if at all, to REER undervaluation and nominal, bilateral undervaluation vis-à-vis the U.S. dollar.

Ultimately, GERAF allows Treasury to quantify the impact of government action on the exchange rate on:

- "the gap between the country's real effective exchange rate (REER) and the real effective exchange rate that achieves an external balance over the medium term that reflects appropriate policies (equilibrium REER)"; as well as

- the gap between the "nominal, bilateral United States dollar rate consistent with the equilibrium REER" and the "actual nominal, bilateral United States dollar rate" during the period under investigation.

Treasury would normally consider two key external policies to constitute "government action on the exchange rate," as these are generally used as primary policy tools for directly affecting exchange rates. Specifically, Treasury will use GERAF to assess the impact on currency valuation arising from:

i) intervention in foreign exchange markets; and

ii) controls on cross-border capital flows.

Treasury will employ GERAF to assess the extent to which currency valuations have been affected by the actual levels of foreign exchange intervention and capital controls, and how these levels compare to the desirable levels of foreign exchange intervention or capital controls for the economy in question. As necessary, Treasury may consider other policies or actions that may constitute "government action on the exchange rate" on a case-by-case basis. However, such actions may not be possible to incorporate into the GERAF model. Therefore, in assessing the impact of other possible government actions on the exchange rate, Treasury may rely on additional analysis beyond what is feasible using GERAF. For example, 19 CFR 351.528 states that in making assessments of government action on the exchange rate, consideration may be given to the "government's degree of transparency regarding actions that could alter the exchange rate."

For more technical details on the GERAF methodology, see https://home.treasury.gov/policy-issues/international/exchange-rate-analysis.

Global Exchange Rate Assessment Framework Methodology

Prepared by Staff of the U.S. Department of Treasury, Office of International Affairs, Global Economics and Debt[1]

Current Version: August 2020

This paper explains the methodology underlying the Global Exchange Rate Assessment Framework (GERAF), a flexible tool created by the Department of the Treasury (Treasury) to study currency valuations. The model provides a rigorous, multilaterally consistent method for assessing external imbalances, exchange rate misalignment, and the role of policy in contributing to both.

This paper proceeds as follows. Section I provides a brief review of the literature on assessing currency valuations. Section II discusses GERAF's contribution to the applied practice of estimating currency valuations and notable differences from other currency valuation models. Section III describes the calculation of current account gaps, which forms the model's core. Section IV explains the transformation of current account gaps into exchange rate gaps. Section V concludes. Appendix A lists data sources and descriptions. Appendix B lists countries included in the GERAF sample. Appendix C presents robustness checks and regression extensions.

I. Literature review

GERAF builds on a substantial body of literature and applied practices for assessing currency valuations. Given the complexity of the task, researchers have employed a variety of methods. Some confront the problem looking directly at exchange rates; others study the structure of current accounts and then translate those findings into exchange rates.

Estimating fair-value real exchange rates via their theoretical determinants is the most direct approach. For instance, one can estimate real effective exchange rates (REERs) directly in a Dynamic Equilibrium Exchange Rate (DEER) model, exploiting a panel cointegration approach to measure the long-run effect of factors such as productivity and terms of trade on exchange rates (Stolper and Fuentes (2007)). Such models are able to assess currencies on a relatively high-frequency basis but as a result do not have the ability to assess if these valuations are consistent with both internal balance (i.e., real output is close to potential) and external balance (i.e., external demand and the current account are at sustainable levels).

Conversely, exchange rate valuations can be estimated vis-à-vis those consistent with current account balances that achieve medium-term equilibrium in the global economy. This approach uses lower-frequency data that allows slower moving macroeconomic variables to be included, thus improving model fit and providing a richer explanation of exchange rate misalignments. Moreover, estimating exchange rate valuation via external accounts tends to yield more stable and statistically robust results due to lower-frequency data. Some examples include Fundamental Equilibrium Exchange Rate (FEER) based models, which estimate the impact of

[1] Alexander Herman, Max Harris, and Daniel Hall.

factors such as domestic demand gaps, external demand gaps, and lagged REERs on current accounts and then derive the underlying current account consistent with closed domestic and external demand gaps (i.e., both domestic and external demand are at their respective potential levels).[2] Other notable FEER-based models include the Peterson Institute of International Economics' FEER model (see Cline and Williamson (2008)). While better equipped to assess currency misalignment in a more globally consistent manner, this class of models typically does not take into account the impact of particular macroeconomic policies on exchange rates.

The International Monetary Fund (IMF) applies both methods – looking directly at the REER and looking at the REER indirectly through current accounts – in its External Balance Assessment (EBA). As described in Cubeddu et al. (2019), the EBA provides a comprehensive framework for assessing exchange rate misalignments and quantifying the role of macroeconomic policies in contributing to those misalignments. The EBA's current account model variant first estimates the current account norm—that is, the cyclically adjusted current account that would occur when macroeconomic policies are set at desirable medium-term levels. Comparing the norm to the observed cyclically adjusted current account results in the current account gap, which can be further decomposed into policy gaps (owing to deviations of collective or individual policies from their desired levels) and residual gaps (other policy distortions, factors not explained by the model, and regression residuals). These current account gaps can then be transformed into implied REER gaps.

This approach provides a nuanced framework for assessing, among other factors, the impact of policies on currency valuations. By construction, the model is multilaterally consistent. Because most variables are expressed as deviations from GDP-weighted world averages, larger economies have a larger influence in shaping the contributions to current account norms (consistent with their greater economic weight). Consistency adjustments ensure that current account gaps add up to zero in nominal terms (i.e., fully addressing total gaps would mechanically eliminate excess imbalances). This approach also includes a large number of explanatory factors, including demographic variables that affect saving and investment behavior over the medium term. Finally, policy gaps can be broken down into domestic and foreign components. Doing so allows the estimated gap for each country to reflect domestic policy distortions as well as policy distortions in other countries.

II. GERAF contributions

GERAF builds on the EBA's current account model and norm-gap analysis as documented in Cubeddu et al. (2019) to create a flexible model that allows for rigorous estimation of currency valuations relative to the dollar. Employing a framework in line with the IMF EBA exercise allows us to assess an economy's current account and exchange rate based not only on structural factors and macroeconomic fundamentals, but macroeconomic policy distortions as well. Moreover, such a modeling framework allows us to disentangle the impact of domestic policy distortions versus those from abroad on excess imbalances.

Building on this approach, we make several contributions to the applied practice of assessing external imbalances based on fundamentals and policies. First, we construct and employ an

[2] See Stolper and Fuentes (2007).

index for assessing the relative quality of safe assets across countries. Second, we incorporate comprehensive estimates of foreign exchange intervention across all countries in the sample consistent with the methodology used in Treasury's Report to Congress on Macroeconomic and Foreign Exchange Policies of Major Trading Partners of the United States ("Treasury's Foreign Exchange Report").[3] Third, we account for differential impacts of foreign exchange intervention on current accounts in the presence of varying degrees of capital account mobility, allowing for a refined explanation of the efficacy of foreign exchange intervention. (Notably, whereas the suite of EBA models assume that foreign exchange intervention can affect current account imbalances only when capital controls are present, GERAF estimates the contribution of foreign exchange intervention to external balances even when the capital account is fully open.) Fourth, in our normative assessment of excess imbalances, we introduce the concept of an "inertia gap." This latter component seeks to identify the portion of misalignments due to cumulative past policy distortions, notably those due to past foreign exchange intervention and their effect on net foreign asset positions.

A more detailed discussion of these contributions follows in Section III.

III. GERAF model specification and deriving current account gaps

Model specification and variable construction

GERAF's foundation is its empirical model of current account determinants. For a panel series of 51 countries (comprising 91% of world GDP in 2018) over the period 1986-2018, GERAF estimates the impact of the key drivers of current account balances using a panel-corrected standard error model.[4] The model breaks down these factors into four groups:

[3] Treasury's report is submitted pursuant to the Omnibus Trade and Competitiveness Act of 1988, 22 U.S.C. § 5305, and Section 701 of the Trade Facilitation and Trade Enforcement Act of 2015, 19 U.S.C. § 4421.

[4] In line with Cubeddu et al. (2019), the baseline GERAF specification employs a pooled Generalized Least Squares (GLS) method regression, controlling for cross-sectional dependence. The regression also includes a panel-wide AR(1) correction to control for potential autocorrelation in the dependent variable.

Cyclical factors:	*Macroeconomic fundamentals*:	*Structural fundamentals*:	*Policy variables*:
• Output gap	• Trade openness (exports + imports) / GDP	• Old-age dependency ratio (OADR)	• Cyclically adjusted fiscal balance/GDP
• Commodity terms of trade gap	• Net foreign assets (NFA)/GDP (lagged)	• Population growth	• Public health spending/GDP (lagged)
	• NFA/GDP * NFA debtor (lagged)	• Prime savers share	• Foreign exchange intervention (FXI):
	• Relative output per worker	• Life expectancy at prime age	○ FXI/GDP
	• Forecasted real GDP growth	• Life expectancy at prime age * Future OADR	○ FXI/GDP * Capital account openness
	• Safe asset index	• Institutional and political environment	• Detrended private credit/GDP
		• Oil and natural gas trade balance * Resource temporariness	• Capital controls:
			○ Relative output per worker * Capital account openness (lagged)
			○ Demeaned VIX * Capital account openness (lagged)
			○ Demeaned VIX * Capital account openness * Safe asset index (lagged)

Note: VIX index corresponds to the CBOE index measuring constant, 30-day expected volatility of the S&P 500 index.

As noted above, the GERAF model specification includes several novel variables:

Safe asset index: Cubeddu et al. (2019) and the methodology underlying earlier EBA model iterations (see Phillips et al. (2013)) include a reserve currency status variable that measures the share of a country's own currency in the total stock of global foreign exchange reserves. While such a variable may be intended to capture the "exorbitant privilege" of reserve currency countries, it fails to fully capture the impact of "flight to safety" pressures. For example, conventional safe haven currencies such as the Japanese yen or the Swiss franc are highly responsive to changes in investor sentiment in risk-off episodes but comprise relatively small shares of global foreign exchange reserves. Moreover, a variable based only on the stock of reserves will by construction assume an equal effect across all euro area countries, whereas country-specific risk premia vary. To refine the measurement of safe asset demand and its effect on financing current accounts, we introduce a country-specific safe asset index (see Figure 1).

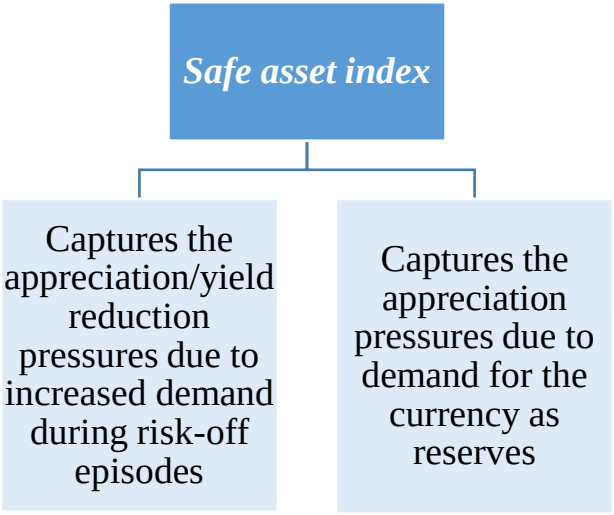


Figure 1: Safe asset index

This index intends to capture two facets of relative safeness of currencies and government securities: (i) price factors and (ii) quantity factors. To measure the price factors, we construct time-varying conditional correlations based on the nominal exchange rate (expressed as local currency per Special Drawing Right (SDR)),[5] the 10-year government bond yield, and the inverse of the VIX index.[6] The underlying notion is that in a risk-off environment, as uncertainty or volatility rises, a safe haven country will generally see its exchange rate appreciate and its government bond yields fall. Thus, the greater the co-movement between uncertainty and appreciation (interest rate reductions), the more the currency (government security) is in demand in a risk-off environment. The conditional correlations are estimated for each country on a monthly basis using a dynamic conditional correlation estimator, a particular type of multivariate generalized autoregressive conditional heteroskedasticity model (see Engle (2002); Engle and Sheppard (2001)).[7] The sum of these two conditional correlations can then be standardized relative to the entire panel of 51 countries and collapsed to the annual level. The trend component of this standardized index is then extracted in order for the variable to reflect longer-term, structural fundamentals in the relative price of safe assets. Lastly, the price factor index is weighted by the country's currency share of foreign exchange reserves. By doing this, the index combines price factors (which fluctuate in times of stress) with the long-term structural demand for safe assets (the quantity of global foreign exchange reserves, the shares of which exhibit relative stability over time).

As expected, this final index shows an outsized role of the United States (reflecting the substantial global demand to hold U.S. safe assets). Relative to a variable that was based only on the global stock of foreign exchange reserves, our safe asset index displays larger values for

[5] The SDR is used as a numeraire for exchange rates in order to include exchange rate variation for the United States.

[6] Using the inverse of the VIX allows for an intuitive positive correlation between increasing uncertainty/volatility, increasing currency appreciation, and decreasing bond yields, where all three series move in the same direction.

[7] Such an approach allows conditional correlations to follow a GARCH (1,1)-like process, implicitly controlling for time-varying volatility.

Japan and Switzerland (reflecting their role as safe havens), as well as heterogeneity across euro area countries. When placed in the GERAF baseline specification, the coefficient displays the expected negative sign and is statistically significant.

Refined estimates of foreign exchange intervention: The GERAF specification includes estimates of foreign exchange intervention consistent with the methodology set forth in Treasury's Foreign Exchange Report. Estimates are normally based on publicly available data for intervention on foreign asset purchases by authorities or estimated based on valuation-adjusted foreign exchange reserves. This adjustment requires assumptions about both the currency and asset composition of reserves in order to isolate returns on assets held in reserves and currency valuation moves from actual purchases and sales, including estimations of transactions in foreign exchange derivatives markets. Estimates can also be based on alternative data series when they provide a more accurate picture of foreign exchange balances than estimates derived from changes in valuation-adjusted reserves. These estimates are then combined with data reported to the IMF on official transactions in foreign exchange derivatives markets. Ultimately, this approach provides more refined intervention estimates than using changes in reserve asset positions or the flow of reserves from balance of payments statistics as a proxy for intervention.

Bayoumi, Gagnon, and Saborowski (2015) demonstrate that capital account mobility tends to lessen the impact of foreign exchange intervention on current accounts. Hence, in addition to foreign exchange intervention, GERAF includes foreign exchange intervention interacted with capital account openness to control for the differential effects of foreign exchange intervention across varying degrees of capital mobility. The full interpretation of the effect of foreign exchange intervention takes into account the combination of these regressors. In this context, both coefficients display the expected signs and are statistically significant in the baseline GERAF specification.

For a complete list of variables, sources, and descriptions, see Appendix A. For a complete list of countries in the sample, see Appendix B. Table 1 lists summary statistics for the panel sample of observations in the baseline regression specification.

As previously mentioned, the GERAF model specification is estimated across 51 economies and 33 years between 1986 and 2018. Each of the 23 independent variables takes the expected sign and is consistent with previous empirical findings in the literature. Additionally, the model fit is generally in line with different specifications found in the literature. Table 2 shows results for the baseline specification.

For robustness checks and regression extensions, see Appendix C.

Normative assessments of excess imbalances

GERAF can then provide a normative assessment of excess imbalances based on: (i) the historical relationship between the current account and each of the regressors; (ii) the deviations between observed and desired policy levels; (iii) the level of net foreign assets in the absence of official reserve positions (i.e., the inertia gap); and (iv) the regression residual.

As mentioned above, GERAF introduces the concept of an inertia gap so that normative current account assessments take into account the level of official reserve holdings. While larger net foreign asset positions are descriptively associated with higher current account balances, it is not the case that higher levels of official reserve holdings (i.e., greater precautionary external buffers) make higher current account balances warranted or desirable.[8] To this end, the inertia gap adjusts the contribution of net foreign assets to current account norms by stripping out official reserves from the total net foreign asset stock, essentially including only private net foreign assets in the final normative assessment of excess imbalances.[9]

The remainder of the GERAF norm and gap analysis is consistent with that in Cubeddu et al. (2019). The baseline GERAF specification is expressed as:

$$\left(\frac{CA}{GDP}\right)_{i,t} = \alpha + \beta^{cyc} X_{i,t}^{cyc'} + \beta X'_{i,t} + \delta Z'_{i,t} + \gamma P'_{i,t} + \varepsilon_{i,t} \tag{3.1}$$

where $X_{i,t}^{cyc'}$ denotes the vector of cyclical factors, $X'_{i,t}$ denotes the vector of macroeconomic and structural fundamentals, $Z'_{i,t}$ denotes the (lagged) net foreign asset position, and $P'_{i,t}$ denotes the vector of policy variables (set at their observed values). Here, α denotes the regression constant and $\varepsilon_{i,t}$ represents the regression residual (zero mean, normally distributed, and assumes an AR(1) process). Using the model coefficients, predicted current account values can be denoted as:

$$\widehat{\left(\frac{CA}{GDP}\right)}_{i,t} = \hat{\alpha} + \widehat{\beta^{cyc}} X_{i,t}^{cyc'} + \hat{\beta} X'_{i,t} + \hat{\delta} Z'_{i,t} + \hat{\gamma} P'_{i,t} \tag{3.2}$$

This can also be expressed in terms of deviations between observed and desired policy levels (the latter denoted as $P_{i,t}^{*'}$), as well as the deviation between the observed net foreign asset position and the adjusted net foreign asset position (the latter denoted as $Z_{i,t}^{\times'}$):

$$\widehat{\left(\frac{CA}{GDP}\right)}_{i,t} = \underbrace{\widehat{\beta^{cyc}} X_{i,t}^{cyc'}}_{Cyc.\ component} + \underbrace{\hat{\alpha} + \hat{\beta} X'_{i,t} + \hat{\delta} Z_{i,t}^{\times'} + \hat{\gamma} P_{i,t}^{*'}}_{Cyclically\ adjusted\ CA\ norm} + \underbrace{\hat{\delta}\left(Z'_{i,t} - Z_{i,t}^{\times'}\right)}_{Inertia\ gap} + \underbrace{\hat{\gamma}\left(P'_{i,t} - P_{i,t}^{*'}\right)}_{Policy\ gap} \tag{3.3}$$

Here, the cyclically adjusted current account norm corresponds to the current account that, according to the model, would exist if policies were set at their desired levels and with adjusted net foreign asset positions, accounting for observed macroeconomic and structural fundamentals and stripping out cyclical factors. The cyclical component corresponds to the portion of the predicted current account attributable to cyclical factors (i.e., output gaps and commodity terms of trade gaps). The inertia gap measures the degree to which official reserves (a subset of the net foreign asset position) contribute to the deviation between the predicted current account and its

[8] This normative view is consistent with the findings of Bayoumi, Gagnon, and Saborowski (2015), who find that lagged intervention positively impacts current accounts, potentially operating through the portfolio balance channel.

[9] In line with the specification in Cubeddu et al. (2019), GERAF uses lagged values of the net foreign asset position.

norm. Lastly, the policy gap measures the degree to which deviations between observed and desired policies impact the deviation between the predicted current account and its norm. For further discussion on the effect of policy gaps, see Box 1.

GERAF defines the observed cyclically adjusted current account as:

$$\left(\frac{CA}{GDP}\right)_{i,t}^{cyclically\ adjusted} = \left(\frac{CA}{GDP}\right)_{i,t} - \underbrace{\widehat{\beta^{cyc}} X_{i,t}^{cyc\prime}}_{Cyclical\ \ component} \tag{3.4}$$

Combining equations 3.1, 3.3, and 3.4 the cyclically adjusted current account can also be expressed as:

$$Cyclically\ adjusted\ CA = Cyclically\ adjusted\ CA\ norm + total\ CA\ gap \tag{3.5}$$

or:

$$Cyclically\ adjusted\ CA = Cyclically\ adjusted\ CA\ norm + inertia\ gap + policy\ gap + regression\ residual \tag{3.5}$$

While most variables are expressed relative to the annual GDP-weighted world average, further adjustments are necessary to ensure current account gaps over the GERAF sample add up to zero in nominal terms in each year (see Cubeddu et al. (2019)). In the case of GERAF, multilateral consistency adjustments are made to a portion of the cyclical component of the current account,[10] each individual policy gap, the inertia gap, and the residual. Country amounts are adjusted by a GDP-weighted share of each respective cumulative component (expressed in nominal terms) in every year. Thus, the GERAF sample current account statistical discrepancy is implicitly attributed to current account norms (i.e., GERAF does not attempt to model the statistical discrepancy of current accounts at the global level).

Similar to the methodology laid out in Cubeddu et al. (2019), GERAF can simultaneously estimate country-and-year-specific standard errors associated with each estimated current account norm. These standard errors, which can be applied to the norms or to the overall current account gaps, highlight the degree of model-implied uncertainty surrounding each estimated norm and gap. The corresponding upper and lower bounds can also be translated into exchange rate gaps, as explained further in Section IV.

The standard errors are estimated using the variance-covariance matrix of the regression as follows:

$$\sqrt{\hat{V}\left(\frac{CA}{GDP}\right)_{i,t}^{cyclically\ adjusted\ norm}} = \sqrt{\hat{V}\left(\hat{\alpha} + \hat{\beta} X_{i,t}' + \hat{\delta} Z_{i,t}^{\times\prime} + \hat{\gamma} P_{i,t}^{*\prime}\right)} \tag{3.6}$$

[10] For the cyclical component of the current account, this adjustment is only applied to the commodity of terms of trade gap, as output gaps by construction add up to zero.

Box 1: Example of policy gaps

GERAF's normative analysis is founded on the gap between observed levels of policy variables and their desired levels. Treasury calibrates these desired levels for each year in line with Treasury's view of the policies that will achieve strong, sustainable, and balanced growth over the medium term (reflecting appropriate domestic and external balances for all countries).

To better understand the calculation of policy gaps, consider a simplified example where there are two countries in the world: A and B. Each accounts for half of the world economy. The only policy lever is fiscal policy, and the desirable fiscal policy for both countries is a balance of 0% of GDP. Suppose Country A has a balance of 0% of GDP and Country B has a balance of -4% of GDP (i.e., the fiscal balance is in deficit).

Let p_i denote the fiscal balance of country i expressed as a percent of GDP,
w denote the GDP-weighted world fiscal balance expressed as a percent of world GDP,
P_i denote the fiscal balance for country i relative to the world average w,
$*$ denote policies at their desirable levels.

The following results:

$$p_A = 0\%$$
$$p_B = -4\%$$
$$w = 0.5(0\%) + 0.5(-4\%) = -2\%$$
$$P_A = 0\% - (-2\%) = 2\%$$
$$P_B = -4\% - (-2\%) = -2\%$$
$$w^* = 0.5(0\%) + 0.5(0\%) = 0\%$$
$$p_A^* = p_B^* = 0\%$$
$$P_A^* = P_B^* = 0\%$$

The policy gaps are thus:

$$P_A^{GAP} = P_A - P_A^* = 2\%$$
$$P_B^{GAP} = P_B - P_B^* = -2\%$$

Note that both countries have policy gaps even though only Country B has an undesirable deficit. This results from defining variables relative to the world average: there will be a policy gap whenever a country's policy distortion (or lack thereof) differs from the world average.

We can isolate the role of domestic policy distortions in contributing to the total policy gap. The domestic policy gap is simply the difference between observed and desired policy:

$$p_A^{GAP,domestic} = p_A - p_A^* = 0\%$$

Country A's fiscal policy is at its desired level, so the entirety of its gap is due the policy distortion in Country B. As for country B, $p_B^{GAP,domestic} = -4\%$.

When assessing whether or not a country's policies are distorting its current account, it is helpful to look at the domestic policy gap. When assessing the total impact of policy distortions in a multilaterally consistent manner, it is most appropriate to look at the total policy gap.

IV. Exchange rate gaps

After calculating current account gaps – whether total gaps or those relating to specific policies – GERAF estimates the corresponding exchange rate gaps. The first transformation is from current account gaps to REER gaps, and the second transformation is from REER gaps to multilaterally consistent bilateral real exchange rate gaps.

Current account to REER conversion

To transform current account gaps into REER gaps, GERAF uses country-specific semi-elasticities that relate the responsiveness of the current account to the REER. The semi-elasticity is defined as follows:

$$\eta^{CA} = \frac{\Delta\left(\frac{CA}{GDP}\right)}{\frac{\Delta REER}{REER}} \tag{4.1}$$

Following the CGER-inspired approach outlined in Cubeddu et al. (2019), it is assumed that exchange rate adjustment occurs through the trade balance (TB). The trade balance semi-elasticity can be estimated as

$$\eta^{TB} = \eta^{x} s^{x} - \eta^{m} s^{m} \tag{4.2}$$

where η^{x} (η^{m}) is the elasticity of export (import) volume with respect to the REER,
s^{x} (s^{m}) is the share of nominal exports (imports) to GDP.

η^{x} and η^{m} are assumed to be common to every country and, as in Cubeddu et al. (2019), they are calibrated to -0.11 and 0.57 respectively. s^{x} and s^{m} are calculated for every country by averaging the share of exports and imports to GDP, respectively, over 2010-19. Intuitively, the formula shows that the more open an economy, the larger the semi-elasticity in absolute terms and thus the more responsive the trade balance to a change in the REER.

The conversion from CA gap to REER gap is then:

$$REER^{gap} = \frac{CA^{gap}}{\eta^{TB}} \tag{4.3}$$

Note that this semi-elasticity is used to convert the total current account gap into the total REER gap and current account gaps due to specific policy distortions into the REER gaps due to those distortions.

REER to bilateral real exchange rate conversion

Because REERs are weighted averages of bilateral real exchange rates, it is possible to convert REERs (and REER gaps) into a set of multilaterally consistent bilateral real exchange rates against the dollar (and bilateral real exchange rate gaps against the dollar). For this conversion, GERAF employs the method described in Alberola et al. (1999) and outlined below.

Begin with the definition of the REER for currency i:

$$q_i = \sum_j^m w_{ij} r_{ij} \tag{4.4}$$

where q_i is the log of the REER for currency i,
m is the number of currencies,
w_{ij} is the weight of currency j in the index for currency i, with $\sum_j^m w_{ij} = 1$ and $w_{ii} = 0$,
r_{ij} is the log of the real bilateral exchange rate between currencies i and j.

The set of REERs can be expressed in matrix notation as:

$$Q = (W - I)R \tag{4.5}$$

where Q is an $(m \times 1)$ column vector of REERs,
R is an $(m \times 1)$ column vector of the bilateral real exchange rates relative to the numeraire (in the present case, the dollar),
W is an $(m \times m)$ matrix of trade weights with zeroes along the diagonal,
I is the $(m \times m)$ identity matrix.

Given REERs (Q), the aim is to obtain bilateral real exchange rates relative to the dollar (R). The system is over determined, however, as there are m exchange rates in R but only $m - 1$ are independent. Thus $B = W - I$ is not invertible. The problem is solved by eliminating the row and column in B corresponding to the numeraire currency n, removing the entries in Q and R corresponding to the numeraire currency, and expressing the remaining REERs relative to the numeraire currency. Equation 4.5 becomes

$$Q_{-n} - 1 * q_n = B_{-n} R_{-n} - 1 * q_n \tag{4.6}$$

where the subscript $-n$ denotes that the numeraire currency has been deleted, 1 is a vector of 1's, and q_n is the trade-weighted average of the $n - 1$ bilateral rates for the numeraire currency.

Letting $C = B - 1 * (w_{n1}, w_{n2}, \dots, w_{nn-1})$ equation 4.6 can be rewritten as

$$Q_{-n} - 1 * q_n = C R_{-n} \tag{4.7}$$

In terms of REER gaps and bilateral real exchange rate gaps, equation 4.7 becomes

$$\hat{Q}_{-n} - 1 * \hat{q}_n = C \hat{R}_{-n} \tag{4.8}$$

where ^ indicates deviations from equilibrium. The vector of bilateral real exchange rate misalignments vis-à-vis the numeraire is thus

$$\hat{R}_{-n} = C^{-1}\left(\hat{Q}_{-n} - 1 * \hat{q}_n\right) \tag{4.9}$$

GERAF follows this procedure with the dollar as numeraire to compute $\hat{R}_{-n}$, which consists of the bilateral real exchange rate misalignments against the dollar for the 50 other countries in the sample (the rest of the world is assumed to be broadly in line and does not factor into the analysis).

In addition to estimated REER gaps, $\hat{Q}_{-n}$, this transformation requires W, the matrix of weights. GERAF assigns currency weights based on trade flows and applies a double-weighting approach for exports that takes into account third-market effects as detailed in Turner and Van't dack (1993), which underpins the standard BIS method for computing REER trade weights. Currency j's weight in currency i's basket is as follows:

Import weight $\quad w_{ij}^{m} = \frac{m_i^j}{m_i}$

Export weight $\quad w_{ij}^{x} = \left(\frac{x_i^j}{x_i}\right)\frac{y_j}{y_j+\sum_h x_h^j} + \sum_{k\neq j}\left(\frac{x_i^k}{x_i}\right)\left(\frac{x_j^k}{y_k+\sum_h x_h^k}\right)$

Total weight $\quad w_{ij} = \left(\frac{m_i}{x_i+m_i}\right)w_{ij}^{m} + \left(\frac{x_i}{x_i+m_i}\right)w_{ij}^{x}$

where:

$x_i^j\left(m_i^j\right)$ is i's exports to (imports from) j,
$x_i(m_i)$ is i's total exports (imports),
y_j is home supply of domestic gross manufacturing output of economy j, and
$\sum_h x_h^j$ is the sum of exports from h to j excluding those from i.

Trade flows are calculated based on manufactured goods (SITC 5-8). Home supply of domestic gross manufacturing is proxied by manufacturing value added plus imports of manufactures minus exports of manufactures.

Thus, GERAF's final output is the vector $\hat{R}_{-n}$ of bilateral exchange rate gaps against the dollar. Note that the input vector of REER gaps, $\hat{Q}_{-n}$, will change according to the specific gap being investigated. For instance, $\hat{Q}_{-n}$ could consist of total REER gaps, in which case $\hat{R}_{-n}$ would represent total bilateral real exchange rate gaps with the dollar. Alternatively, $\hat{Q}_{-n}$ could consist of REER gaps due to a specific policy (e.g. fiscal policy), in which case $\hat{R}_{-n}$ would reflect bilateral real exchange rate gaps with the dollar resulting from fiscal policy distortions. Note also that these bilateral real exchange rate gaps are equivalent to bilateral nominal exchange rate gaps in this backward-looking exercise where inflation differentials are taken as given.

V. Conclusion

GERAF provides Treasury with a robust framework for assessing currency valuations on a variety of dimensions. Beginning with a model of current account determinants, it calculates the gap between the observed cyclically adjusted current account and the current account norm (the current account that would exist if policies were set at their desired levels and with adjusted net foreign asset positions, accounting for observed macroeconomic and structural fundamentals and stripping out cyclical factors). This gap – or portions of it depending on the specific policy distortions of interest – is then converted into the corresponding REER gap and bilateral exchange rate gap against the dollar, all while maintaining multilateral consistency. This tool will assist Treasury in its work on exchange rates.

References

Alberola, Enrique, Susana G. Cervero, Humberto Lopez, and Angel Ubide. 1999. "Global Equilibrium Exchange Rates: Euro, Dollar, 'Ins,' 'Outs,' and Other Major Currencies in a Panel Cointegration Framework." IMF Working Paper 99/175, International Monetary Fund, Washington, DC.

Bayoumi, Tamim, Joseph Gagnon, and Christian Saborowski. 2015. "Official financial flows, capital mobility, and global imbalances." *Journal of International Money and Finance* 52: 146-74.

Chinn, Menzie D., and Hiro Ito. 2006. "What matters for financial development? Capital controls, institutions, and interactions." *Journal of Development Economics* 81(1): 163-92.

Cline, William R., and John Williamson. 2008. "New estimates of fundamental equilibrium exchange rates." Policy Brief No. PB08-7. Peterson Institute for International Economics.

Cubeddu, Luis, Signe Krogstrup, Gustavo Adler, Pau Rabanal, Mai Chi Dao, Swarnali Ahmed Hannan, Luciana Juvenal, Nan Li, Carolina Osorio Buitron, Cyril Rebillard, Daniel Garcia-Macia, Callum Jones, Jair Rodriguez, Kyun Suk Chang, Deepali Gautum, and Zijao Wang. 2019. "The External Balance Assessment Methodology: 2018 Update." IMF Working Paper 19/65, International Monetary Fund, Washington, DC.

Drehmann, Mathias, Claudio Borio, and Kostas Tsatsaronis. 2011. "Anchoring Countercyclical Capital Buffers: The Role of Credit Aggregates." *International Journal of Central Banking* 7(4): 189-240.

Engle, Robert. 2002. "Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models." *Journal of Business & Economics Statistics* 20(3): 339-50.

Engle, Robert, and Kevin Sheppard. 2001. "Theoretical and Empirical Properties of Dynamic Conditional Correlation Multivariate GARCH." NBER Working Paper 8554, National Bureau of Economic Research.

Grigoli, Francesco, Alexander Herman, Andrew Swiston, and Gabriel Di Bella. 2015. "Output Gap Uncertainty and Real-Time Monetary Policy." IMF Working Paper 15/14, International Monetary Fund, Washington, DC.

Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff. 2019. "Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold?" *The Quarterly Journal of Economics* 134(2): 599-646.

Phillips, Steve, Luis Catão, Luca Ricci, Rudolfs Bems, Mitali Das, Julia Di Giovanni, Filiz

Unsal, Marola Castillo, Jungjin Lee, Jair Rodriguez, and Mauricio Vargas. 2013. "The External Balance Assessment (EBA) Methodology." IMF Working Paper 13/272, International Monetary Fund, Washington, DC.

Quinn, Dennis P. 1997. "The Correlates of Change in International Financial Regulation." *American Political Science Review* 91: 531-51.

Quinn, Dennis P., and A. Maria Toyoda. 2008. "Does Capital Account Liberalization Lead to Growth?" *Review of Financial Studies* 21(3): 1403-49.

Stolper, Thomas, and Monica Fuentes. 2007. "GSDEER and Trade Elasticities." Paper presented to a workshop at the Peterson Institute sponsored by Bruegel, KIEP, and the Peterson Institute, February.

Turner, Philip and Jozef Van't dack. 1993. "Measuring International Price and Cost Competitiveness." *BIS Economic Papers*, no 39.

Table 1. Summary Statistics

Variable	Obs.	Economies	Avg. years	Years	Mean	Std. dev.	Min	p10	p25	p50	p75	p90	Max	Kurtosis
Dependent variable														
Current account/GDP	1,273	51	25.0	1986 - 2018	-0.003	0.048	-0.145	-0.054	-0.034	-0.010	0.023	0.059	0.164	3.945
Cyclical factors														
Output gap	1,273	51	25.0	1986 - 2018	-0.002	0.029	-0.169	-0.032	-0.016	-0.002	0.013	0.030	0.139	7.414
Commodity TOT gap	1,273	51	25.0	1986 - 2018	0.000	0.013	-0.084	-0.011	-0.005	0.000	0.005	0.012	0.074	11.160
Macroeconomic Fundamentals														
Trade openness/GDP	1,273	51	25.0	1986 - 2018	0.554	0.337	0.088	0.215	0.341	0.473	0.633	1.017	1.807	5.501
L. NFA/GDP	1,273	51	25.0	1986 - 2018	-0.212	0.423	-1.912	-0.663	-0.425	-0.222	-0.037	0.203	1.996	6.297
L. NFA/GDP * (Dummy if L.NFA/GDP < -60%)	1,273	51	25.0	1986 - 2018	-0.036	0.133	-1.312	-0.063	0.000	0.000	0.000	0.000	0.000	30.089
L.Output per worker, relative to top 3 economies	1,273	51	25.0	1986 - 2018	0.169	0.363	-0.381	-0.273	-0.143	0.086	0.469	0.614	1.154	2.309
Real GDP growth, forecast in 5 years	1,273	51	25.0	1986 - 2018	0.039	0.018	-0.021	0.018	0.024	0.035	0.052	0.065	0.100	2.586
Safe asset index	1,273	51	25.0	1986 - 2018	0.013	0.054	-0.041	0.000	0.000	0.000	0.000	0.037	0.448	44.946
Structural Fundamentals														
Old-age dependency ratio	1,273	51	25.0	1986 - 2018	0.251	0.099	0.102	0.136	0.159	0.259	0.334	0.384	0.594	2.060
Population growth	1,273	51	25.0	1986 - 2018	0.010	0.007	-0.007	0.001	0.004	0.010	0.015	0.021	0.030	2.637
Prime savers share	1,273	51	25.0	1986 - 2018	0.485	0.062	0.361	0.405	0.430	0.488	0.538	0.569	0.621	1.880
Life expectancy at prime age	1,273	51	25.0	1986 - 2018	31.058	3.189	21.663	26.864	28.817	31.431	33.561	35.013	37.567	2.804
Life expectancy at prime age * Future OADR	1,273	51	25.0	1986 - 2018	11.333	5.644	2.230	4.371	6.508	10.533	15.394	19.154	30.175	2.557
Institutional/political environment (ICGR-12)	1,273	51	25.0	1986 - 2018	0.727	0.122	0.348	0.565	0.635	0.739	0.831	0.876	0.961	2.426
Oil and natural gas trade balance * Resource temporariness	1,273	51	25.0	1986 - 2018	0.006	0.019	0.000	0.000	0.000	0.000	0.002	0.018	0.163	30.865
Policy Variables														
Cyclically-adjusted fiscal balance														
Observed	*1,273*	*51*	*25.0*	*1986 - 2018*	*-0.020*	*0.035*	*-0.247*	*-0.065*	*-0.038*	*-0.016*	*0.003*	*0.017*	*0.104*	*6.344*
Instrumented	*1,273*	*51*	*25.0*	*1986 - 2018*	*0.007*	*0.018*	*-0.050*	*-0.014*	*-0.005*	*0.006*	*0.020*	*0.031*	*0.065*	*2.818*
L.Public health spending/GDP	1,273	51	25.0	1986 - 2018	0.043	0.023	0.005	0.012	0.021	0.044	0.061	0.074	0.095	1.943
FXI/GDP														
Observed	*1,273*	*51*	*25.0*	*1986 - 2018*	*0.003*	*0.059*	*-0.855*	*-0.015*	*-0.002*	*0.000*	*0.013*	*0.035*	*0.261*	*92.052*
Instrumented	*1,273*	*51*	*25.0*	*1986 - 2018*	*-0.001*	*0.022*	*-0.106*	*-0.023*	*-0.010*	*0.001*	*0.013*	*0.024*	*0.061*	*7.321*
FXI/GDP * K openness														
Observed	*1,273*	*51*	*25.0*	*1986 - 2018*	*0.000*	*0.056*	*-0.855*	*-0.010*	*-0.001*	*0.000*	*0.009*	*0.023*	*0.261*	*113.183*
Instrumented	*1,273*	*51*	*25.0*	*1986 - 2018*	*-0.002*	*0.020*	*-0.106*	*-0.020*	*-0.009*	*0.001*	*0.008*	*0.016*	*0.051*	*10.244*
Detrended private credit/GDP	1,273	51	25.0	1986 - 2018	0.004	0.113	-0.653	-0.118	-0.043	0.012	0.063	0.122	0.387	6.661
L.Relative output per worker * K openness	1,273	51	25.0	1986 - 2018	0.187	0.319	-0.263	-0.143	-0.087	0.061	0.447	0.605	1.154	2.615
L.demeaned VIX * K openness	1,273	51	25.0	1986 - 2018	-0.002	0.055	-0.108	-0.071	-0.042	-0.015	0.035	0.076	0.142	2.720
L.demeaned VIX * K openness * Safe asset index	1,273	51	25.0	1986 - 2018	0.000	0.004	-0.036	0.000	0.000	0.000	0.000	0.000	0.061	99.264

Notes: Summary statistics are calculated based on the baseline regression sample. For easier interpretation of the data, variables shown here are not constructed relative to the annual world GDP-weighted average.
Source: U.S. Treasury staff calculations.

Table 2. GERAF Current Account Model: Baseline Specification

	(1) GERAF Baseline
Cyclical factors	
Output gap #	-0.370***
	(0.000)
Commodity TOT gap	0.273***
	(0.000)
Macroeconomic Fundamentals	
Trade openness/GDP #	0.018***
	(0.006)
L. NFA/GDP	0.039***
	(0.000)
L. NFA/GDP * (Dummy if L.NFA/GDP < -60%)	-0.015
	(0.379)
L.Output per worker, relative to top 3 economies	0.037*
	(0.099)
Real GDP growth, forecast in 5 years #	-0.231**
	(0.013)
Safe asset index	-0.065***
	(0.004)
Structural Fundamentals	
Demographic block	
Old-age dependency ratio #	-0.121***
	(0.006)
Population growth #	-0.616*
	(0.074)
Prime savers share #	0.207***
	(0.000)
Life expectancy at prime age #	-0.006***
	(0.000)
Life expectancy at prime age # * Future OADR	0.015***
	(0.000)
Institutional/political environment (ICGR-12) #	-0.080***
	(0.000)
Oil and natural gas trade balance * Resource temporariness #	0.300***
	(0.008)
Policy Variables	
Cyclically-adjusted fiscal balance (instrumented) #	0.537***
	(0.000)
L.Public health spending/GDP #	-0.267*
	(0.058)
FX Intervention	
FXI/GDP (instrumented) #	0.682***
	(0.002)
FXI/GDP (instrumented) # * K openness	-0.509**
	(0.045)
Detrended private credit/GDP #	-0.097***
	(0.000)
Capital Controls	
L.Relative output per worker * K openness	0.039
	(0.114)
L.demeaned VIX * K openness	0.033**
	(0.025)
L.demeaned VIX * K openness * Safe asset index	-0.057
	(0.602)
Constant	-0.022***
	(0.000)
Observations	1,273
Number of countries	51
R-squared	0.385
RMSE	0.019

"L." denotes variables expressed using a one year lag. "#" denotes variables expressed relative to the annual world GDP-weighted average. P-values in parentheses. Standard errors are robust to heteroskedasticity, autocorrelation and cross-sectional dependence. Regression includes a panel-wide AR(1) correction to control for potential autocorrelation in the dependent variable. ***, **, * next to a number indicate statistical significance at 1, 5 and 10 percent, respectively. Source: U.S. Treasury staff calculations.

Appendix A: Data Sources and Descriptions

Table A1. GERAF Data Sources

Variable*	Sources**	Notes
Dependent variable		
Current account/GDP	IMF World Economic Outlook (WEO); national authorities; and Haver Analytics.	
Cyclical factors		
Output gap	IMF WEO; Haver Analytics; and Treasury staff estimates.	1/
Commodity TOT gap	IMF International Financial Statistics (IFS); Haver Analytics; and Treasury staff estimates.	2/
Macroeconomic Fundamentals		
Trade openness/GDP	IMF Direction of Trade Statistics (DOTS); IMF WEO; and Haver Analytics.	
L. NFA/GDP	IMF IFS; IMF WEO; and Haver Analytics.	
L. NFA/GDP * (Dummy if L.NFA/GDP < -60%)	IMF IFS; IMF WEO; Haver Analytics; and Treasury staff calculations.	
L.Output per worker, relative to top 3 economies	IMF WEO; national authorities; UN World Population Prospects, 2019 Revision; Haver Analytics; and Treasury staff calculations.	
Real GDP growth, forecast in 5 years	IMF WEO.	3/
Safe asset index	Chicago Board Options Exchange (CBOE); national authorities; IMF IFS; Bank of International Settlements (BIS); IMF Currency Composition of Official Foreign Exchange Reserves (COFER); Haver Analytics; and Treasury staff estimates.	4/

Table A1. GERAF Data Sources

Variable*	Sources**	Notes
Structural Fundamentals		
Old-age dependency ratio (OADR)	UN World Population Prospects, 2019 Revision; and Haver Analytics.	
Population growth	UN World Population Prospects, 2019 Revision; and Haver Analytics.	
Prime savers share	UN World Population Prospects, 2019 Revision; and Haver Analytics.	
Life expectancy at prime age	UN World Population Prospects, 2019 Revision; and Haver Analytics.	
Life expectancy at prime age * Future OADR	UN World Population Prospects, 2019 Revision; and Haver Analytics.	
Institutional/political environment (ICGR-12)	PRS Group, International Country Risk Guide (ICRG).	
Oil and natural gas trade balance * Resource temporariness	IMF WEO; World Bank World Development Indicators (WDI); IMF Balance of Payments Statistics (BOPS); Haver Analytics; and British Petroleum Statistical Review of World Energy.	5/
Policy Variables		
Cyclically-adjusted fiscal balance		
Observed	*IMF Fiscal Monitor (FM); IMF WEO; Haver Analytics; and Treasury staff estimates.*	*6/*
Instrumented	*IMF FM; IMF WEO; Treasury staff estimates; national authorities; PRS Group, ICRG; CBOE; Ilzetzki, Reinhart, and Rogoff (2019); Haver Analytics; and Treasury staff calculations.*	*7/*
L.Public health spending/GDP	OECD Government Statistics; World Bank WDI; and Haver Analytics.	

Table A1. GERAF Data Sources

Variable*	Sources**	Notes
FXI/GDP		
Observed	*IMF IFS; national authorities; IMF WEO; Bloomberg L.P.; Haver Analytics; Treasury staff calculations; and Treasury staff estimates.*	*8/*
Instrumented	*IMF IFS; national authorities; IMF WEO; Bloomberg L.P.; Haver Analytics; Treasury staff calculations; Treasury staff estimates; and World Bank WDI.*	*9/*
FXI/GDP * K openness		
Observed	*IMF IFS; national authorities; IMF WEO; Bloomberg L.P.; Haver Analytics; Treasury staff calculations; Treasury staff estimates; Quinn database; and Chinn-Ito database.*	*8/*
Instrumented	*IMF IFS; national authorities; IMF WEO; Bloomberg L.P.; Haver Analytics; Treasury staff calculations; Treasury staff estimates; World Bank WDI; Quinn database; and Chinn-Ito database.*	*10/*
Detrended private credit/GDP	BIS; World Bank WDI; IMF WEO; Haver Analytics; Drehmann et al. (2011); and Treasury staff estimates.	
L.Relative output per worker * K openness	IMF WEO; national authorities; UN World Population Prospects, 2019 Revision; Haver Analytics; Treasury staff calculations; Quinn database; and Chinn-Ito database.	
L.demeaned VIX * K openness	CBOE; Haver Analytics; Quinn database; and Chinn-Ito database.	
L.demeaned VIX * K openness * Safe asset index	CBOE; national authorities; IMF IFS; Bank of International Settlements (BIS); IMF Currency Composition of Official Foreign Exchange Reserves (COFER); Haver Analytics; Treasury staff estimates; Quinn database; and Chinn-Ito database.	
Other Data		
CA-REER semi elasticity	Cubeddu et al. 2019; IMF WEO; IMF IFS; national authorities; Haver Analytics; and Treasury staff calculations.	

Table A1. GERAF Data Sources

Variable*	Sources**	Notes
REER trade weights	UN COMTRADE; UN National Accounts; IMF DOTS; national authorities; Haver Analytics; and Treasury staff calculations.	11/
Additional Explanatory Variables (See Appendix C)		
Reserve currency status	IMF Currency Composition of Official Foreign Exchange Reserves (COFER); and Haver Analytics.	
Change in FX Reserves/GDP	IMF IFS; IMF WEO; and Haver Analytics.	
Real interest rates	IMF IFS; IMF WEO; national authorities; and Haver Analytics.	
Real interest rates * K openness	IMF IFS; IMF WEO; national authorities; Haver Analytics; Quinn database; and Chinn-Ito database.	
Inflation (period average)	IMF WEO; and Haver Analytics.	
Inflation (period average; bounded index, 0 to 1)	IMF WEO; Haver Analytics; and Treasury staff calculations.	12/
Share of urban population	World Bank WDI; and Haver Analytics.	
Young-age dependency ratio (YADR)	UN World Population Prospects, 2019 Revision; and Haver Analytics.	
Gini index	World Bank WDI; and Haver Analytics.	
Income share held by top ten percent	World Bank WDI; and Haver Analytics.	
Financial center dummy	IMF External Balance Assessment dataset (2019 vintage).	

Table A1. GERAF Data Sources

Variable*	Sources**	Notes
Fixed exchange rate regime dummy	Ilzetzki, Reinhart, and Rogoff (2019); and Treasury staff calculations.	

* Variable construction consistent with that of Cubeddu et al. (2019), unless otherwise noted.

** Where necessary and applicable, any gaps in data are filled with data from the 2019 vintage of the IMF External Balance Assessment dataset.

1/ Uses IMF desk estimates where available, otherwise estimated using via HP filter with λ=100 (which closely replicates IMF desk estimates, per Grigoli et al. (2015)).

2/ Gap estimated using via HP filter with λ=100.

3/ Collected from archived WEO databases.

4/ Country-specific index reflecting the relative quality of safe assets. To capture price factors, we estimate time-varying monthly conditional correlations between a) local currency-to-SDR exchange rates and the inverse of the VIX index, and b) 10-year sovereign bond yields and the inverse of the VIX index for each country. Conditional correlations are derived from country-specific dynamic conditional correlation multivariate generalized autoregressive conditional heteroskedasticity (DCC-MGARCH) estimations (see Engle (2002); Engle and Sheppard (2001)). The sum of these two conditional correlations are then standardized relative to the entire panel of countries, collapsed to the annual level, and then, in order to reflect more structural dynamics, we take the trend component of this standardized index using an HP filter where λ=100. Lastly, to capture quantity factors, the price factor index is weighted by the country's currency share of foreign exchange reserves in the COFER database.

5/ Variable construction broadly consistent with that of Cubeddu et al. (2019), but uses fuel trade balance instead of oil trade balance due to limited data availability.

6/ Variable construction broadly consistent with that of Cubeddu et al. (2019). Uses IMF desk estimates where available, otherwise estimated by taking the residual of a regression of the overall fiscal balance on the output gap. Unlike Cubeddu et al. (2019), which uses a country-specific regression approach, we prefer a pooled Ordinary Least Squares (OLS) fixed-effect regression specification. Doing so allows us to control for country-specific factors while simultaneously exploiting a much larger regression sample.

7/ Variable construction broadly consistent with that of Cubeddu et al. (2019), using a two-stage regression approach for instrumentation. Here, the first-stage regression uses the VIX index instead of U.S. corporate spreads as an instrument to proxy global risk aversion, and uses the ICRG democratic accountability sub-index instead of the Polity democracy ranking index as an instrument to proxy country-specific degrees of democracy. In line with Cubeddu et al. (2019), the first-stage regression uses a pooled OLS approach, and also controls for the independent model regressors.

8/ Uses methodology consistent with Treasury's Macroeconomic and Foreign Exchange Policies of Major Trading Partners of the United States. Estimates are normally based on publicly available data for intervention on foreign asset purchases by authorities, or estimated based on valuation-adjusted foreign exchange reserves. This adjustment requires assumptions about both the currency and asset composition of reserves in order to isolate returns on assets held in reserves and currency valuation moves from actual purchases and sales, including estimations of transactions in foreign exchange derivatives markets. Estimates can also be based on alternative data series when they provide a more accurate picture of foreign exchange balances than estimates derived from changes in valuation-adjusted reserves.

Table A1. GERAF Data Sources

Variable*	Sources**	Notes

9/ Variable construction broadly consistent with that of Cubeddu et al. (2019), using a two-stage regression approach for instrumentation. Here, the first-stage regression uses the same measures of global accumulation of reserves and reserve adequacy, but they are expressed relative to the global weighted-average instead of the emerging market average. In line with Cubeddu et al. (2019), the first-stage regression includes a dummy for emerging markets to control for emerging market-specific dynamics. The first-stage regression uses a pooled OLS approach, and also controls for the independent model regressors.

10/ Defined as instrumented FXI/GDP interacted with capital account openness.

11/ Variable construction broadly consistent with Turner and Van't dack (1993).

12/ Defined as inflation rate divided by one plus the rate of inflation.

Appendix B: List of Countries

Table B1. List of Countries

Argentina	Malaysia
Australia	Mexico
Austria	Morocco
Belgium	Netherlands
Brazil	New Zealand
Canada	Nigeria
Chile	Norway
China	Pakistan
Colombia	Peru
Costa Rica	Philippines
Czech Republic	Poland
Denmark	Portugal
Egypt	Russia
Finland	South Africa
France	Spain
Germany	Sri Lanka
Greece	Sweden
Guatemala	Switzerland
Hungary	Thailand
India	Tunisia
Indonesia	Turkey
Ireland	United Kingdom
Israel	United States
Italy	Uruguay
Japan	Vietnam
Korea	

Appendix C: Robustness Checks and Regression Extensions

Table C1. GERAF Current Account Model: Alternative Estimators

	(1) GERAF Baseline (PCSE)	(2) Pooled OLS	(3) Pooled OLS	(4) Pooled OLS	(5) Pooled OLS	(6) PCSE	(7) PCSE	(8) PCSE
Cyclical factors								
Output gap #	-0.370***	-0.250***	-0.330***	-0.246***	-0.329***	-0.370***	-0.370***	-0.367***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Commodity TOT gap	0.273***	0.172**	0.301***	0.175**	0.312***	0.341***	0.281***	0.370***
	(0.000)	(0.029)	(0.001)	(0.031)	(0.001)	(0.000)	(0.000)	(0.000)
Macroeconomic Fundamentals								
Trade openness/GDP #	0.018***	0.012***	0.050***	0.011**	0.046***	0.035***	0.017***	0.034***
	(0.006)	(0.007)	(0.000)	(0.015)	(0.000)	(0.004)	(0.007)	(0.004)
L. NFA/GDP	0.039***	0.066***	0.061***	0.067***	0.057***	0.024***	0.037***	0.018**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.000)	(0.043)
L. NFA/GDP * (Dummy if L.NFA/GDP < -60%)	-0.015	-0.046**	-0.094***	-0.047**	-0.089***	-0.031*	-0.009	-0.023
	(0.379)	(0.014)	(0.000)	(0.017)	(0.000)	(0.079)	(0.601)	(0.198)
L.Output per worker, relative to top 3 economies	0.037*	0.038**	0.043	0.037**	0.030	0.043	0.040*	0.028
	(0.099)	(0.036)	(0.202)	(0.045)	(0.355)	(0.264)	(0.081)	(0.473)
Real GDP growth, forecast in 5 years #	-0.231**	-0.471***	-0.568***	-0.537***	-0.638***	-0.317***	-0.264***	-0.339***
	(0.013)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.006)	(0.000)
Safe asset index	-0.065***	-0.094***	-0.072***	-0.099***	-0.083***	-0.046**	-0.075***	-0.064***
	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.035)	(0.002)	(0.007)
Structural Fundamentals								
Demographic block								
Old-age dependency ratio #	-0.121***	-0.141***	-0.200***	-0.149***	-0.194***	-0.128**	-0.125***	-0.109*
	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)	(0.035)	(0.006)	(0.079)
Population growth #	-0.616*	-0.724***	-1.013***	-0.696***	-0.835***	-0.614	-0.586*	-0.376
	(0.074)	(0.001)	(0.002)	(0.002)	(0.010)	(0.149)	(0.088)	(0.397)
Prime savers share #	0.207***	0.202***	0.046	0.209***	0.052	0.057	0.222***	0.067
	(0.000)	(0.000)	(0.228)	(0.000)	(0.177)	(0.319)	(0.000)	(0.241)
Life expectancy at prime age #	-0.006***	-0.005***	-0.003	-0.005***	-0.003	-0.003	-0.006***	-0.003
	(0.000)	(0.000)	(0.165)	(0.000)	(0.240)	(0.288)	(0.000)	(0.311)
Life expectancy at prime age # * Future OADR	0.015***	0.008***	0.013**	0.007***	0.012**	0.016**	0.014***	0.013*
	(0.000)	(0.001)	(0.010)	(0.003)	(0.017)	(0.025)	(0.001)	(0.060)
Institutional/political environment (ICGR-12) #	-0.080***	-0.111***	-0.047**	-0.110***	-0.042*	-0.042*	-0.086***	-0.045*
	(0.000)	(0.000)	(0.046)	(0.000)	(0.092)	(0.078)	(0.000)	(0.068)
Oil and natural gas trade balance * Resource temporariness #	0.300***	0.145*	0.318**	0.127	0.283**	0.585***	0.292**	0.533***
	(0.008)	(0.073)	(0.018)	(0.167)	(0.047)	(0.001)	(0.013)	(0.002)
Policy Variables								
Cyclically-adjusted fiscal balance (instrumented) #	0.537***	0.782***	0.341**	0.789***	0.352**	0.282**	0.537***	0.227*
	(0.000)	(0.000)	(0.045)	(0.000)	(0.038)	(0.033)	(0.000)	(0.094)
L.Public health spending/GDP #	-0.267*	-0.239**	-0.607***	-0.263**	-0.670***	-0.573***	-0.295**	-0.630***
	(0.058)	(0.016)	(0.000)	(0.012)	(0.000)	(0.001)	(0.039)	(0.001)
FX Intervention								
FXI/GDP (instrumented) #	0.682***	0.729***	0.439*	0.842***	0.513*	0.453**	0.815***	0.557**
	(0.002)	(0.002)	(0.060)	(0.001)	(0.053)	(0.033)	(0.001)	(0.016)
FXI/GDP (instrumented) # * K openness	-0.509**	-0.269	0.163	-0.364	0.016	-0.172	-0.676***	-0.361
	(0.045)	(0.300)	(0.544)	(0.154)	(0.955)	(0.493)	(0.009)	(0.162)
Detrended private credit/GDP #	-0.097***	-0.114***	-0.073***	-0.112***	-0.071***	-0.080***	-0.093***	-0.075***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capital Controls								
L.Relative output per worker * K openness	0.039	0.047**	0.049*	0.050**	0.053*	0.030	0.040	0.031
	(0.114)	(0.015)	(0.072)	(0.012)	(0.061)	(0.296)	(0.113)	(0.286)
L.demeaned VIX * K openness	0.033**	0.033*	0.071***	-0.070	-0.039	0.054***	-0.077*	-0.065
	(0.025)	(0.070)	(0.000)	(0.221)	(0.451)	(0.000)	(0.083)	(0.133)
L.demeaned VIX * K openness * Safe asset index	-0.057	-0.014	-0.189*	0.079	-0.089	-0.178*	0.031	-0.086
	(0.602)	(0.928)	(0.059)	(0.619)	(0.388)	(0.050)	(0.778)	(0.352)
Constant	-0.022***	-0.018***	-0.038**	-0.019**	-0.037*	-0.045**	-0.031***	-0.045*
	(0.000)	(0.000)	(0.038)	(0.037)	(0.056)	(0.044)	(0.000)	(0.054)
Country-fixed effects	No	No	Yes	No	Yes	Yes	No	Yes
Time-fixed effetcs	No	No	No	Yes	Yes	No	Yes	Yes
Observations	1,273	1,273	1,273	1,273	1,273	1,273	1,273	1,273
Number of countries	51	51	51	51	51	51	51	51
R-squared	0.385	0.605	0.744	0.616	0.755	0.545	0.415	0.568
RMSE	0.019	0.030	0.025	0.030	0.025	0.019	0.019	0.018

"L." denotes variables expressed using a one year lag. "#" denotes variables expressed relative to the annual world GDP-weighted average. P-values in parentheses. OLS standard errors are robust to heteroskedasticity; PCSE standard errors are robust to heteroskedasticity, autocorrelation and cross-sectional dependence. PCSE regressions include a panel-wide AR(1) correction to control for potential autocorrelation in the dependent variable. ***, **, * next to a number indicate statistical significance at 1, 5 and 10 percent, respectively.

Source: U.S. Treasury staff calculations.

Table C2. GERAF Current Account Model: Robustness

	(1) GERAF Baseline	(2)	(3)	(4)	(5)	(6)	(7)
Cyclical factors							
Output gap #	-0.370***	-0.390***	-0.385***	-0.396***	-0.397***	-0.386***	-0.387***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Commodity TOT gap	0.273***	0.308***	0.319***		0.305**		0.304**
	(0.000)	(0.000)	(0.000)		(0.024)		(0.025)
Commodity TOT gap * Trade openness				0.422***	-0.040	0.465***	0.003
				(0.000)	(0.871)	(0.000)	(0.989)
Macroeconomic Fundamentals							
Trade openness/GDP #	0.018***	0.023***	0.024***			0.023***	0.023***
	(0.006)	(0.000)	(0.000)			(0.000)	(0.000)
L. NFA/GDP	0.039***	0.026***	0.024***	0.026***	0.026***	0.024***	0.025***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L. NFA/GDP * (Dummy if L.NFA/GDP < -60%)	-0.015	0.010	0.010	0.011	0.009	0.013	0.011
	(0.379)	(0.467)	(0.470)	(0.427)	(0.498)	(0.338)	(0.402)
L.Output per worker, relative to top 3 economies	0.037*	0.019	0.034	0.043*	0.043*	0.034	0.035
	(0.099)	(0.366)	(0.137)	(0.062)	(0.057)	(0.133)	(0.121)
Real GDP growth, forecast in 5 years #	-0.231**	-0.114	-0.116	-0.128	-0.131	-0.112	-0.116
	(0.013)	(0.191)	(0.182)	(0.142)	(0.133)	(0.197)	(0.182)
Safe asset index	-0.065***	-0.035		-0.068***	-0.066***	-0.046**	-0.045**
	(0.004)	(0.103)		(0.002)	(0.003)	(0.034)	(0.038)
Reserve currency status			-0.048***				
			(0.004)				
Structural Fundamentals							
Demographic block							
Old-age dependency ratio #	-0.121***	-0.087**	-0.080*	-0.106**	-0.104**	-0.090**	-0.088**
	(0.006)	(0.040)	(0.058)	(0.015)	(0.016)	(0.036)	(0.038)
Population growth #	-0.616*	-0.658*	-0.707**	-0.608*	-0.606*	-0.660*	-0.657*
	(0.074)	(0.056)	(0.045)	(0.084)	(0.085)	(0.058)	(0.058)
Prime savers share #	0.207***	0.203***	0.200***	0.233***	0.227***	0.219***	0.214***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Life expectancy at prime age #	-0.006***	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Life expectancy at prime age # * Future OADR	0.015***	0.017***	0.019***	0.015***	0.015***	0.018***	0.018***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional/political environment (ICGR-12) #	-0.080***	-0.069***	-0.071***	-0.067***	-0.066***	-0.072***	-0.071***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Oil and natural gas trade balance * Resource temporariness #	0.300***	0.443***	0.405***	0.366***	0.370***	0.425***	0.427***
	(0.008)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Policy Variables							
Cyclically-adjusted fiscal balance (instrumented) #	0.537***	0.496***	0.486***	0.587***	0.578***	0.530***	0.521***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.Public health spending/GDP #	-0.267*	-0.340**	-0.337**	-0.239*	-0.234*	-0.330**	-0.324**
	(0.058)	(0.015)	(0.016)	(0.086)	(0.092)	(0.018)	(0.020)
FX Intervention							
FXI/GDP (instrumented) #	0.682***		1.233***	1.271***	1.294***	1.210***	1.234***
	(0.002)		(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
FXI/GDP (instrumented) # * K openness	-0.509**		-1.059**	-1.146***	-1.138***	-1.067**	-1.060**
	(0.045)		(0.014)	(0.008)	(0.008)	(0.014)	(0.014)
(ΔFX Reserves)/GDP (instrumented) #		0.283***					
		(0.001)					
Detrended private credit/GDP #	-0.097***	-0.097***	-0.094***	-0.099***	-0.098***	-0.096***	-0.095***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capital Controls							
L.Relative output per worker * K openness	0.039	0.053**	0.044*	0.035	0.034	0.041*	0.040
	(0.114)	(0.025)	(0.077)	(0.160)	(0.169)	(0.098)	(0.103)
L.demeaned VIX * K openness	0.033**	0.015	0.016	0.008	0.012	0.012	0.016
	(0.025)	(0.254)	(0.296)	(0.579)	(0.385)	(0.395)	(0.251)
L.demeaned VIX * K openness * Safe asset index	-0.057	0.009		0.049	0.020	0.026	-0.001
	(0.602)	(0.931)		(0.678)	(0.865)	(0.810)	(0.994)
L.demeaned VIX * K openness * Reserve currency status			0.043				
			(0.705)				
Constant	-0.022***	-0.025***	-0.026***	-0.022***	-0.022***	-0.026***	-0.026***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,273	1,285	1,285	1,297	1,297	1,285	1,285
Number of countries	51	51	51	51	51	51	51
R-squared	0.385	0.379	0.377	0.356	0.363	0.373	0.380
RMSE	0.019	0.019	0.019	0.019	0.019	0.019	0.019

Instrumented variables in each alternate specification control for the independent model regressors in their respective specification. "L." denotes variables expressed using a one year lag. "#" denotes variables expressed relative to the annual world GDP-weighted average. P-values in parentheses. Standard errors are robust to heteroskedasticity, autocorrelation and cross-sectional dependence. Regressions include a panel-wide AR(1) correction to control for potential autocorrelation in the dependent variable. ***, **, * next to a number indicate statistical significance at 1, 5 and 10 percent, respectively.
Source: U.S. Treasury staff calculations.

Table C3. GERAF Current Account Model: Extensions

	(1) GERAF Baseline	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Cyclical factors													
Output gap #	-0.370***	-0.378***		-0.378***		-0.384***	-0.379***	-0.386***	-0.386***	-0.400***	-0.399***	-0.397***	-0.388***
	(0.000)	(0.000)		(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Commodity TOT gap	0.273***	0.297***	0.226***	0.298***	0.227***	0.291***	0.294***	0.306***	0.297***	0.293***	0.290***	0.344***	0.302***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Macroeconomic Fundamentals													
Trade openness/GDP #	0.018***	0.025***	0.028***	0.025***	0.028***	0.022***	0.023***	0.023***	0.022***	0.016**	0.016**	0.026***	0.022***
	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)	(0.011)	(0.000)	(0.000)
L. NFA/GDP	0.039***	0.023***	0.020***	0.023***	0.021***	0.024***	0.024***	0.025***	0.025***	0.025***	0.025***	0.032***	0.026***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L. NFA/GDP * (Dummy if L.NFA/GDP < -60%)	-0.015	0.013	0.015	0.013	0.015	0.013	0.013	0.011	0.012	0.014	0.015	0.006	0.011
	(0.379)	(0.358)	(0.291)	(0.362)	(0.294)	(0.335)	(0.339)	(0.423)	(0.372)	(0.300)	(0.300)	(0.684)	(0.420)
L.Output per worker, relative to top 3 economies	0.037*	0.049*	0.047*	0.049*	0.046*	0.033	0.030	0.034	0.035	0.055**	0.052**	0.011	0.037
	(0.099)	(0.050)	(0.077)	(0.051)	(0.079)	(0.140)	(0.184)	(0.156)	(0.121)	(0.024)	(0.031)	(0.697)	(0.107)
Real GDP growth, forecast in 5 years #	-0.231**	-0.112	-0.168*	-0.112	-0.168*	-0.113	-0.111	-0.122	-0.146*	-0.129	-0.139	-0.073	-0.119
	(0.013)	(0.237)	(0.095)	(0.238)	(0.096)	(0.203)	(0.211)	(0.161)	(0.094)	(0.177)	(0.146)	(0.525)	(0.172)
Safe asset index	-0.065***	-0.031	-0.030	-0.031	-0.030	-0.044**	-0.042**	-0.043**	-0.038*	-0.039*	-0.043**	-0.028	-0.042**
	(0.004)	(0.169)	(0.158)	(0.171)	(0.161)	(0.040)	(0.047)	(0.044)	(0.074)	(0.064)	(0.038)	(0.202)	(0.047)
Structural Fundamentals													
Demographic block													
Old-age dependency ratio #	-0.121***	-0.070	-0.068	-0.070	-0.068	-0.085**	-0.081*	-0.088**	-0.071*	-0.121***	-0.134***	-0.103**	-0.094**
	(0.006)	(0.126)	(0.145)	(0.124)	(0.144)	(0.048)	(0.060)	(0.037)	(0.093)	(0.008)	(0.005)	(0.026)	(0.028)
Population growth #	-0.616*	-0.523	-0.933**	-0.523	-0.933**	-0.651*	-0.671*	-0.645*	-0.105	-0.751**	-0.738**	-1.332***	-0.666*
	(0.074)	(0.171)	(0.019)	(0.171)	(0.019)	(0.066)	(0.059)	(0.062)	(0.807)	(0.036)	(0.041)	(0.002)	(0.052)
Prime savers share #	0.207***	0.210***	0.183***	0.210***	0.183***	0.213***	0.211***	0.214***	0.187***	0.151**	0.167***	0.185***	0.216***
	(0.000)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.001)	(0.018)	(0.010)	(0.003)	(0.000)
Life expectancy at prime age #	-0.006***	-0.007***	-0.008***	-0.007***	-0.008***	-0.007***	-0.007***	-0.007***	-0.008***	-0.007***	-0.007***	-0.005***	-0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Life expectancy at prime age # * Future OADR	0.015***	0.019***	0.022***	0.019***	0.022***	0.018***	0.018***	0.018***	0.019***	0.016***	0.018***	0.015***	0.018***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Institutional/political environment (ICGR-12) #	-0.080***	-0.076***	-0.120***	-0.076***	-0.120***	-0.072***	-0.066***	-0.072***	-0.083***	-0.079***	-0.076***	-0.075***	-0.069***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Oil and natural gas trade balance * Resource temporariness #	0.300***	0.483***	0.491***	0.483***	0.492***	0.434***	0.442***	0.428***	0.440***	0.380***	0.397***	0.461***	0.416***
	(0.008)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Policy Variables													
Cyclically-adjusted fiscal balance (instrumented) #	0.537***	0.495***	0.605***	0.492***	0.604***	0.558***	0.563***	0.523***	0.567***	0.610***	0.607***	0.584***	0.509***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
L.Public health spending/GDP #	-0.267*	-0.368**	-0.222	-0.368**	-0.222	-0.319**	-0.349**	-0.331**	-0.324**	-0.179	-0.167	-0.320*	-0.316**
	(0.058)	(0.013)	(0.148)	(0.013)	(0.149)	(0.026)	(0.013)	(0.021)	(0.019)	(0.231)	(0.266)	(0.052)	(0.022)
FX Intervention													
FXI/GDP (instrumented) #	0.682***	1.227***	1.410***	1.226***	1.409***	1.230***	1.205***	1.235***	1.181***	1.315***	1.307***	0.701*	1.257***
	(0.002)	(0.002)	(0.000)	(0.002)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.083)	(0.001)
FXI/GDP (instrumented) # * K openness	-0.509**	-1.041**	-1.181**	-1.040**	-1.180**	-1.060**	-1.038**	-1.056**	-0.999**	-1.048**	-1.024**	-0.320	-1.067**
	(0.045)	(0.025)	(0.014)	(0.025)	(0.014)	(0.016)	(0.018)	(0.015)	(0.020)	(0.021)	(0.024)	(0.526)	(0.014)
Detrended private credit/GDP #	-0.097***	-0.093***	-0.106***	-0.093***	-0.106***	-0.099***	-0.097***	-0.096***	-0.098***	-0.093***	-0.092***	-0.096***	-0.096***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capital Controls													
L.Relative output per worker * K openness	0.039	0.022	0.029	0.023	0.029	0.042*	0.045*	0.041	0.037	0.021	0.022	0.054*	0.038
	(0.114)	(0.421)	(0.322)	(0.419)	(0.319)	(0.093)	(0.072)	(0.104)	(0.135)	(0.434)	(0.410)	(0.085)	(0.125)
L.demeaned VIX * K openness	0.033**	0.020	0.011	0.020	0.011	0.015	0.014	0.016	0.016	-0.000	-0.004	0.017	0.016
	(0.025)	(0.147)	(0.438)	(0.143)	(0.431)	(0.266)	(0.293)	(0.226)	(0.229)	(0.975)	(0.776)	(0.268)	(0.250)
L.demeaned VIX * K openness * Safe asset index	-0.057	-0.023	0.045	-0.023	0.044	0.005	0.005	-0.003	-0.028	0.037	0.056	0.060	-0.002
	(0.602)	(0.837)	(0.666)	(0.831)	(0.672)	(0.960)	(0.964)	(0.980)	(0.794)	(0.729)	(0.595)	(0.576)	(0.987)
Real interest rates #		-0.001*	-0.001**										
		(0.095)	(0.039)										
Real interest rates * K openness #				-0.001	-0.002*								
				(0.119)	(0.051)								
Inflation #						-0.000							
						(0.991)							
Inflation (bounded index, 0 to 1) #							0.025*						
							(0.061)						
Share of urban population #								0.004					
								(0.773)					
Young-age dependency ratio #									-0.023**				
									(0.033)				
Gini #										-0.078***			
										(0.000)			
Income share held by top ten percent #											-0.108***		
											(0.000)		
L.Financial center												-0.009	
												(0.306)	
Fixed exchange rate regime													0.002
													(0.461)
Constant	-0.022***	-0.027***	-0.031***	-0.027***	-0.031***	-0.026***	-0.027***	-0.026***	-0.025***	-0.022***	-0.020***	-0.015*	-0.028***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.069)	(0.000)
Observations	1,273	1,164	1,164	1,164	1,164	1,270	1,270	1,285	1,285	1,169	1,159	893	1,285
Number of countries	51	51	51	51	51	51	51	51	51	50	50	40	51
R-squared	0.385	0.365	0.312	0.365	0.311	0.378	0.378	0.381	0.384	0.390	0.391	0.416	0.384
RMSE	0.019	0.019	0.020	0.019	0.020	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019

Instrumented variables in each alternate specification control for the independent model regressors in their respective specification. "L." denotes variables expressed using a one year lag. "#" denotes variables expressed relative to the annual world GDP-weighted average. P-values in parentheses. Standard errors are robust to heteroskedasticity, autocorrelation and cross-sectional dependence. Regressions include a panel-wide AR(1) correction to control for potential autocorrelation in the dependent variable. ***, **, * next to a number indicate statistical significance at 1, 5 and 10 percent, respectively.
Source: U.S. Treasury staff calculations.