Effects of Inequality on the US Current Account: A Long-Run Perspective

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1 Introduction

Much political economic debate in the United States has centered on the current account deficit, in particular its effects on economic performance. In the wake of the Global Financial Crisis, attention has focused on global account imbalances (i.e. the US's large current account deficit and China and Germany's large surpluses) as a potential cause. Given the recent focus on inequality, it is important to consider its role in the development of such imbalances. In other words, symptoms of economic performance and policy, namely the distribution of income and wealth within a country, may also directly impact a country's current account balance.

The literature omits two significant factors that this paper will hope to address. First, long-run dynamics are difficult to identify under current data and methods. Exploiting an extensive data set from Piketty & Zucman (2014), enabling time-series analysis and the application of the cointegrated vector autoregression (CVAR) model, can help fill this gap. Second, inequality considerations have focused on income and its concentration as it relates to consumption behavior. Again utilizing the extensive time-series data compiled by Piketty & Zucman (2014) we include private wealth accumulation, thus incorporating a proxy for wealth concentration into the model–a factor that would effect both savings and investment variables in the flow of net financial assets. Additionally, we also consider actual data on wealth inequality.

From the longer time-series of net foreign assets (figure 2, appendix section A.3), it is apparent

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that the development of a negative balance for the US in the last 25 years is not a novel position. Thus inequality may have contributed to past deficits, outside the period of global imbalances in the last 20 years.

In applying a CVAR model to estimate such possible long-run relationships we embrace a *general-to-specific* method whereby a statistical model of the data is first determined, and then long and short run hypotheses are tested by imposing restrictions on the true statistical representation of the data. In other words we do not follow a micro-founded approach in developing a model on inequality's effects on the current account. Still, the following intuition motivates our research: an increase in income inequality will increase household indebtedness and thus increase the current account deficit as a result of decreased private saving in the face of constant investment; an increase in wealth inequality may have the opposite effect, by increasing the concentration of available resources to acquire foreign assets and thus increasing the net foreign assets owned overall by the US. To consider our results we also estimate an alternate model with other determinants of total net foreign assets, foreign factor income and investment income balance. As both are positive contributing components we would expect both to have positive effects on net foreign assets

Overall we find that while income inequality may have a marginal negative effect on net foreign assets and thus the current account balance, through either pushing forces or long-run common trends, wealth inequality has absolutely no effect. Conversely, the *total* accumulation of private wealth has an enormously strong negative effect on the net foreign account and is itself associated with decreasing wealth inequality. We find similar results in our alternative model, however with net foreign factor income playing the role of significant variable.

2 Background

Two basic approaches have been explored, the first building a micro-founded mechanism for inequality's effect on the current account. Using a DSGE model to examine the effects of inequality (and hence household leverage) on financial stability and economic crises, Kumhof & Ranciere (2010) suggest the consideration of an open economy model to account for the foreign-financed consumption boom in the United States. Thus they conjecture that income inequality is a possible mechanism to explain global current account imbalances. To empirically test the validity of the above claim Kumhof et al. (2012) employ an ARDL model, and find that increasing income inequality leads to significantly greater current account deficits. This effect is incorporated into a DSGE model and calibrated for several advanced economies. More precisely, the mechanism suggests financially developed countries absorb increasing inequality with higher household debt, thus smoothing consumption and decreasing the current account.

Belabed et al. (2013) also develop a micro-foundational model yet emphasize a relative, rather than permanent, income hypothesis mechanism to find similar results. Using a stock-flow consistent (SFC) macroeconomic model calibrated to three countries for the last 25 years, China, Germany, and the US, they find that increasing income inequality in the US contributes to its deficit while Germany's stable and lower income inequality contributes to its surplus. Additionally the shift in the functional income distribution in favor of capital has helped both Germany and China increase their surpluses.

In a synthesis of the above two papers, Al-Hussami & Remesal (2012) build a theoretical model incorporating relative consumption, or "expenditure cascades", and household leverage excluding physical capital, arguing that capital flows overwhelmingly financed consumption. The intertemporal current account is derived from household budget constraints, thus they are simply augmenting the benchmark Obstfeld & Rogoff (1996) model while considering shocks to income inequality. From their current account model, they study the effects of consumption externalities on the current account with the following equation

$$\frac{dCA}{d\gamma} = -\xi\alpha\frac{dC_L}{d\gamma} \tag{1}$$

where ξ is the share of lower-income households, α is a share of net foreign assets and γ is a parameter measuring the degree of consumption externalities, or relative consumption. The effect is negative so long as $\beta(1+r) < 1$, where β is the typical discount factor.

They estimate their theoretical model with the simple linear regression

$$\begin{aligned} CA_{it} = \alpha + \beta_1 inequality_{it} + \beta_2 financial\ liberalization \\ + \beta_3(inequality_{it} * financial\ liberalization) + \beta_4 X_{it} + \delta_t + \varepsilon_{it} \end{aligned} \tag{2}$$

for a panel of countries and find that financial liberalization and income inequality are both negatively correlated with the current account and significant.

In a somewhat different exercise, Dutt & Mukhopadhyay (2005) eschew a micro-founded model and simply use a vector autoregression (VAR) method to consider globalization's effect on inequality. Thus they only measure *between* country inequality. From their impulse response analysis they find a shock to a country's current account leads to increasing international inequalities.

Bofinger (2012) argues the opposite, that increasing inequality has lead to an increase in the accumulation of financial assets, i.e. saving, and increased saving increases the account surplus. He cites the common increasing inequality of both China and the US from 1995-2005 leading to diverging account balances.

Finally, Zucman (2013) finds that offshore tax havens may be holding up to 6% of total global wealth, in particular assets of the top 1% of wealth holders globally–a large share of whom are Americans. Because this 6% estimate is entirely unrecorded in national accounts the US net debt, or cumulative account deficit, may in fact be significantly smaller than estimated. The author also estimates that the Eurozone, consequently, is a net creditor rather than debtor as previously assumed.

3 Methodology

Because we do not follow a micro-founded model to analyze the effect of inequality on the current account of the US, we utilize components of national income accounting and then estimate the effects of inequality using a *general-to-specific* method, in particular the CVAR model.

3.1 National Income Accounting

Following Obstfeld & Rogoff (1996) we define current account balance as $CA_t = S_t - I_t$, where CA_t measures changes in national account flows. Given the available historic data, Piketty & Zucman (2014) define S and I for the US using the following methodology for observations between 1870-1929:

$$S_t = \frac{(K - FI)}{NNP} + \frac{X - M + FY_t + (FT + FK)_{transf}}{Y_t} \tag{3}$$

$$I_t = \frac{(K - FI)}{NNP} \tag{4}$$

and the following methodology for data between 1930-2010:

$$S_t = \frac{(Inv - KD)}{Y_t} + \frac{X - M + FY_t + (FT + FK)_{transf}}{Y_t} - \frac{GDP - GDI}{Y_t} \tag{5}$$

$$I_t = \frac{(Inv - KD)}{Y_t} \tag{6}$$

where

$$\begin{aligned}
K &= \text{Net Capital formation} \\
FI &= \text{Net Foreign Investment} \\
NNP &= \text{Net National Product} \equiv GDP - depreciation \\
X - M &= \text{Net Exports} \\
FY_t &= \text{Net Foreign Factor Income} \equiv GNP - GDP \\
FT &= \text{Net Foreign Taxes and Current Transfers} \\
FK &= \text{Net Foreign Capital Transfers} \\
Y_t &= \text{National Income} \\
Inv &= \text{Gross Domestic Capital Formation} \\
KD &= \text{Capital Depreciation} \\
GDI &= \text{Gross Domestic Investment}
\end{aligned}$$

However, given the stationary of CA_t as a flow variable (see Augmented Dickey-Fuller test results in the appendix, section B) we focus of the net foreign asset (NFA) position of the US, a stock concept, defined as $NFA_t = FA_t - FL_t$ where FA_t are foreign assets and FL_t foreign liabilities.

3.2 Wealth Accounting

An important variable in our model is *beta*, the ratio of total capital wealth to national income as derived by Piketty & Zucman (2014). In other words, a measure of private wealth accumulation since nearly all net wealth in the US is private. (We name it *beta*, rather than β to distinguish it from cointegrating vectors in the CVAR model.) In using data from Piketty & Zucman (2014), we also follow their accounting methodology where accumulation of private wealth is defined using

$$W_t = National\ Wealth - Government\ Wealth \tag{7}$$

and national income is defined as

$$Y_t = Nominal\ GNP - Net\ Domestic\ Income, \tag{8}$$

where GNP from before 1929 comes from Balke & Gordon (1989), Table 10. From 1929 the national income Y_t was included in the National Income and Products Accounts series and from 1960 in the Integrated Macroeconomic Accounts data, both from the Federal Reserve. (Note that national wealth includes net foreign assets and excludes household durable goods.) Annual observations were imputed using the following derived growth rate of private wealth:

$$\begin{aligned} 1 + g_t = & (Savings\text{-}induced\ wealth\ growth\ rate) * (Real\ rate\ of\ capital\ gains) \\ & * (Total\text{-}other\text{-}volume\text{-}changes\text{-}induced\ wealth\ growth\ rate) - 1 \end{aligned} \tag{9}$$

3.3 Econometric Model

We focus on the CVAR model to estimate long-run pushing forces on the net foreign account, interpreted as the cointegrating relationships in the model and also the common stochastic trends. We pay close attention to these results as a long-run relationship suggests the discussions of inequality in the context of global imbalances has past precedents. By imposing only statistical assumptions on the model, confirmed by misspecification testing, we impose no theoretical relations on the variables. This *general-to-specific* approach allows us to test many different hypotheses and identification schemes between net foreign assets, or the current account, and the inequality and wealth concentration variables.

Unit-root testing on each variable, in levels and differences, confirms that the CVAR is the correct model to apply. (See section B of the Appendix for test results. Note that lowercase variables indicate the variable as defined in section 3.1 is represented as a share of national income.)

Let $\mathbf{x_t} = (nfa\ beta\ top1\ top1w)'_t$, where nfa is the net foreign asset position of the US as a share of national income, *beta* represents the share of private wealth accumulation to national income (as defined by **?**), $top1$ equals the top 1%'s share of total income and $top1w$ represents the top 1%'s share of total private wealth. Then the theoretical CVAR(k) model estimates the following equation:

$$\Delta \mathbf{x_t} = \alpha\beta' \mathbf{x_{t-1}} + \sum_{i=1}^{k} \Gamma_i \Delta \mathbf{x_{t-i}} + \mu_0 + \mathbf{\Phi D_t} + \varepsilon_\mathbf{t} \tag{10}$$

where the disturbance ε_t is assumed to be Gaussian and $iid(0, \Omega)$, $\mathbf{D_t}$ is a vector of dummy and deterministic variables, k is the lag order of the VAR process, Γ_i is a short-run parameter, β' is the cointegrating vector, and α determines short-run adjustments from disequilibria.

3.4 CVAR Model Specification

We specify a lag order $k = 3$ based the Akaike Final Prediction Error of a VAR(k) model and the Hannan-Quinn information criterion of the CVAR(K) model (see all tests results in appendix, section C). Most importantly, choosing a lag of three supports the absence of serial correlation in the model based upon LM(1) and LM(k) test results (table 5).

From residual analysis we include nine dummy variables, notably for 1976, the same structural break date indicated by the Zivot-Andrews univariate test for $top1w$. This reflects the effect of the Tax Reform Act of 1976 on wealth inequality when the capital gains rate was effectively increased via a minimum tax increase to 15%. Other significant dummies are for years 1941 and 1946, where nfa experienced greater volatility in response to US involvement in and the end of the second World War.

Because our system variable do not have strong linear trends (appendix section A.3) we exclude a linear trend but allow for a non-zero mean in the cointegration relations. (We test for a trend in linear trend in the cointegration relations and cannot reject a null of a zero coefficient on the trend term–see section E of the appendix.)

Regarding the rank of the CVAR model, the trace test statistics, adjusting for our finite sample by simulating asymptotic values using the Bartlett correction, suggest a rank $r = 1$. Given our system has $p = 4$ total variables this indicates one cointegrating relation, or pulling force on the system, and three unit roots, or pushing forces. (See test results in appendix, section E.)

Thus our specified baseline CVAR model is

$$\Delta \mathbf{x_t} = \alpha\beta' \begin{pmatrix} nfa \\ beta \\ top1 \\ top1w \\ \mu \end{pmatrix}_{t-1} + \sum_{i=1}^{3} \Gamma_i \Delta \mathbf{x_{t-i}} + \mu_0 + \mathbf{\Phi D_t} + \varepsilon_{\mathbf{t}}. \tag{11}$$

3.5 Structural VAR & MA Representations

The error terms ε_t have no economic interpretation so we assume that the VAR residuals ε_t are related to some independent structural shocks, u_t and divided into $p - r$ permanent shocks and r transitory shocks. The residuals and structural shocks are related by a matrix B such that

$$u_t = B\varepsilon_t \Leftrightarrow \varepsilon_t = B^{-1}u_t$$

where the errors terms u_t are $iidN_p(0, I_p)$. The transitory shocks are defined by a single zero-column in the impact matrix $\tilde{C} = CB^{-1}$ since there is $r = 1$ cointegrating relationship, whereas the permanent shocks have three non-zero columns in $\tilde{C}$ since there exist $p - r = 3$ common stochastic trends.

From this formulation we derive the structural VAR (SVAR) model corresponding to our CVAR model as

$$B\Delta\mathbf{x_t} = \tilde{\alpha}\beta'\mathbf{x_{t-1}} + \sum_{i=1}^{2}\tilde{\Gamma}_i\Delta\mathbf{x_{t-i}} + \tilde{\Phi}\mathbf{D_t} + \mu_0 + u_t \tag{12}$$

where $\tilde{\alpha} = B\alpha$, $\tilde{\Gamma}_i = B\Gamma_i$, and $\tilde{\Phi} = B\Phi$. Identification of the SVAR model will require imposing p^2 restrictions on the model. Most of the restriction are satisfied by the assumption of a diagonal variance matrix for u_t. Identification of permanent shocks in our baseline model sets exogenous shocks to $top1w$ and $top1$.

To isolate the common stochastic trends, or pushing forces, of the long-run equilibrium relations, it helps to derive the corresponding MA form of the model as follows

$$\mathbf{x_t} = C\sum_{i=1}^{t}(\varepsilon_i + \Phi D_i) + C^*(L)(\varepsilon_t + \Phi D_t) + \tilde{\mathbf{x}}_\mathbf{0} \tag{13}$$

where $C = \beta_\perp(\alpha'_\perp(I_p - \sum_{i=1}^{2}\Gamma_i)\beta_\perp)^{-1}\alpha'_\perp$ and is considered the long-run impact matrix and $C^*(L)$ is a stationary, infinite order polynomial.

Inference from the above transformations assumes our model is complete and that the VAR residual covariance matrix is diagonal. This is of course not empirically true, thus our inference from impulse responses to the structural VAR is preliminary and only suggestive. Additionally VECM confidence intervals can not be estimated for impulse responses with standard software packages, thus only coefficient signs are the only useful result.

4 Data

The cited literature uses data from shorter periods, mostly relying on the seminal data set from Lane & Milesi-Ferretti (2001) covering 1970-1998. We exploit the novel data set constructed by Piketty & Zucman (2014) which includes national saving, investment, and external balance accounts for the US from 1870-2010 defined above, among other industrialized countries. Additionally we compute investment income balance and external balances from the data. (The entire series is available in their online data appendix: http://gabriel-zucman.eu/capitalisback/.)

One wrinkle in the data is that foreign asset, FA_t, and liability, FL_t, data contains only 24 observations between 1869 and 1945. However, other series are available for computing annual changes in the current account flow as well as changes in external accounts, and thus we impute net foreign asset values for missing observations. (See appendix, section A.1, for details.) Thus our variable $nfa2$ contains some imputed values and is also measured as a share of national income.

Income distribution data, namely the concentration of income accruing to the top ranked 1% of households in the US, is available from Alvaredo et al. (2013) through their *World Top Incomes Database*. The series is available from 1913, the inception of the US income tax.

Data on the share of private wealth in the US also comes from Piketty & Zucman (2014) and is available for 1870-2010. The derived variable $beta_t = \frac{W_t}{Y_t}$ is equivalent to β_t from Piketty (2014). It provides a general proxy for the accumulation of overall private wealth, which in the US accounts for virtually all net wealth. Notably, wealth inequality data is also available for 1916-2000 from Kopczuk & Saez (2004) as the amount of private wealth held by the top 1% of ranked households based on estate tax returns (other quantiles are also available). This is our variable $top1w$. One concern with the Kopczuk & Saez (2004) data is there exist only seven observations between 1950 and 1982. Imputation of missing observations is discussed in the appendix, section A.2.

5 Results

Given our baseline CVAR model (equation (11)) has a rank of $r = 1$, we interpret identification on the one cointegration relation, and therefore pulling force back to equilibrium, and the complementary $p - r = 3$ common stochastic trends, or long-run equilibrium pushing forces. We first rely on the specification tests of long-run exclusion and stationarity to guide our hypothesis testing on the identification of the cointegration relation parameters. Because we cannot reject long-run exclusion of either, $top1$, $top1w$ or $nfa2$, identification focuses on these restrictions.

We also find weak exogeneity in $nfa2$, suggesting it does not adjust to long-run disequilibria, or that there exists no pulling force as an error-correction to cointegration relationships of external accounts. This is not unexpected, however, as net foreign assets should be a lagging indicator. Interestingly, our test for pure adjustment, or a unit-vector in alpha, is not rejected for $top1w$. Therefore an exogenous shock to wealth inequality should be purely adjusting and only behave as a pushing force back towards the long-run cointegrating relationship. In other words, shocks to wealth inequality have no permanent effect on the system and $top1w$ is endogenous. (All test statistics for above identification results are listed in the appendix, section F.)

The restricted baseline CVAR model is accepted with a Bartlett corrected p-value of 0.759 (appendix section F.2, tables 15 - 18). The $r = 1$ cointegrating vector β_1^c is thus

$$\beta_1^c \mathbf{x}_{t-1} = nfa2 + \underset{[5.595]}{34.624} beta + 0 top1 + 0 top1w - \underset{[-5.430]}{124.622} \sim \mathrm{I}(0). \tag{14}$$

Such an identification scheme rejects our hypothesis of a negative long-run relationship between inequality (in either income or wealth) and the current account deficit as measured by net foreign asset changes. At the same time we find evidence of a very strong (significant) comoving relation between private wealth accumulation and net foreign assets, which lends credence to our initial intuition as well.

Depending on vector normalization choices, considering the MA representation (appendix section G) of the restricted baseline CVAR model (equation (14)) offers some possible interpretations of the $p - r = 3$ common stochastic trends, or pushing forces, in our system. Given the unit vector in alpha for $top1w$ identified above, we normalize on (consider shocks to) $nfa2$ (particularly because of its weak exogeneity), $beta$ and $top1$. Estimates (appendix section G, table 20) suggest the following common stochastic trends:

CT(1) Cumulated shocks to net foreign assets.

CT(2) Cumulated shocks to private wealth accumulation with a small negative (significant) effect from wealth inequality.

CT(3) Cumulated shocks to income inequality with a moderate negative (insignificant) effect from wealth inequality.

From the MA representation, $\tilde{\beta}_\perp$ (table 21) describes the loadings to each of the variables for the common stochastic trends, or how they react to the trends. In CT(1), a small negative (significant) effect to private wealth accumulation coincides with shocks to net foreign assets or a current account surplus. From CT(2) there exists a very negative and significant effect of decreased wealth inequality from shocks to private wealth accumulation. More significant is CT(3), whereby loadings to net foreign assets are negative, significant and the opposite sign of both income and wealth inequality. This supports the intuition for a negative long-run impact of income inequality on the current account. At the same time our initial intuition of wealth inequality leading to an account surplus is not necessarily supported (at the 5% level).

The long-run impact matrix C (table 22), also from the MA representation, indicates the influence on each variable from cumulated disturbances or the permanent stochastic effects. Thus the normalization pattern imposed above suggests the following *significant* long-run effects.

Column-wise inspection shows that *cumulated empirical shocks to*:

1. net foreign assets ($nfa2$) have a small negative effect on private wealth accumulation ($beta$) and a positive effect on itself;
2. private wealth accumulation have a very large negative effect on wealth inequality ($top1w$);
3. income inequality ($top1$) have a negative effect on net foreign assets and positive effects on income and wealth inequality;
4. and wealth inequality have a positive effect on itself.

Row-wise inspection shows that *over time*:

1. net foreign assets have been positively impacted most by its own shocks and negatively impacted by income inequality shocks;
2. private wealth accumulation has been marginally negatively impacted by shocks to net foreign assets and marginally positively impacted by shocks to income inequality;
3. income inequality has been positively impacted by its own shocks;
4. and wealth inequality has been impacted very negatively by private wealth accumulation shocks and positively, but orders of magnitude less, by its own shocks.

The suggested permanent effects from the common stochastic trends reinforce some earlier results: that net foreign assets are strongly negatively comoving with private wealth accumulation in both the long and short runs; that private wealth accumulation decreases wealth inequality in the long run; that both income and wealth inequality have insignificant effects themselves on net foreign assets and thus the current account.

Impulse response functions, however, do show some permanent negative impact on net foreign assets given shocks to income inequality (figure 6, appendix section H.1) and positive impacts from shocks to wealth inequality. Wealth inequality shocks have a permanent effect an order of magnitude less than income inequality's negative effect. An important limitation of the error correcting CVAR model is that confidence intervals can not be estimated for impulse responses and thus inference is inadequate.

For comparative purposes we also estimate a UVAR(2) model and its impulse responses (appendix section H.2). We find that again shocks to income inequality have a significantly negative effect on net foreign assets while shocks to wealth inequality have a significantly positive effect. The former effect lasts half the length than the latter. We also find wealth inequality is significantly negatively effected from shocks to private wealth accumulation.

Overall we cannot claim that either income or wealth as measured inequality has any significant effect on net foreign assets. However, we do find very significant and negative comovement of total private wealth accumulation on net foreign assets, the stock of the current account. One interpretation may be that the distribution of wealth, whether amongst corporations, households or estates, does not matter, only that the accumulation of it increases capital flows and negatively impacts the current account. Another interpretation may be that the share of wealth held by the top 1% is simply underestimated, particularly given Zucman (2013)'s recent results. Either would show that wealth concentration has no discernible effect.

However, the estimated strongly negative long-run relationship between private wealth accumulation and wealth inequality supports a mechanism through which the distribution of wealth may impact the current account, contradicting our initial hypothesis. Though wealth inequality was found to be purely adjusting (a unit vector in α), it is decreasing with private wealth accumulation. At the same time that private wealth accumulation is increasing and wealth inequality decreasing, net foreign assets is decreasing–thus the current account may indeed be becoming more negative overall. The UVAR(2) estimation and its impulse responses suggest the robustness of these results.

Given the inconclusive identification of the restricted baseline CVAR model, we estimate a model with added determinants of the net foreign account: the net foreign factor income, fy_t, and the investment income balance, $inva_t$, both as shares of national income. Thus our new vector becomes $\mathbf{x_t} = (nfa2\ beta\ inva\ fy\ top1\ top1w)'_t$. Specification of the alternative model finds a rank of $r = 3$ and therefore three cointegrating relations and $p - r = 3$ common stochastic trends. (In this alternative system net foreign factor income is found to be weakly exogenous, and thus not correcting to cointegrating relations whatsoever. Also investment income balance is found to have a unit-vector in α and thus *only* exhibits transitory, adjusting effects.)

Nearly all long-run identification schemes suggested by the CATSmining procedure for our alternative system restrict $nfa2$ to zero, complicating any interpretation of the impact on the current account. Focusing on the unrestricted estimate (appendix section I.1) we find the strongest cointegrating relations suggest the net foreign account positively comoves with the investment income balance and wealth inequality and negatively comoves with net foreign factor income and income inequality. It is notable how small in magnitude the α vectors' pushing forces are (table 26) relative to the cointegrating relations. Consideration of the MA representation and its common stochastic trends may thus be more instructive.

From the MA representation of the alternative model (appendix section I.2, table 31) we again find evidence that cumulated shocks to income or wealth inequality have no significant permanent effect on the current account via net foreign assets. Expectedly we find that shocks to net foreign factor income have a very significant and positive effect on net foreign assets, and thus a current account surplus. However cumulated shocks to net foreign factor assets do significantly decrease wealth inequality. Like in our baseline model, the variable whose cumulated shocks have the most significant positive impact on net foreign assets also significantly negative impact wealth inequality. This again suggests that long-run inequality of wealth has no impact on the long-run current account balance.

Interestingly, the corresponding UVAR(2) form of our alternative model, in its impulse responses (appendix section I.3), shows significant negative impacts from shocks to income and wealth inequality to net foreign assets–suggesting a resulting current account deficit. However the UVAR model does not account for contemporaneous effects, in particular from shocks to net foreign factor on inequality. This may be one reason the CVAR model shows no impacts to net foreign assets from inequality shocks.

6 Conclusion

We find a very strong negative and significant comoving relation between private wealth accumulation (Piketty's *beta*, or capital income divided by national income) and net foreign assets, which lends credence to our initial intuition that increasing wealth concentration may lead to current account deficits in the long run. However we do not find this relationship to hold for wealth inequality, as measured by Kopczuk & Saez (2004) using estate tax records and with many inputed observations between 1950 and 1980. In fact, wealth inequality is found to be endogenous in the baseline model and decrease with increasing private wealth accumulation. This initial finding suggests that the overall distribution of wealth does not impact the current account, only the total amount of wealth. As the level of wealth increases the net foreign account decreases suggesting a current account deficit. Because we define the current account as $CA_t = S_t - I_t$, the increase in wealth and decrease in net foreign assets suggests the change is occurring through $I - t$.

We also find that shocks to private wealth accumulation lead to decreases in wealth inequality. This relationship deserves further study since our wealth accumulation variable is a broader measure than estate endowments and taxes.

Also, one of the long-run effects from the stochastic trends pushing the system does suggest income inequality negatively impacts net foreign assets and thus leads to a current account deficit. It may be that the cumulation of income inequality and increase in private wealth reflect similar patterns in the economy.

At the same time our alternative specification, including the determinants to net foreign assets investment income balance and net foreign factor income, found no significant impact from inequality shocks on net foreign assets and thus the current account. The more primitive UVAR model of this specification, however, suggests such effects may be possible.

While our overall results do not support an effect of wealth inequality on the current account and only possible marginal effects from income inequality, the very significant role played by private wealth accumulation suggests deeper study is needed. Because each of the variables in the national income accounting can be defined so differently empirically, it is difficult to assign any conclusive inference. Our interpretation is wed to the accounting definitions employed by Piketty & Zucman (2014) as well as all of their historical sources.

References

Al-Hussami, F., & Remesal, Á. M. (2012). Current account imbalances and income inequality: Theory and evidence. Tech. rep., Kiel Advanced Studies Working Papers.

Alvaredo, F., Atkinson, A. B., Piketty, T., & Saez, E. (2013). The world top incomes database. URL http://topincomes.g-mond.parisschoolofeconomics.eu/

Balke, N., & Gordon, R. J. (1989). The estimation of prewar gnp: Methodology and new evidence. Tech. rep., NBER.

Belabed, C. A., Theobald, T., & van Treeck, T. (2013). Income distribution and current account imbalances. IMK Working Paper 126-2013, IMK at the Hans Boeckler Foundation, Macroeconomic Policy Institute.
URL http://ideas.repec.org/p/imk/wpaper/126-2013.html

Bofinger, P. (2012). The impact of inequality on macroeconomic dynamics. In *INET Berlin Conference Paper*.

Dutt, A. K., & Mukhopadhyay, K. (2005). Globalization and the inequality among nations: A var approach. *Economics Letters*, *88*(3), 295–299.

Kopczuk, W., & Saez, E. (2004). Top wealth shares in the united states, 1916-2000: Evidence from estate tax returns. *National Tax Journal*, *57*(2), 445–87.

Kumhof, M., Lebarz, C., Ranciere, R., Richter, A., & Throckmorton, N. A. (2012). Income inequality and current account imbalances. IMF Working Papers 12/8, International Monetary Fund.

Kumhof, M., & Ranciere, R. (2010). Inequality, leverage and crises. IMF Working Papers 10/268, International Monetary Fund.

Lane, P. R., & Milesi-Ferretti, G. M. (2001). The external wealth of nations: Measures of foreign assets and liabilities for industrial and developing countries. *Journal of International Economics*, *55*(2), 263–294.

Obstfeld, M., & Rogoff, K. S. (1996). *Foundations of International Macroeconomics*. MIT press Cambridge, MA.

Piketty, T. (2014). *Capital in the 21st Century*. Harvard University Press.

Piketty, T., & Zucman, G. (2014). Capital is back: Wealth-income ratios in rich countries, 1700-2010. *The Quarterly Journal of Economics*, *129*(3), forthcoming.

Zucman, G. (2013). The missing wealth of nations: Are europe and the us net debtors or net creditors? *The Quarterly Journal of Economics*, *128*(3), 1321–1364.

A Appendix

A Data

A.1 NFA Calculation

Lane & Milesi-Ferretti (2001) propose the following method of approximating NFA for developed countries:

$$NFA_t \approx NFA_{s-1} + \sum_{i=s}^{t} CA_i + KA_{st} \tag{15}$$

where KA_{st} is the capital account balance and primarily reflects capital transfers. Thus our variable $nfa2$ follows this general method and represents the imputation of NFA as a share of national income using the current account balance (as calculated in section 3.1). Alternatively, we also impute NFA values using the change in net foreign assets using the following methods

$$NFA_t \approx NFA_{s-1} + \sum_{i=s}^{t} \Delta NFA_i \tag{16}$$

where $\Delta NFA = netX + INVA$ or the sum of net exports and investment income balance where

$$INVA = FY + FT + FK \tag{17}$$

Overall our results are robust to the method of imputation.

A.2 Wealth Inequality Imputation

Because the top 1% share of wealth ($top1w$) data contains only seven observations from 1950 to 1982, we estimate three different interpolation models to fill in the data. The first is a simple linear model, which connects existing observations with a line. The second estimates an AR(1) model for the original data between 1916-1950, finding a lagged coefficient of 0.94 with a z-statistic of 11.69, and predicts fitted values of $\widehat{top1w}$. The third model predicts fitted values based on estimates of an ARMA(1,1) model for the entire series of original data, filtering over missing observations and finding coefficients of 0.986 (43.06) and -0.290 (-2.68) for AR and MA terms, respectively, with

z-statistics in parentheses. Figure 1, below, compares the three interpolation methods with the original observations.

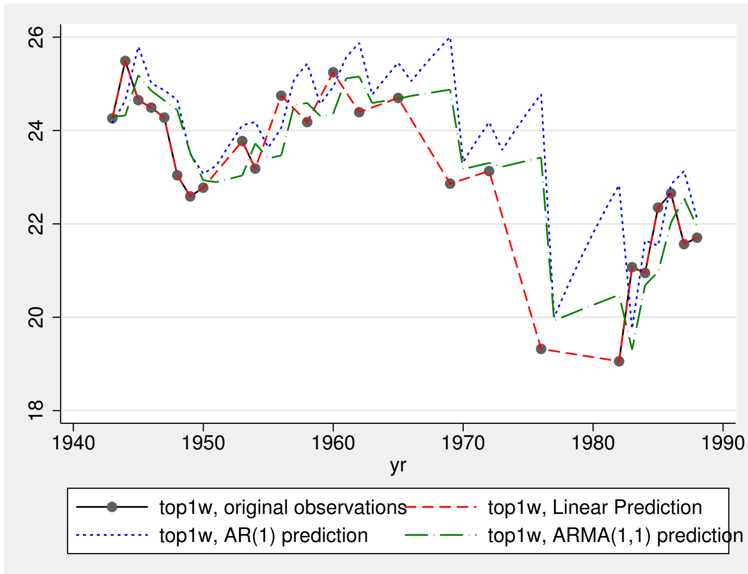


Figure 1: *top1w* Interpolation Model Comparisons

Correlograms indicate that the ARMA(1,1) imputation produces the least serially correlated residuals, thus we utilize a series, $top1w_{arma}$, for model estimation that contains imputed observations of *top1w* using an ARMA(1,1) model.

	AC	PAC	Q
lag1	-.05670938	-.05946456	.21562207
lag2	-.0848025	-.08337784	.70556957
lag3	.28382771	.30617784	6.2838925
lag4	-.15499228	-.23581757	7.9750841
lag5	-.12672405	.00303046	9.1247986
lag6	.10682428	-.07987573	9.9558652
lag7	-.0925553	.07492233	10.590687
lag8	.1146431	.14620335	11.582047

Table 1: ACF and PAC for ARMA(1,1) model of top1w

A.3 Plots

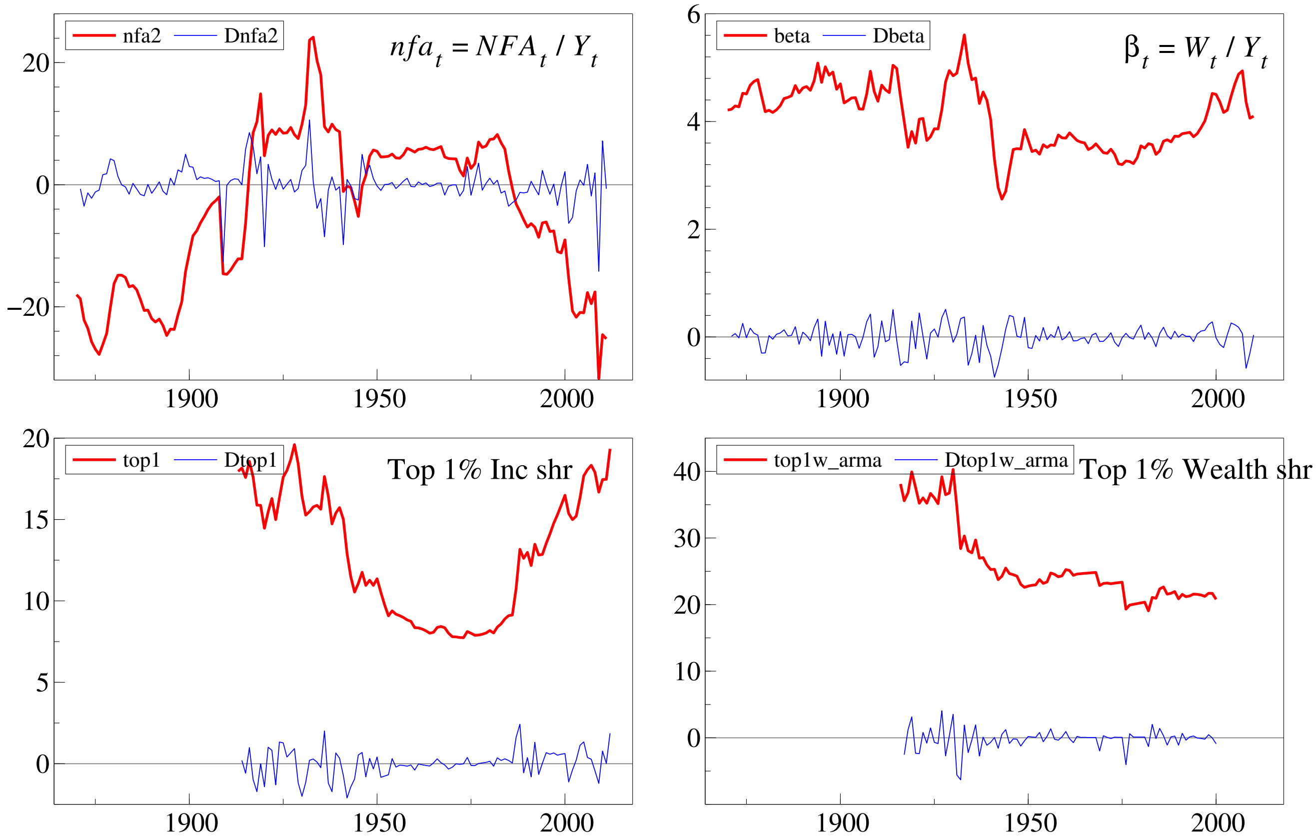


Figure 2: Variables in Levels (red) and Differences (blue) for the Baseline Model

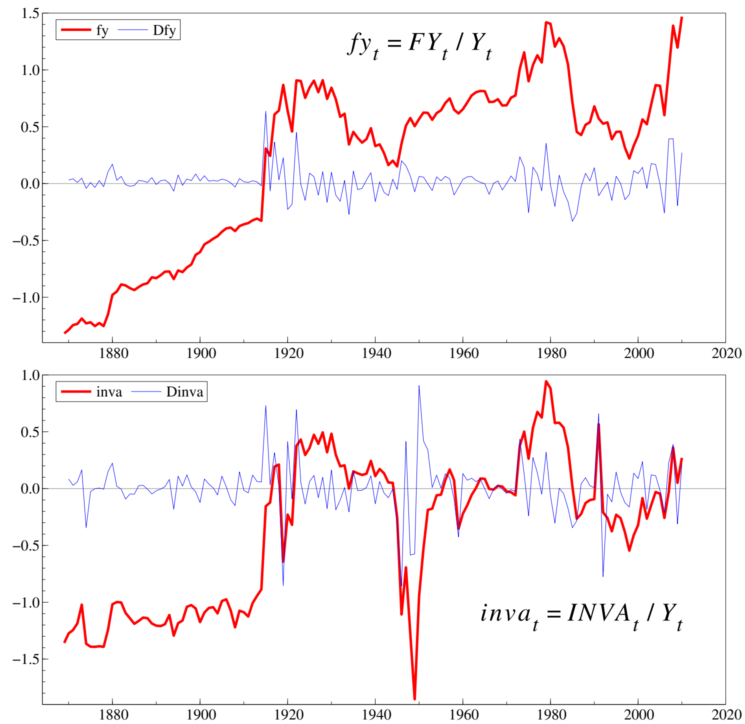


Figure 3: Additional Variables in Levels (red) and Differences (blue)

B Unit Root Testing

Variable	Dickey-Fuller	p-value
ca	-3.923	0.0113
$deltanfa$	-3.492	0.0403
$nfa1$	-0.825	0.9635
$nfa2$	-0.7773	0.9675
$inva$	-3.107	0.1046
fy	-2.052	0.5729
$beta$	-2.564	0.2967
$top1$	-0.2832	0.9899
$top1w_{orig}$	-1.721	0.7417
$top1w$	-2.237	0.4692
$top1w_{ar}$	-2.614	0.2734
$top1w_{arma}$	-2.413	0.373

Variable	Dickey-Fuller	p-value
$D.ca$	-12.31	1.20E-19
$D.deltanfa$	-11.62	1.70E-18
$D.nfa1$	-10.98	2.40E-17
$D.nfa2$	-11	2.20E-17
$D.inva$	-13.26	6.50E-21
$D.fy$	-12.64	4.10E-20
$D.beta$	-9.665	1.20E-14
$D.top1$	-8.611	2.80E-12
$D.top1w_{orig}$	-8.474	5.80E-12
$D.top1w$	-10.59	1.40E-16
$D.top1w_{ar}$	-11.08	1.60E-17
$D.top1w_{arma}$	-10.95	2.80E-17

Table 2: Augmented Dickey-Fuller Test Results in Levels and Differences, incl. Trend

Variable	Rho test stat.	Trend test stat.	p-value
ca	-25.68	-3.853	0.0141
$deltanfa$	-22.08	-3.552	0.0342
$nfa1$	-3.558	-1.032	0.9397
$nfa2$	-3.499	-1.016	0.9419
$inva$	-18.25	-3.1	0.1062
fy	-8.4	-2.118	0.5358
$beta$	-17.19	-2.941	0.1494
$top1$	-0.6934	-0.3097	0.9893
$top1w_{orig}$	-5.254	-1.537	0.8161
$top1w$	-8.183	-2.075	0.5603
$top1w_{ar}$	-10.18	-2.373	0.3943
$top1w_{arma}$	-9.003	-2.207	0.486

Table 3: Phillips-Perron Test Results, incl. Trend

Results presented below are for the baseline model comprised of the vector $\mathbf{x_t} = \begin{pmatrix} nfa2 \\ beta \\ top1 \\ top1w_{arma} \\ \mu \end{pmatrix}$

C Lag Length Determination

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-682.15725	.b	.b	.b	645.97687	17.822266	17.870967	17.944022
1	-364.92588	634.46274	16	1.11e-124	.25854086	9.9980747	10.241582	10.606855*
2	-335.13882	59.574118	16	6.173e-07	.18136467	9.6399693	10.078282*	10.735774
3	-312.24685	45.783945	16	.00010514	.15297294*	9.460957	10.094075	11.043787
4	-300.91892	22.655848	16	.12324879	.17558509	9.5823097	10.410233	11.652164
5	-287.8679	26.102034	16	.05260936	.19476595	9.6589066	10.681636	12.215785
6	-276.72069	22.294421	16	.13393696	.230146	9.7849531	11.002488	12.828856
7	-244.67581	64.089766	16	1.056e-07	.16084083	9.3682029*	10.780543	12.899131
8	-229.63935	30.072929*	16	.0176277	.17876432	9.3932298	11.000375	13.411182

Table 4: Lag Length Determination for VAR(k) of x = [$nfa2$ $beta$ $top1$ $top1w_{arma}$]' (STATA)

Model	k	T	Regr	Log-Lik	SC	H-Q	LM(1)	LM(k)
VAR(8)	8	77	33	207.394	2.060	−0.351	0.010	0.272
VAR(7)	7	77	29	192.357	1.548	−0.571	0.803	0.460
VAR(6)	6	77	25	160.312	1.477	−0.349	0.001	0.023
VAR(5)	5	77	21	149.165	0.864	−0.670	0.224	0.064
VAR(4)	4	77	17	136.114	0.301	−0.941	0.143	0.215
VAR(3)	3	77	13	124.786	−0.308	−1.257	0.233	0.746
VAR(2)	2	77	9	101.894	−0.616	−1.273	0.002	0.017
VAR(1)	1	77	5	72.107	−0.745	−1.110	0.000	0.000

Table 5: Lag Length Determination for CVAR(k) model (CATS)

VAR(k) ≪ VAR(p)	Test		Test Stat.	p-value
VAR(7) ≪ VAR(8) :	ChiSqr(16)	=	30.073	[0.018]
VAR(6) ≪ VAR(8) :	ChiSqr(32)	=	94.163	[0.000]
VAR(6) ≪ VAR(7) :	ChiSqr(16)	=	64.090	[0.000]
VAR(5) ≪ VAR(8) :	ChiSqr(48)	=	116.457	[0.000]
VAR(5) ≪ VAR(7) :	ChiSqr(32)	=	86.384	[0.000]
VAR(5) ≪ VAR(6) :	ChiSqr(16)	=	22.294	[0.134]
VAR(4) ≪ VAR(8) :	ChiSqr(64)	=	142.559	[0.000]
VAR(4) ≪ VAR(7) :	ChiSqr(48)	=	112.486	[0.000]
VAR(4) ≪ VAR(6) :	ChiSqr(32)	=	48.396	[0.032]
VAR(4) ≪ VAR(5) :	ChiSqr(16)	=	26.102	[0.053]
VAR(3) ≪ VAR(8) :	ChiSqr(80)	=	165.215	[0.000]
VAR(3) ≪ VAR(7) :	ChiSqr(64)	=	135.142	[0.000]
VAR(3) ≪ VAR(6) :	ChiSqr(48)	=	71.052	[0.017]
VAR(3) ≪ VAR(5) :	ChiSqr(32)	=	48.758	[0.029]
VAR(3) ≪ VAR(4) :	ChiSqr(16)	=	22.656	[0.123]
VAR(2) ≪ VAR(8) :	ChiSqr(96)	=	210.999	[0.000]
VAR(2) ≪ VAR(7) :	ChiSqr(80)	=	180.926	[0.000]
VAR(2) ≪ VAR(6) :	ChiSqr(64)	=	116.836	[0.000]
VAR(2) ≪ VAR(5) :	ChiSqr(48)	=	94.542	[0.000]
VAR(2) ≪ VAR(4) :	ChiSqr(32)	=	68.440	[0.000]
VAR(2) ≪ VAR(3) :	ChiSqr(16)	=	45.784	[0.000]
VAR(1) ≪ VAR(8) :	ChiSqr(112)	=	270.573	[0.000]
VAR(1) ≪ VAR(7) :	ChiSqr(96)	=	240.500	[0.000]
VAR(1) ≪ VAR(6) :	ChiSqr(80)	=	176.410	[0.000]
VAR(1) ≪ VAR(5) :	ChiSqr(64)	=	154.116	[0.000]
VAR(1) ≪ VAR(4) :	ChiSqr(48)	=	128.014	[0.000]
VAR(1) ≪ VAR(3) :	ChiSqr(32)	=	105.358	[0.000]
VAR(1) ≪ VAR(2) :	ChiSqr(16)	=	59.574	[0.000]

Table 6: Lag Reduction Tests for CVAR(k) model (CATS)

D Structural Breaks

Variable	t min	t min obs
ca	-5.493	1959
$deltanfa$	-5.145	1959
$nfa1$	-4.48	1959
$nfa2$	-4.435	1959
$inva$	-4.553	1959
fy	-4.326	1959
$beta$	-5.372	1983
$top1$	-3.485	2013
$top1w_{orig}$	.	.
$top1w$	-5.902	1976
$top1w_{ar}$	-6.452	1976
$top1w_{arma}$	-6.357	1976

(Note: Critical values at 1% = -5.57; 5% = -5.08; 10% = -4.82)

Table 7: Univariate Zivot-Andrews Test Statistics (Break in Both Trend and Intercept)

Recursive Testing for Parameter Constancy:

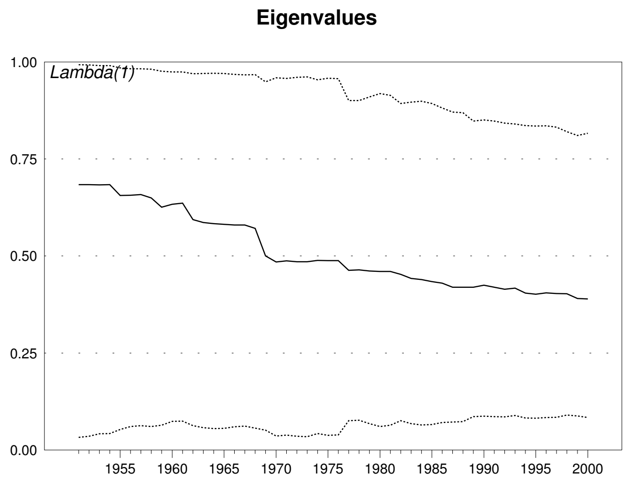


Figure 4: Test of Eigenvalue Constancy

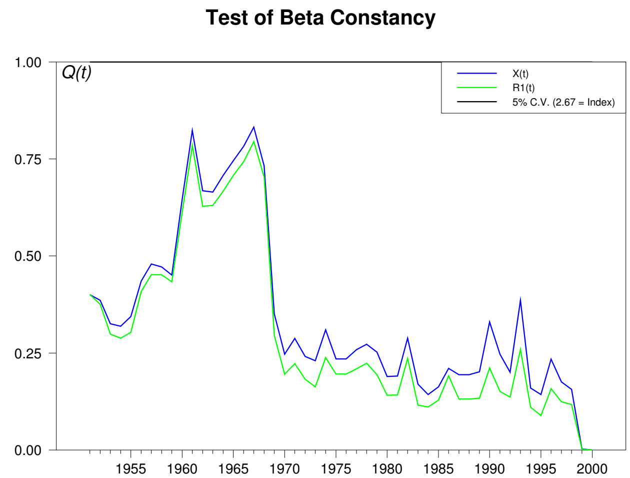


Figure 5: Test of Cointegration Vector Constancy (Note: Constancy rejected when > 1.0)

E Specification Testing

r	DGF	5% C.V.	TREND	CONSTANT
1	1	3.841	1.000 [0.317]	5.278 [0.022]
2	2	5.991	1.428 [0.490]	11.885 [0.003]
3	3	7.815	10.785 [0.013]	16.035 [0.001]

(Note: Null hypothesis is that $\beta_i = 0$ for variable)

Table 8: Likelihood-Ratio Test For Variable Exclusion in Cointegration Relation

E.1 Cointegration Rank

p-r	r	Eig.Value	Trace	Trace*	Frac95	P-Value	P-Value*
4	0	0.390	71.062	63.909	53.745	0.001	0.004
3	1	0.240	31.076	22.494	34.719	0.118	0.545
2	2	0.088	8.867	7.840	20.498	0.751	0.833
1	3	0.017	1.364	0.936	9.104	0.890	0.948

Table 9: Trace Test Statistics with Asymptotic Simulated Critical Values (denoted by *)

	Real	Imaginary	Modulus	Argument
Root1	1.000	0.000	1.000	0.000
Root2	1.000	−0.000	1.000	−0.000
Root3	1.000	0.000	1.000	0.000
Root4	0.921	0.000	0.921	0.000
Root5	−0.425	−0.333	0.540	−2.476
Root6	−0.425	0.333	0.540	2.476
Root7	0.088	0.419	0.428	1.363
Root8	0.088	−0.419	0.428	−1.363
Root9	0.246	0.291	0.381	0.868
Root10	0.246	−0.291	0.381	−0.868
Root11	0.233	−0.000	0.233	−0.000
Root12	−0.197	−0.000	0.197	−3.142

Table 10: Roots of Companion Matrix

F Identification

F.1 Short-Run Identification

Restrictions on α:

r	DGF	5% C.V.	NFA2	BETA	TOP1	TOP1W
1	1	3.841	0.084	3.529	3.551	13.431
			[0.772]	[0.060]	[0.060]	[0.000]

Table 11: Test of Weak Exogeneity ($\mathcal{H}_0 : \alpha_i = 0$)

r	DGF	5% C.V.	NFA2	BETA	TOP1	TOP1W
1	3	7.815	21.517	27.893	35.694	5.501
			[0.000]	[0.000]	[0.000]	[0.139]

(Note: LR-test, Chi-Square(4-r) or Chi-Square(r), p-values in brackets.)

Table 12: Test of Unit-Vector in Alpha ($\mathcal{H}_0 : \alpha_i = 1$)

F.2 Long-Run Identification

Restrictions on β':

r	DGF	5% C.V.	NFA2	BETA	TOP1	TOP1W	CONSTANT
1	1	3.841	0.941	4.501	0.419	0.011	5.278
			[0.332]	[0.034]	[0.517]	[0.917]	[0.022]

Table 13: Test of Long-Run Exclusion on Variables in Cointegration Relations ($\mathcal{H}_0 : \beta_i = 0$)

r	DGF	5% C.V.	NFA2	BETA	TOP1	TOP1W
1	3	7.815	21.246	4.369	14.620	13.880
			[0.000]	[0.224]	[0.002]	[0.003]

Table 14: Test of Stationarity of Individual Variables

Restricted Baseline Model Estimation Results:
(Note: This includes the weak exogeneity restriction on $nfa2$)

Test of Restricted Model:	CHISQR(3)	=	1.795	[0.616]
Bartlett Correction:	CHISQR(3)	=	1.176	[0.759] (Correction Factor: 1.526)

THE EIGENVECTOR(s)(transposed)					
	NFA2	BETA	TOP1	TOP1W	CONSTANT
Beta(1)	0.052	1.805	0.000	0.000	−6.495

Table 15

β'					
	NFA2	BETA	TOP1	TOP1W	CONSTANT
Beta(1)	1.000 [NA]	34.624 [5.595]	0.000 [NA]	0.000 [NA]	−124.622 [−5.430]

Table 16: Matrices Based on 1 Cointegrating Vector

α	
	Alpha(1)
DNFA2	0.000 [0.000]
DBETA	−0.002 [−2.674]
DTOP1	−0.007 [−1.920]
DTOP1W	−0.024 [−5.842]

Table 17

Π					
	NFA2	BETA	TOP1	TOP1W	CONSTANT
DNFA2	0.000 [0.000]	0.000 [0.000]	0.000 [NA]	0.000 [NA]	0.000 [0.000]
DBETA	−0.002 [−2.674]	−0.078 [−2.674]	0.000 [NA]	0.000 [NA]	0.280 [2.674]
DTOP1	−0.007 [−1.920]	−0.233 [−1.920]	0.000 [NA]	0.000 [NA]	0.839 [1.920]
DTOP1W	−0.024 [−5.842]	−0.819 [−5.842]	0.000 [NA]	0.000 [NA]	2.947 [5.842]

Table 18

G MA Representation

The MA, or Granger, representation of the restricted baseline CVAR model estimated in section G (equation (14)).

$\alpha'_{\perp}$				
	NFA2	BETA	TOP1	TOP1W
CT(1)	1.000	0.000	0.000	0.000
CT(2)	0.000	−0.949	0.317	0.000
CT(3)	0.000	−0.303	−0.909	0.287

Table 19

$\alpha'_{\perp}$				
	NFA2	BETA	TOP1	TOP1W
CT(1)	1.000 [NA]	0.000 [NA]	0.000 [NA]	0.000 [NA]
CT(2)	0.000 [NA]	1.000 [NA]	0.000 [NA]	−0.095 [−2.622]
CT(3)	0.000 [NA]	0.000 [NA]	1.000 [NA]	−0.285 [−1.895]

Table 20

The Loadings to the Common Trends, $\tilde{\beta}_{\perp}$:			
	CT1	CT2	CT3
NFA2	0.917 [3.946]	5.329 [1.005]	−1.559 [−2.447]
BETA	−0.026 [−3.946]	−0.154 [−1.005]	0.045 [2.447]
TOP1	−0.112 [−0.982]	−3.768 [−1.447]	1.314 [4.198]
TOP1W	−0.173 [−0.842]	−9.863 [−2.098]	1.105 [1.956]

Table 21

The Long-Run Impact Matrix, C				
	NFA2	BETA	TOP1	TOP1W
NFA2	0.917 [3.946]	5.329 [1.005]	−1.559 [−2.447]	−0.062 [−0.335]
BETA	−0.026 [−3.946]	−0.154 [−1.005]	0.045 [2.447]	0.002 [0.335]
TOP1	−0.112 [−0.982]	−3.768 [−1.447]	1.314 [4.198]	−0.016 [−0.175]
TOP1W	−0.173 [−0.842]	−9.863 [−2.098]	1.105 [1.956]	0.622 [3.768]

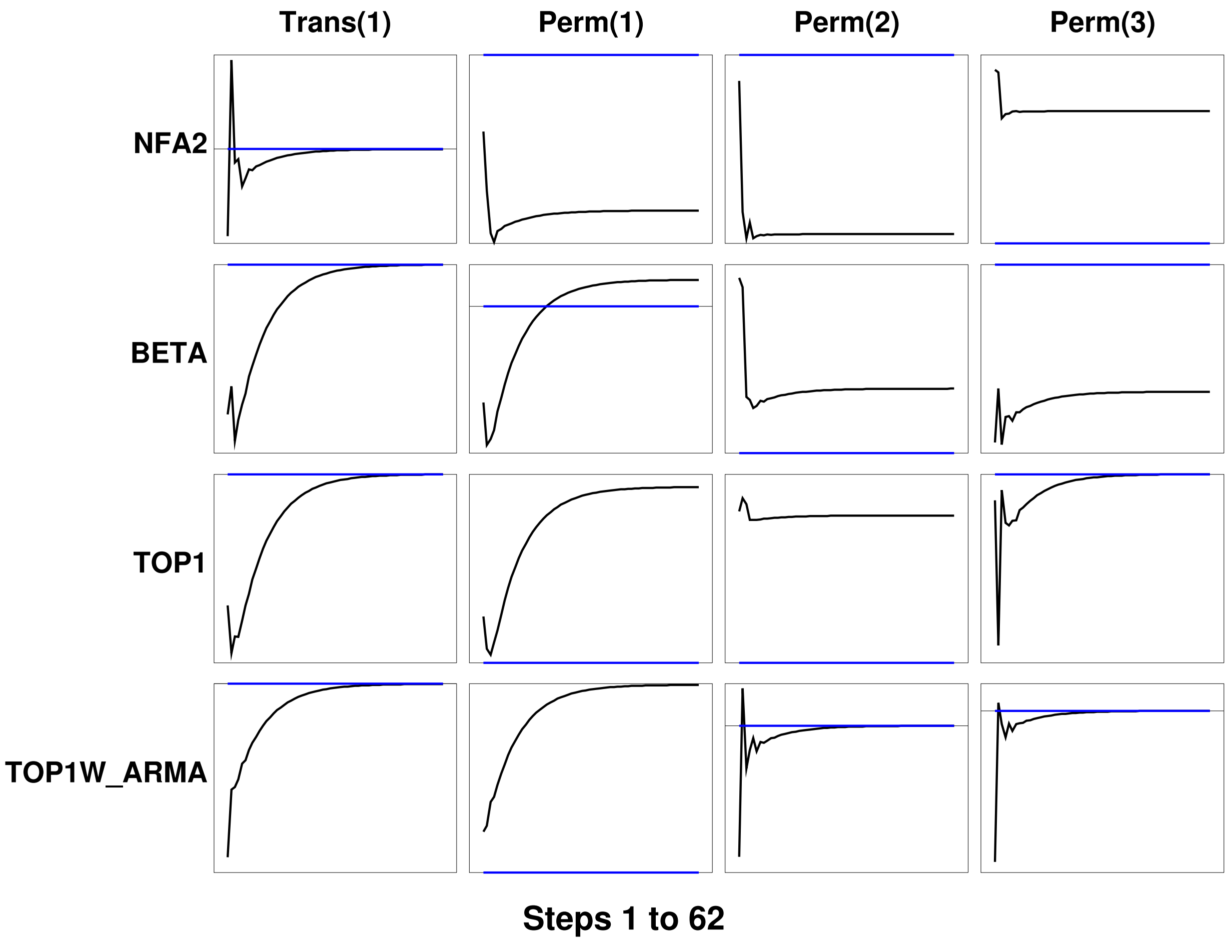
Table 22

Residual S.E. and Cross-Correlations				
	NFA2	BETA	TOP1	TOP1W
	1.819	0.053	0.893	1.612
NFA2	1.000	NA	NA	NA
BETA	−1.000	1.000	NA	NA
TOP1	−0.816	0.816	1.000	NA
TOP1W	−0.749	0.749	0.792	1.000

Table 23

H Impulse Responses

H.1 Structural-MA Representation

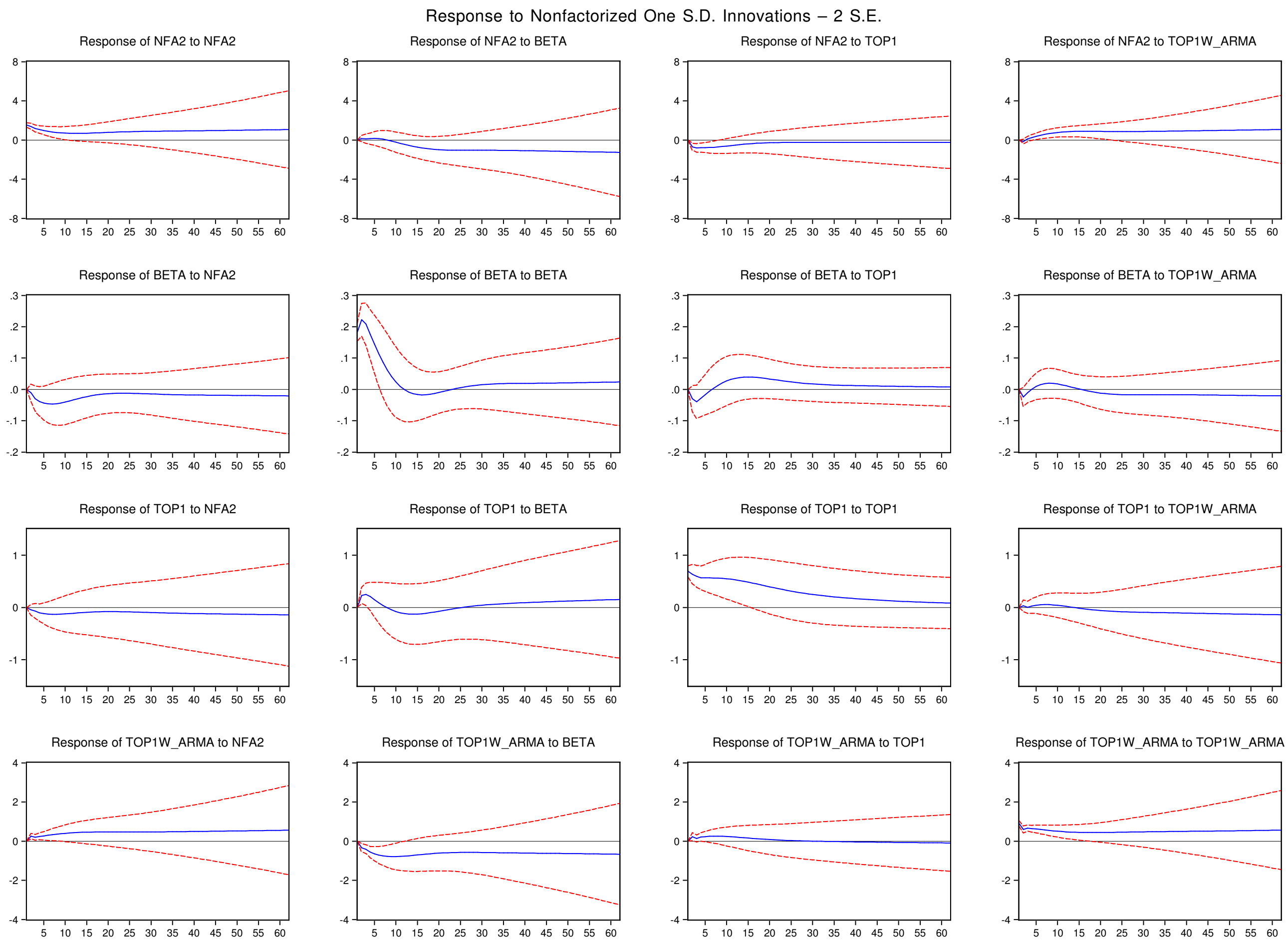


(Note: Shocks follow structural MA-model and transitory/permanent decomposition of shocks where $\tilde{C} = (\tilde{C}_1 \tilde{C}_2)$ and $\tilde{C}_2 = \begin{pmatrix} nfa2 & * & * & * \\ beta & * & * & * \\ top1 & * & * & 0 \\ top1w & * & 0 & 0 \end{pmatrix}$ while $\tilde{C}_1$ is a column of zeros.)

Figure 6: Permanent and Transitory Shocks to Structural MA Model (equation (13)) Corresponding to Restricted Baseline CVAR Model in Section G

H.2 UVAR Representation

The model estimated is $\mathbf{x}_t = \mathbf{A}_0 + \mathbf{A}_1\mathbf{x}_{t-1} + \mathbf{A}_2\mathbf{x}_{t-2} + \mathbf{A}_3\mathbf{D}_t + \varepsilon_t$. Note that serial correlation is rejected however this simplified model's residuals fail normality tests.



(Note: Top1_ARMA is the ARMA modeled interpolation of $top1w$ missing observations from appendix section A.2)

Figure 7: UVAR Residual One SD Impulse Response with Asymptotic SE's

I Alternative Model

Comparison of baseline model (equation (11)) with the alternative model

$$\Delta \mathbf{x_t} = \alpha\beta' \begin{pmatrix} nfa2 \\ beta \\ inva \\ fy \\ top1 \\ top1w \\ \mu \end{pmatrix}_{t-1} + \sum_{i=1}^{2} \Gamma_i \Delta \mathbf{x_{t-i}} + \mu_0 + \mathbf{\Phi D_t} + \varepsilon_\mathbf{t}.$$

Specification testing rejects any stationarity or long-run exclusion. Weak exogeneity is accepted in fy (p-value of 0.652) and a unit-vector in α is accepted for $inva$ (p-value of 0.340). The system has a rank of $r = 3$, implying $p - r = 3$ common stochastic trends in the system.

I.1 Rank $r = 3$ Imposed

THE EIGENVECTOR(s)(transposed)							
	NFA2	BETA	INVA	FY	TOP1	TOP1W	CONSTANT
Beta(1)	−0.077	−0.056	3.351	−4.192	−0.216	0.067	3.973
Beta(2)	−0.026	1.332	1.023	−0.950	−0.081	0.125	−6.124
Beta(3)	0.197	−0.287	0.602	−3.943	0.100	−0.235	7.871

Table 24

The matrices based on 3 cointegrating vectors:

β'							
	NFA2	BETA	INVA	FY	TOP1	TOP1W	CONSTANT
Beta(1)	1.000	0.722	−43.459	54.365	2.801	−0.875	−51.521
Beta(2)	1.000	−51.418	−39.482	36.655	3.110	−4.842	236.314
Beta(3)	1.000	−1.454	3.051	−19.982	0.507	−1.192	39.889

Table 25

α			
	Alpha(1)	Alpha(2)	Alpha(3)
DNFA2	0.000	−0.007	−0.135
	[0.037]	[−2.213]	[−5.270]
DBETA	−0.004	0.001	−0.013
	[−3.172]	[1.710]	[−4.363]
DINVA	0.011	0.001	0.001
	[9.570]	[1.945]	[0.418]
DFY	−0.000	0.000	0.002
	[−0.280]	[1.198]	[0.752]
DTOP1	−0.007	0.005	−0.012
	[−1.745]	[3.446]	[−1.211]
DTOP1W	−0.008	0.017	0.020
	[−1.628]	[10.074]	[1.550]

Table 26

Π							
	NFA2	BETA	INVA	FY	TOP1	TOP1W	CONSTANT
DNFA2	−0.142	0.580	−0.134	2.446	−0.091	0.197	−7.166
	[−5.128]	[3.271]	[−0.290]	[3.229]	[−2.775]	[5.509]	[−5.140]
DBETA	−0.016	−0.018	0.096	0.085	−0.015	0.016	−0.173
	[−4.972]	[−0.882]	[1.759]	[0.947]	[−3.914]	[3.730]	[−1.049]
DINVA	0.013	−0.033	−0.518	0.618	0.035	−0.015	−0.350
	[4.081]	[−1.598]	[−9.510]	[6.913]	[9.016]	[−3.593]	[−2.126]
DFY	0.002	−0.019	0.002	−0.032	0.001	−0.003	0.152
	[0.740]	[−1.339]	[0.047]	[−0.515]	[0.443]	[−1.121]	[1.338]
DTOP1	−0.015	−0.223	0.082	0.038	−0.011	−0.002	0.949
	[−1.332]	[−3.182]	[0.448]	[0.126]	[−0.877]	[−0.108]	[1.724]
DTOP1W	0.028	−0.894	−0.251	−0.216	0.039	−0.097	5.145
	[2.068]	[−10.232]	[−1.102]	[−0.577]	[2.448]	[−5.523]	[7.486]

Table 27

I.2 The MA-Representation

$\alpha'_\perp$						
	NFA2	BETA	INVA	FY	TOP1	TOP1W
CT(1)	0.026	−0.031	−0.008	0.999	−0.026	0.000
CT(2)	0.074	−0.944	−0.144	−0.025	0.285	0.000
CT(3)	0.126	−0.190	−0.360	−0.034	−0.848	0.314

Table 28

$\alpha'_\perp$						
	NFA2	BETA	INVA	FY	TOP1	TOP1W
CT(1)	−1.578	5.614	1.000	−48.236	0.000	0.000
	[−0.212]	[0.245]	[NA]	[−0.207]	[NA]	[NA]
CT(2)	−0.536	−0.479	0.000	−24.459	1.000	0.000
	[−0.147]	[−0.043]	[NA]	[−0.214]	[NA]	[NA]
CT(3)	−2.857	4.539	0.000	−121.431	0.000	1.000
	[−0.156]	[0.080]	[NA]	[−0.211]	[NA]	[NA]

Table 29

The Loadings to the Common Trends, $\tilde{\beta}_\perp$:			
	CT1	CT2	CT3
NFA2	−0.409	−0.650	0.174
	[−0.309]	[−1.800]	[1.037]
BETA	0.056	0.017	−0.026
	[1.734]	[1.979]	[−6.288]
INVA	0.031	0.022	−0.028
	[0.255]	[0.676]	[−1.803]
FY	0.025	−0.030	−0.011
	[0.317]	[−1.387]	[−1.119]
TOP1	−0.129	1.156	−0.161
	[−0.246]	[8.080]	[−2.429]
TOP1W	−0.823	−0.041	0.360
	[−1.550]	[−0.286]	[5.353]

Table 30

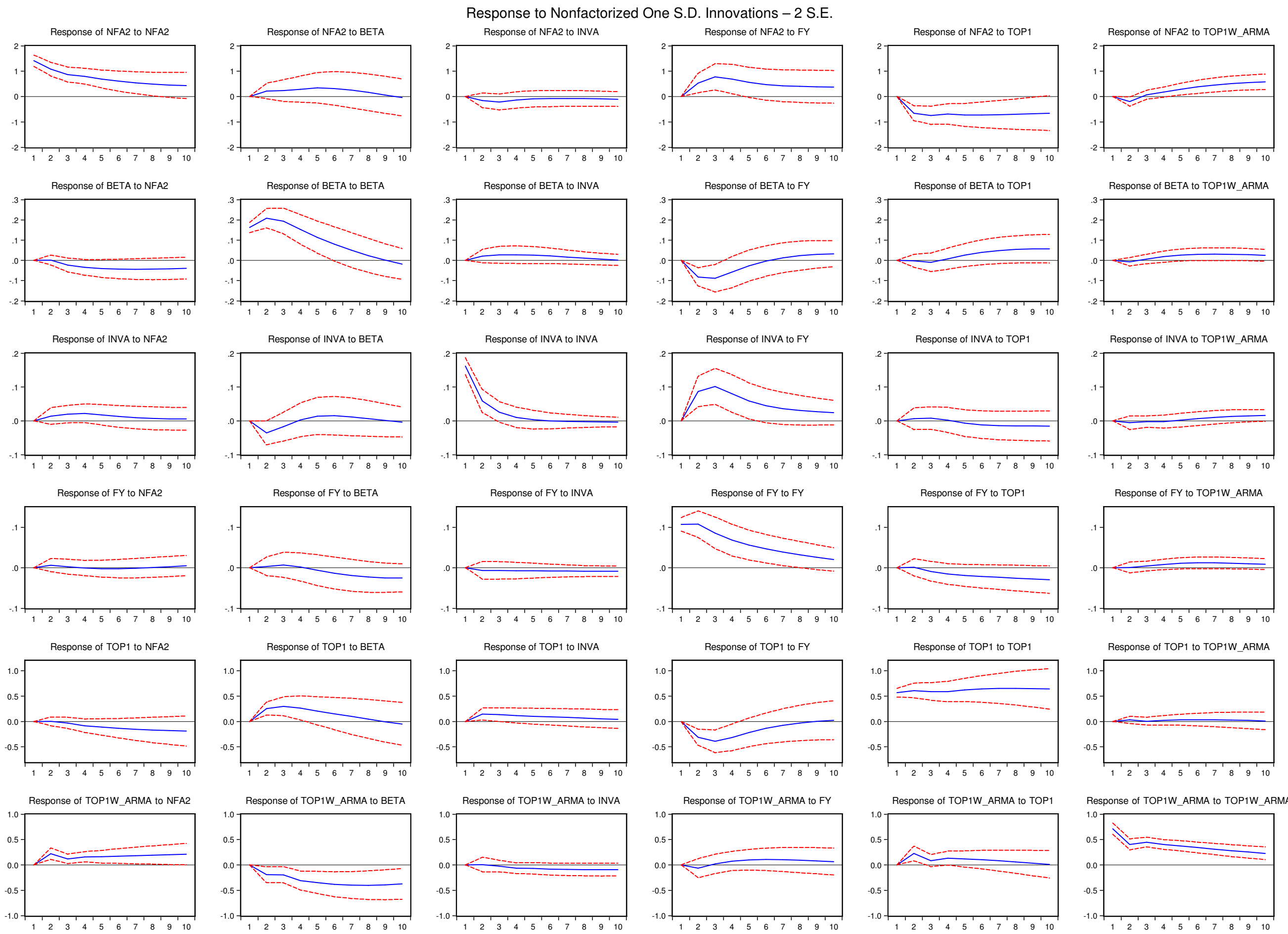
The Long-Run Impact Matrix, C						
	NFA2	BETA	INVA	FY	TOP1	TOP1W
NFA2	0.496	−1.193	−0.409	14.487	−0.650	0.174
	[4.636]	[−0.515]	[−0.309]	[4.400]	[−1.800]	[1.037]
BETA	−0.024	0.188	0.056	−0.002	0.017	−0.026
	[−9.240]	[3.342]	[1.734]	[−0.023]	[1.979]	[−6.288]
INVA	0.018	0.037	0.031	1.328	0.022	−0.028
	[1.880]	[0.173]	[0.255]	[4.401]	[0.676]	[−1.803]
FY	0.008	0.103	0.025	0.878	−0.030	−0.011
	[1.338]	[0.751]	[0.317]	[4.499]	[−1.387]	[−1.119]
TOP1	0.044	−2.009	−0.129	−2.474	1.156	−0.161
	[1.034]	[−2.187]	[−0.246]	[−1.896]	[8.080]	[−2.429]
TOP1W	0.291	−2.963	−0.823	−3.041	−0.041	0.360
	[6.775]	[−3.186]	[−1.550]	[−2.301]	[−0.286]	[5.353]

Table 31

Residual S.E. and Cross-Correlations						
	NFA2	BETA	INVA	FY	TOP1	TOP1W
	1.602	0.039	0.147	0.095	0.635	0.643
NFA2	1.000	NA	NA	NA	NA	NA
BETA	−0.245	1.000	NA	NA	NA	NA
INVA	0.921	0.090	1.000	NA	NA	NA
FY	0.935	0.113	0.969	1.000	NA	NA
TOP1	−0.385	−0.072	−0.215	−0.448	1.000	NA
TOP1W	−0.287	−0.855	−0.556	−0.608	0.350	1.000

Table 32

I.3 UVAR IRF



(Note: Top1_ARMA is the ARMA modeled interpolation of *top1w* missing observations from appendix section A.2)

Figure 8: UVAR Residual One SD Impulse Response with Asymptotic SE's