Do exchange rate shocks matter for Pakistan's export performance?

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Abstract

Pakistan experienced significant contraction in exports, together with sharp appreciation in real effective exchange rate, between 2015 and 2018. However, subsequent devaluations have only had a limited effect in reversing the trend. This has raised questions on the usefulness of exchange rate policies in promoting exports. This paper uses a Bayesian SVAR model to answer this question. I find that exchange rate shocks do have a significant effect on exports. However, the effect materialises with a lag of at least one year. The exchange rate elasticity of exports increases from close to 0 in the first quarter to 1.33 in the sixth quarter. These shocks also explain all of the slowdown in exports between 2015 and 2018.

Keywords: Bayesian SVAR; Sign Restrictions; Exchange Rate Elasticity of Exports.

JEL Classification Numbers: C32, C52, E17, F31.

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I INTRODUCTION

Pakistan's exports underwent significant contraction between 2015 and 2018. This is also the period when government adopted a fixed exchange rate policy resulting in significant appreciation in real effective exchange rate (REER). However, even though the REER has depreciated by 18% between 2017 quarter 4 and 2018 quarter 2, growth in the dollar value of exports has remained dismal. This has led to suggestions that an exchange rate policy is not effective in rebalancing the economy towards exports.

The renewed interest in exchange rate policies is also due to IMF's emphasis on moving towards a near floating exchange rate regime. An important reason for doing so is to allow exchange rate to play a role of shock absorber. For example, an exogenous increase in import bill will cause trade balance to worsen. Allowing exchange rate to depreciate in response to worsening trade balance can limit the effect of such a shock thus letting exchange rate play an important role of shock absorber. However, this only works if price elasticity of demand for exports and imports are large enough such that the Marshall-Lerner condition is satisfied.[1]

This paper focuses on studying the responsiveness of exports to changes in REER. Data provided by Pakistan Bureau of Statistics (PBS) shows that quantity of exports

[1] The Marshall-Lerner condition determines if an exchange rate devaluation will improve trade balance or not. The Marshall-Lerner condition for trade balance in terms of foreign currency is given by:

$$PED_{exp} + \left[\frac{E * Imports}{Exports}\right] PED_{imp} > 1 \tag{1}$$

where E is the price of foreign currency in terms of domestic currency. An increase in E implies depreciation. It is important to note that the Marshall-Lerner condition is easier to satisfy when a country is running trade deficit (i.e. $\frac{E*Imports}{Exports} > 1$) than when the country is running trade surplus (i.e. $\frac{E*Imports}{Exports} < 1$).

has indeed increased following exchange rate depreciation. The year-on-year increase in the quantum index of exports for fiscal year 2018 equals 7.3%. But, at 10.9%, the REER depreciated by more over similar period. A cursory look at these data points may suggest low elasticity estimates for exports implying that exchange rate depreciation will cause the dollar value of exports to decrease.

Such analysis, however, may be misleading. Pakistan's exports performance over recent years has also been affected by factors other than exchange rate. Slowdown in economic growth across EU countries has adversely affected Pakistan's export demand. On the supply side, high energy costs at home and delays in issuing of refunds have been key impediments affecting exports. Moreover, exports may take considerable time before responding to changes in exchange rate. It is, therefore, important to account for similar factors when identifying the effect of exogenous changes in exchange rate on exports.

I use a Structural VAR model to identify the effect of exchange rate shocks on exports. The VAR model is estimated using Bayesian methods. Posterior distribution for structural parameters is computed under two alternate identification assumptions. I start with imposing the recursive structure to achieve identification. The identification assumption implies that an exchange rate shock does not have a contemporaneous effect on exports and world industrial production. While this assumption is reasonable, it can be argued that exports do respond to changes in the real exchange rate within the same quarter. In a robustness exercise, I drop the recursive structure and, instead, use the algorithm in Arias et al. (2013) to impose both short-run exclusion restrictions and qualitative sign restrictions to identify structural shocks. This approach is useful as it allows using sign restrictions to identify structural shocks while at the same time allowing to restrict exchange rate shocks from having a contemporaneous effect on world industrial production.[2] Results under both the identification strategies as surprisingly similar.

Analysis from the SVAR model shows that exchange rate shocks do have a significant effect on exports. However, the effect materialises with a considerable lag. It takes at least four quarters before exchange rate shocks have any significant effect on exports. Importantly, the exchange rate elasticity of exports increases from close to 0 in the first quarter to 0.82 in the sixth quarter after the shock. The estimate of 0.82 is significantly greater than estimates suggested for developing countries in the trade literature.[3] Forecast and historical decomposition analysis further shows that, even though exchange rate shocks explain about 20% of fluctuations in exports over a two years' horizon, exchange rate shocks can alone explain all of the slowdown in exports since 2015.

The relevant literature on the effect of real exchange rates on exports does not give a clear answer. Colacelli (2009) use disaggregated data at annual frequency for a large sample of 136 countries to estimate exchange rate elasticity of exports. Results in Colacelli (2009) confirm earlier results in Hooper and Marquez (1995) and Reinhart (1994) that exchange rate elasticities are close to unity for high income

[2]In absence of such an exclusion restriction on the effect of real exchange rate on world industrial production, exchange rate shocks explain more than 20% of fluctuations in world industrial production. This suggests that using sign restrictions alone leads to accepting models which are unrealistic in the context of a small open economy. I discuss this in detail in section V.

[3]In another exercise (not reported here for brevity), I use an ARDL model to estimate the exchange rate elastic of exports. I find the short-run and the long-run elasticity of exports to equal 0.47 and 0.52, respectively. This is considerably less than estimates from SVAR model in this paper.

countries but considerably lower for developing countries. Estimates for exchange rate elasticities for an average exporter equal 0.67 and 0.18 for high income and developing countries, respectively. Focusing only on developed countries, Bayoumi (1999) finds almost similar estimates to Colacelli. Bayoumi finds exchange rate elasticity to increase from 0.31 in the first year to 0.79 in the fourth year.

Other researchers find the opposite. Freund and Pierola (2012) find the effect to be significant for developing countries but insignificant for developed countries. They specifically focus on episodes of export surges and control for exchange rate volatility, trade liberalisation policies and whether the economy is in a crisis. Freund and Pierola argue that, in case of developing countries, large depreciation in the real exchange rate plays an important role in reallocating resources towards exports. Eichengreen and Gupta (2013) find similar results for services exports.

Studies focusing on Pakistan also present mixed results. Ahmad et al. (2017) find exchange rate shocks to have a negative but insignificant effect on exports. Kemal and Qadir (2005) also find that exports do not respond to shocks to real exchange rate. On the other hand, Pasha and Kardar (2018) and Javed et al. (2016) argue that overvalued exchange rate has adversely affected Pakistan's competitiveness in the international market. Researchers have also focused on the role of exchange rate volatility. Kumar and Dhawan (1991) find strong evidence to suggest that volatility in nominal bilateral exchange rate adversely affects Pakistan's exports to developed countries. Focing on a more recent period and different set of trading partners, Mustafa and Nishat (2004) confirm earlier results in Kumar and Dhawan.

However, results based on cross-country regressions are criticised in Rodrik (2005) and Easterly (2005). More relevant discussion in the context of exchange rate elasticities can be found in Obstfeld (2002) and Orcutt (1950). Using SVAR model addresses some limitations discussed in the literature. Unlike in cross-country regressions, SVAR models treat all model variables to be endogenous thus resolving the issue of simultaneity bias. In addition, SVAR models also allow for lags in the underlying transmission mechanism. Nonetheless, this improvement comes at the risk of potential omitted variables for which macro data is generally not available. I take advice from Kilian and Lutekepohl (2017) and, rather than including data on every plausible variable for which data is available, include data on "variables that capture the most important missing information from an economic point of view." I use data for world industrial production, an index for quantum of exports and real effective exchange rate to estimate the model. The choice of variables is motivated by the demand equation for exports found in the small open economy literature (e.g. see Justiniano and Preston, 2010).[4]

The rest of this paper is organised as follows. The next section outlines the model and the baseline identification strategy. Section III explains relavent data and the estimation strategy used to estimate the model. Key results from the baseline model in section II are discussed in section IV. Section V drops the recursive structure and, instead, uses the algorithm in Arias et al. to achieve identification. Finally, section VI concludes.

[4]It should be kept in mind that the parameter determining price elasticity of demand in the SOE literature may not be comparable with elasticity estimates from SVAR models.

II MODEL

I assume that data generating process is captured by the following structural VAR model:

$$B_0 Y_t = c + B_1 Y_{t-1} + ... + B_p Y_{t-p} + w_t \tag{2}$$

where Y_t is a vector of model variables which include world industrial production, quantity of exports and real effective exchange rate in similar order. w_t is a vector of mutually uncorrelated structural shocks. B_i is a 3-by-3 matrix of model coefficients corresponding to each Y_{t-i}. B_0 governs the contemporaneous relationship between model variables. Finally, c is a 3-by-2 matrix which include constants and linear trends.

The reduced-form version of the SVAR model in equation 2 is given by:

$$Y_t = \underbrace{B_0^{-1} c}_{k} + \underbrace{B_0^{-1} B_1}_{A_1} Y_{t-1} + ... + \underbrace{B_0^{-1} B_p}_{A_p} Y_{t-p} + \underbrace{B_0^{-1} w_t}_{u_t} \tag{3}$$

where A_i are matrices of reduced-form parameters. I normalise the covariance matrix of structural shocks such that:

$$\mathbb{E}(w_t w_t^{'}) \equiv \sum_w = I_w \tag{4}$$

where I_w is a 3-by-3 identity matrix. The normalisation of $\mathbb{E}(w_t w_t)$ allows to write the reduced-form covariance matrix as:

$$\mathbb{E}(u_t u_t^{'}) \equiv \sum_u = B_0^{-1} \mathbb{E}(w_t w_t^{'}) B_0^{-1'} = B_0^{-1} B_0^{-1'} \tag{5}$$

Standard estimation procedures allow estimation of the reduced-form VAR in equation 3.[5] However, recovering the SVAR model in equation 2 from the model in equation 3 requires knowledge of B_0^{-1}. Finding an appropriate matrix B_0^{-1} is key to identifying structural shocks in equation 2 from reduced-form shocks in equation 3.

II.I Identification

I orthogonalise reduced-form errors to identify structural shocks w_t from reduced-form shocks u_t. This is done using Cholesky decomposition such that:

$$\sum_u = PP' \qquad where \qquad P = \begin{bmatrix} p_{1,1} & 0 & 0 \\ p_{2,1} & p_{2,2} & 0 \\ p_{3,1} & p_{3,2} & p_{3,3} \end{bmatrix} \tag{6}$$

where P is known as the lower-triangular Cholesky decomposition of $\sum_u$. It follows from equation 5 and equation 6 that $B_0^{-1} = P$ is one possible solution for B_0^{-1}.

The recursive structure implied by the lower-triangular matrix P has important economic implications. The relationship $u_t = Pw_t$ imposes the identification assumption that a world demand shock affects world industrial production, exchange rate and exports at time t. In contrast, while an export shock has no contemporaneous effect on world industrial production, an exchange rate shock has no contemporaneous effect on both the exchange rate and world industrial production.

The restrictions imposed on the contemporaneous effect of an exchange rate shock and an export shock in B_0^{-1} are reasonable. It makes sense that domestic shocks do not affect world industrial production. The assumption that an exchange rate shock

[5]Maximum likelihood estimates of the coefficients for each equation of a VAR model are obtained by an OLS regression of the relevant dependent variable on a constant, a liner trend and p lags of all model variables. The maximum likelihood estimates for parameters of the variance-covariance matrix of reduced-form shocks are also obtained using residuals from OLS regressions.

does not affect exports in the same period is defendable. It is generally understood that exports respond to changes in exchange rate only with a lag.

III DATA & ESTIMATIONS

The model is estimated using Bayesian methods. Bayesian methods allow for including extraneous information in estimation. This approach also helps reduce the variance of unrestricted least square estimators which is often the case due to limited sample size. I use Gibbs algorithm to obtain the posterior distribution for the reduced-form model.[6] Posterior distribution of the structural model is then computed by transforming posterior draws for reduced-form covariance matrix, $\sum_u$. Particularly, for every posterior draw of $\sum_u$, a corresponding posterior draw for B_0^{-1} is constructed conditional on the assumed identification scheme.

The priors for reduced-form model are specified as suggested in Litterman (1986). These are also known as Litterman or Minnesota priors. Litterman suggested that the prior information can be based on the belief that change in the time series is unpredictable. This reduces the VAR model to multivariate random walk model. Moreover, using Minnesota prior shrinks the prior standard deviation of lagged coefficients by a factor of $1/i$ as i increases from 1 to p. This implies that the researcher is increasingly confident that lagged coefficients equal zero as i increases.[7] The advantage of this approch is that I do not need to worry about lag-order selection.

[6] I take 10,000 draws and discard the initial 1000 draws when constructing the posterior distribution.

[7] See chapter 5 in Kilian and Lutekepohl (2017); chapter 10 in Canova (2007); and, chapter 12 in Hamilton (1994) for textbook exposition of Bayesian methods and Minnesota priors.

Instead, I assume a reasonably large lag-order of 8.[8]

I make one change when implementing the Minnesota prior. I impose exogeneity of world industrial production in relation to the domestic economy. To do so, I assume a very tight prior for coefficients on lagged values of exports and exchange rate in the equation for world industrial production. The standard deviation of the prior for these coefficients is set to equal zero. Doing so restricts the lagged value of domestic variables from affecting world industrial production.

I use data on world industrial production, real effective exchange rate and quantity exports for the period from 1994 quarter 3 until 2018 quarter 2. Data for world industrial production is obtained from World Bank's Global Economic Monitor database. The series is seasonally adjusted and is in 2010 constant prices. The real effective exchange rate (REER) data is taken from Bruegel's exchange rate dataset. Finally, data on the quantum index of exports is provided by the Pakistan Bureau of Statistics.

Data on world industrial production and REER is available at monthly frequency. I take three months' average to convert world industrial production series from monthly to quarterly. For REER, I use the begining of quarter value when changing the frequency from monthly to quarterly. Data on quantum index of exports is deseasonalised using seasonal dummies. Finally, all three series are transformed in logs before estimating the model.

[8]This flexibility does come at the cost of imposing additional structure on prior standard deviation of all lagged coefficients.

IV RESULTS

I start with discussing the effect of an exogenous increase in real effective exchange rate on the quantitiy of exports. The left panel of figure 1 plots impulse responses to a postitive REER shock and the right panel of figure 1 plots impulse responses to a world demand shock. Each subplot in the figure plots the 50% quantile of the draws from the posterior distribution of the individual impulse response coefficients. The shaded area includes individual impulse response coefficients between the 16% and the 84% quantiles. A positive REER shock leads to a 2.7 percent appreciation in real exchange rate. The shock has no effect on world industrial production. This is in line with the restriction imposed in estimations where world industrial production is treated as exogenous to the domestic economy.

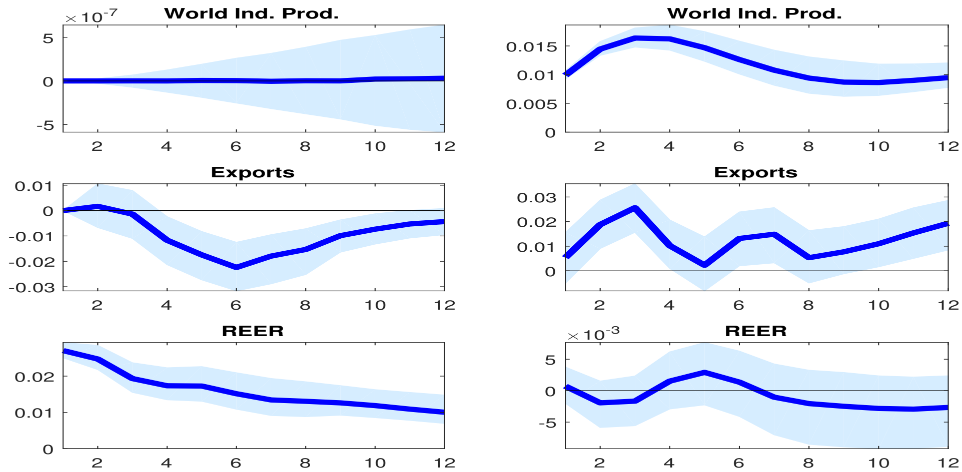
The response of exports to an REER shock is in line with what is generally understood. There is a significant lag in the response of exports. It takes almost an year before an REER shock has an effect on exports. The contractionary effect reaches its peak in the sixth quarter. The effect becomes almost insignificant from tenth quarter onwards.

It is also important to discuss estimates for short-run and long-run exchange rate elasticity of exports. I define exchange rate elasticity of exports over horizon *'i'* after an exogenous REER shock as:

$$PED_{exp,h} = \frac{ln(\widehat{Exp}_{t+h})}{ln(\widehat{REER}_{t+h})} \tag{7}$$

where $PED_{exp,h}$ is exchange rate elasticity of exports over horizon *'h'*. $ln(\widehat{Exp}_{t+h})$

Figure 1: **IRFs to an REER and a World Demand Shock**



Note: *This figure plots simulated quantiles of impulse responses to an exchange rate and world demand shock. The plots show pointwise median and 16% and 84% quantiles of the posterior distribution computed from 2,000 draws. The left panel plots responses for the exchange rate shock. The right panel plots responses for the world demand shock.*

and $ln(\widehat{REER}_{t+h})$ are percentage deviation of exports and real exchange rate from their trend in period *'h'* after an exogenous REER shock, respectively. The shock hits the economy in *'h'* = 0 such that $PED_{exp,0}$ represents exchange rate elasticity of exports at impact. Impulse responses to an REER shock imply that the point estimate for exchange rate elasticity increases from close to zero in the first three quarters to -1.33 in the sixth quarter.[9] These estimates suggest that it should take around six quarters before exchange rate devaluation results in an increase in the dollar value of exports.

Unlike the exchange rate shock, the effect of the world demand shock is relatively

[9]It is significantly greater than the point estimate of -0.47 obtained from the ARDL model. For brevity, I do not report results from the ARDL model in this paper.

immediate but short lived. The right panel of figure 1 shows that exports start increasing almost instantaneously and reach the peak in quarter 3. The point estimate for world-demand elasticity of exports increases from close to 1 in the first quarter to 1.65 in the third quarter. In contrast, the effect of world demand shock on real exchange rate is statistically insignificant.

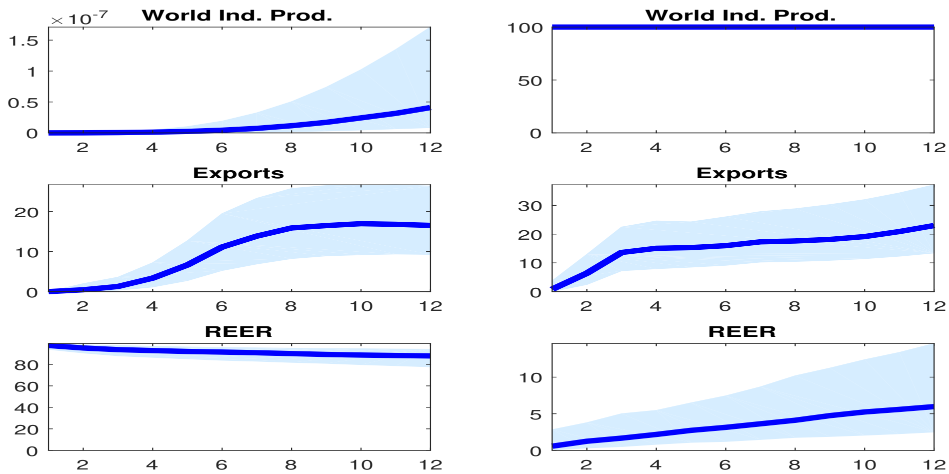
IV.I How Important are these Shocks?

I now turn to answering another important question: how important are these shocks towards explaining the behavior of exports? I use forecast error variance decomposition (FEVD) to show this. FEVD calculates the contribution of each exogenous shock to the mean-squared-error (MSE) of the $h - period$ ahead forecast of a given variable. In other words, it captures how much of the observed deviation for a given variable from its $h - step$ ahead forecast can be explained by each exogenous shock.

Figure 2 plots this for both the exchange rate and the world demand shock. The panel on the left plots FEVD for next twelve periods for the exchange rate shock. These results show that, in the 8th quarter from the point of forecast, exchange rate shocks explain about 20 percent of observed deviation for exports from its forecast value in the same period. However, exchange rate shocks do not affect exports during first year from the point of forecast. The latter is in line with the earlier result that exchange rate shocks affect exports with a lag of four quarters.

The right panel plots the same for world demand shocks. The contribution of world demand shocks is almost similar to exchange rate shocks over two to three years period. However, unlike exchange rate shocks, these shocks do have an immediate

Figure 2: **Forecast Variance Decomposition**



Note: *The figure plots how much of forecast errors in model variables are explained by exchange rate and world demand shocks over forecast horizons from 1st quarter until the 12th quarter. The left panel plots the contribution of exchange rate shocks. The right panel plots the contribution of world demand shocks. The figure plots the 16%, 50% and 84% quantiles.*

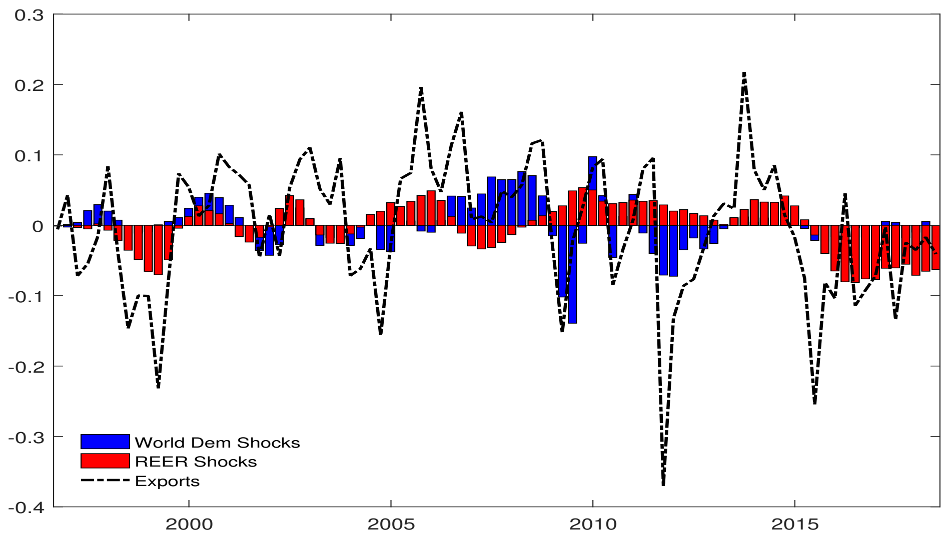
effect on quantity of exports relative to their forecast.

These results confirm that, while exchange rate shocks do have a significant effect on exports, these shocks only explain about one-fifth of variation in exports over a 2 year horizon.

IV.II Historical Contribution

It is often of interest to see how different shocks affected exports during a specific period. Figure 3 plots historical decomposition for exports. It is known with hindsight that the increase in exports in 2013 quarter 3 was due to India restricting

Figure 3: **Exports: Historical Decomposition**



Note: *This figure plots historical contribution of exchange rate and world demand shocks in driving fluctuations in exports for the period from 1996 quarter 3 until 2018 quarter 2. The black line plots data for exports as deviation from its trend. The orange and blue bars are the contribution of real exchange rate and world demand shocks.*

exports of cotton. It is, therefore, reassuring to see that the sharp increase in exports in 2013 is not explained by either of the two shocks. This lends support to the identification strategy in section II.I.

The figure allows us to study the implication of exchange rate policies for exports during the period of last two governments. The PPP government adopted a near floating exchange rate regime after coming to power in 2008. The later PML-N government adopted a de factor fixed exchange rate regime. The rupee value of dollar increased from 62 in March 2008 to close to 101 in July 2013. Thereafter, the exchange rate was kept fixed around 105 until November 2017.

Results show that exchange rate regime remained favourable for exports between 2008 and 2014. Exports continued to grow despite world demand shocks driving down exports. In contrast, fixed exchange rate policy adopted during the PML-N government can alone explain all of the slowdown in exports between 2015 and 2018. Unlike the earlier period, world demand shocks do not play any role in driving export dynamics during this period.

While real exchange rate started to depreciate from 2017 quarter 2 onwards, it was still to have a positive effect on exports as of 2018 quarter 2 (the last data point in my sample). This is due to a considerable lag of 6 quarters before exchange rate shocks have a signficant effect on export volumes.

V ALTERNATE IDENTIFICATION ASSUMPTIONS

Section II.I relied on the recursive structure to achieve identification. The recursive structure implies that, while exports do affects real exchange rate in the same period, an exchange rate shock does not have a contemporaneous effect on exports. Even though it is reasonable to believe that this assumption is credible, it can still be argued that exports do respond to exchange rate shocks within the same quarter.

In this section I drop the recursive structure and, instead, use the approach in Arias, Rubio-Ramirez and Waggoner (2013) to achieve identification. Arias et al. develop a general algorithm which allows to combine both sign restrictions and exclusion restrictions to achieve identification. Sign restrictions - pioneered by Faust (1998), Canova and De Nicholo (2002) and Uhlig (2005) - have become increasingly popular in applied work. Sign restrictions rely on using extraneous information in determining the direction in which a given shock may affect model variables. The advantage of this approach is that I no longer need to impose the restriction that an exchange rate shock does not affect exports within the same quarter. However, using sign restrictions alone presents another challenge. In the context of a small open economy, domestic shocks should not effect international variables. Using sign restrictions alone to find candidate solutions for B_0^{-1} allows domestic shocks (e.g. an exchange rate shock) to have a contemporaneous effect on world industrial production.[10] Using the algorithm in Arias et al. helps avoid this problem.

Equation 8 reproduces the relationship between reduced-form and structural shocks:

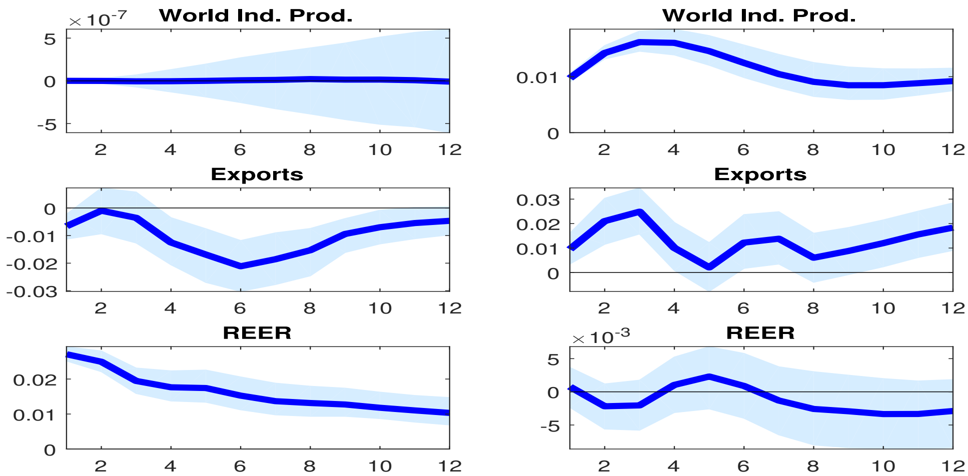
$$u_t = B_0^{-1} w_t \tag{8}$$

The solution to the problem involves obtaining the impact multiplier matrix, B_0^{-1}, which satisfies $\mathbb{E}(u_t u_t^{'}) = B_0^{-1} B_0^{-1'}$ and is also consistent with both exclusion and qualitative sign restrictions. Equation 8 is reproduced below in matrix notation. Equation 9 explicitly shows the restrictions which B_0^{-1} must satisfy:

$$\begin{bmatrix} u_t^w \\ u_t^e \\ u_t^r \end{bmatrix} = \begin{bmatrix} + & * & 0 \\ + & * & - \\ * & * & + \end{bmatrix} \begin{bmatrix} w_t^w \\ w_t^e \\ w_t^r \end{bmatrix} \tag{9}$$

where the first column of the impact multiplier matrix corresponds to the world demand shock and the third column corresponds to an exchange rate shock, respectively. Sign restrictions in equation 9 identify world demand shocks as the shock which increases both world industrial production and exports. I do not restrict how a world demand shock may affect the real exchange rate. In contrast, an exchange rate shock increases the real exchange rate but decreases exports. In addition, reflecting the exclusion restriction, an exchange rate shock also has no contemporaneous effect on world industrial production. The Arias et al. algorithm I use to obtain

Figure 4: **IRFs to an REER and a World Demand Shock**



Note: *This figure plots simulated quantiles of impulse responses to an exchange rate and world demand shock. The plots show pointwise median and 16% and 84% quantiles of the posterior distribution computed from 2,000 draws. The left panel plots responses to an exchange rate shock. The right panel plots responses to a world demand shock.*

candidate solutions for B_0^{-1} is discussed in detail in Kilian and Lutkepohl (2017).[11]

Note that, unlike in the case of recursive model, using sign restrictions leads to a large number of admissible models (i.e. admissible candidate solutions for B_0^{-1}) where each model is equally likely. As pointed out by Kilian and Lutkepohl (2017), the drawback of this approach is that some admissible models may be unrealistic. To circumvent this problem, Kilian and Murphy (2014, 2012) propose imposing additional identifying restrictions based on external information.

[10]In an exercise (not reported here for brevity), I use sign restrictions alone to identify structural shocks. Results show that exchange rate shocks explain more than 20 percent of fluctuations in world industrial production. This finding does not support using sign restrictions alone to identify B_0^{-1}.

[11]See section 13.9 of Kilian and Lutkepohl (2017).

I impose two such restrictions. First, I impose that the exchange rate elasticity of exports is less than $|-0.5|$ at the time of shock. This restriction, while allowing changes in exchange rate to affect exports within the same quarter, limits the extent to which exports can respond to real exchange rate at the time of shock. This is motivated by the J-cuve effect. Second, I assume that the export elasticity to world demand is less than 2. The absence of these two additional restrictions results in export elasticities which are unrealistically large thus discrediting the identification strategy in absence of such restrictions.

Figure 4 plots impulse responses to an exchange rate shock (left panel) and a world demand shock (right panel) for models identified as in equation 9. The median responses to one standard deviation shocks are surprisingly similar to those from the recursive model. The historical contribution of structural shocks under the identification strategy in this section is also similar as in figure 3.

VI CONCLUSION

In this paper, I use a Bayesian SVAR model to study the effect of exchange rate shocks on quantum of exports. The model is estimated using quarterly data from 1994 quarter 3 until 2018 quarter 2. Posterior distribution of structural parameters is obtained under alternate identification assumptions. First, I impose the recursive structure to identify an exchange rate shock and a world demand shock from other factors affecting exports. In the second part, I use the algorithm in Arias et al. which allows to combine sign restrictions with exclusion restrictions in order to achieve identification. I find that results under two identification assumptions are similar.

Results show that an exchange rate shock does have a significant effect on exports. However, the effect materialises with a considerable lag. The exchange rate elasticity of exports increases from close to 0 in the first quarter to 1.33 in the sixth quarter. Moreover, even though exchange rate shocks explain around 20% of fluctuations in exports over a two year horizon, these shocks explain all of the slowdown in exports since 2015.

Historical decomposition further shows that, while real exchange rate started to depreciate from 2017 quarter 2 onwards, it was still to have a positive effect on exports as of 2018 quarter 2 (the last data point in my sample). This is due to a considerable lag of 6 quarters before exchange rate shocks have a signficant effect on export volumes. Data releases for subsequent quarters shows that exports did increase both in volumes and value terms during 2018 quarter 3 and quarter 4. However, in line with results from impulse response analysis, the effect of real exchange rate depreciation in 2017 quarter 2 has now subsided. The second round of REER depreciation in 2017 quarter 4 and during most of 2018 is expected to have its effect on exports in coming months.

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