Macroeconomic Shocks and Trade Balance Adjustments in Papua New Guinea

Bao Nguyen and Dek Sum

Development Policy Centre, Crawford School of Public Policy, Australian National University

26 March 2019

Macroeconomic Shocks and Trade Balance Adjustments in Papua New Guinea*

Bao Hoai Nguyen[†‡] Dek Joe Sum[‡]

March 26, 2019

Abstract

Previous studies have mostly focused on the relationship between macroeconomic shocks and trade balance adjustments of resource-rich countries while largely overlooked countries with trade composition of high resource-export and strong import-dependence such as Papua New Guinea. Utilising a Bayesian Vector Autoregressive (BVAR) model, we quantify the relative importance of macroeconomic shocks on the country's trade balance adjustments and examine how they evolve over time. Our identification strategy takes advantage of the fact that shocks generated from the resource sector and non-resource sector would have heterogeneous impacts on trade activity. We document that at a different point in time, all identified shocks except inflation contributed significantly to the fluctuations in trade balance with varying magnitude. The impulse responses show that one standard deviation of devaluation in the real exchange rate and resource boom lead to an immediate improvement in the trade balance. Shocks in the non-resource sector and inflation are found to have a positive impact on the trade balance, but they are mostly statistically insignificant.

JEL-codes: F31, F32, F14, F41

Keywords: Bayesian VAR, Trade Balance, Resource-Rich Developing Countries, Import-dependent, Papua New Guinea

*The authors would like to thank participants at the ACDE Trade & Development seminar at the Australian National University for their valuable comments.

[†]Centre for Applied Macroeconomic Analysis (CAMA), Australian National University (ANU).

[‡]Development Policy Centre, Crawford School of Public Policy, Australian National University (ANU) and School of Business and Public Policy, University of Papua New Guinea (UPNG). Email: bao.nguyen@anu.edu.au

Corresponding author: dek.sum@anu.edu.au

1 Introduction

There has been a large amount of literature devoted to understand the economic development of resource-rich developing countries. The most frequently visited area in the literature is the Dutch Disease theory, see pioneering work by Corden (1984); Corden and Neary (1982); van Wijnbergen (1984); Sachs and Warner (1995) to more recent work by Arezki and Ismail (2013); Bjørnland et al. (2018), which suggests that a sudden windfall gain from resource boom is usually accrued to profitable sectors servicing the resource industry. Meanwhile, the rest of the economy shrinks as a result of currency appreciation and a decline in trade competitiveness. During resource windfall, policymakers in these countries have to manage significant macroeconomics adjustments on its external balance by deciding how much to consume, save and invest out of this transitory resource income. These decisions are not innocuous for macroeconomic and external stability since they can determine whether these countries may face or avert external sector disruptions in time of resource slowdown. The nature of concentrated trade composition further deprives them the ability to cushion large external shock in commodity prices which leads to frequent external imbalance (Hausmann and Rigobon, 2003). Hence, policymakers are often concerned with external imbalance as prolonged misalignments in the current account precipitates real exchange rate misalignments which is known to precede balance of payment crisis in the economy (Kaminsky et al., 1998). Thus, it is not surprising that many resource-rich countries in the past not only have failed to convert resources wealth into long-term and equitable economic development but also regularly faced abrupt external misalignment.

The determinants of external balance have been examined in number of studies which involves different countries, various econometric tools and different analysis periods. While the majority of the recent studies are country-based studies primarily focused on the persistent US current account deficits, others have focused on a group of countries. The results obtained from these studies reveal some level of agreements with unidirectional causality findings, but a full agreement has not been reached in the literature. The evidence obtained until now can be best described as mixed. For instance, Bems et al. (2007) attributed the fluctuations in the US external balance to supply shocks driven by improvements in total factor productivity by using VAR model with long run restrictions. On the contrary, Straub and Barnett (2008) discovered that oil price shock, monetary policy and private absorptions shocks each accounts for the fluctuation in US current account in a different point in time using DSGE and sign-restrictions VAR. With a different approach, Barnes et al. (2010) revealed that classic fundamental economic variables such as demographic variables, GDP per capita levels, trade openness contribute significantly to the changes in external balance in OECD countries. For a survey done specifically for industrial countries, Freund (2005) found that the determinants of current account are attributable to the adjustments in real exchange rate, trade balance and fiscal deficit. Further to these works, Maria Milesi-Ferretti and Razin (1998) argued that current account in low and middle-income countries is more likely to be driven by the level of foreign reserves level the countries possess and terms of trade shocks due to the nature of its less established financial systems.

Studies in the literature also appears to only focus on the determinants of current account as a whole while largely ignores the dynamic movements in the components of current account such as trade balance adjustments in the event of various macroeconomic shocks. These assumptions seem to be unrealistic as argued by Gruber and Kamin (2007) in their seminal contributions that, by merely determining the causes of current account commonly found in the literature such as currency misalignments or trade balance adjustments are less helpful as these factors are already reasonably obvious. Outlining these determinants without taking extra steps to understand the underlying factors leaves open the more fundamental causes of current account changes. Motivated by the relatively limited literature available in the subject, this paper attempts to investigate how trade balance, the single largest component of current account, responds to different structural macroeconomic shocks in the economy. In particular, we focus exclusively on the trade balance adjustments of Papua New Guinea (PNG), a country which uniquely combines the trade characteristics of a resource-rich country for being highly resource-export dependent and in the meantime, being heavily import-dependent like any other Pacific Island countries in the region.[1] The distinctive trade patterns of PNG has often rendered the country to episodes of external imbalances driven by volatile movements in its trade balance adjustments as presented in Figure 1. The prolonged external imbalance in the economy then precipitates the occurrence of balance of payment crisis, a phenomenon that is not uncommon to PNG especially in the aftermath of resource boom. Hence, the natural questions would be which macroeconomic shock accounts for the largest contribution in trade balance adjustments and to what extent these shocks affect the trade balance movements and how does the trade balance of such trade characteristics like PNG responds to different structural shocks.

To address these questions, we use a structural Vector Autoregressive model with Bayesian inference, or better known as a Bayesian VAR (BVAR) model to identify the impact of resource activity, non-resource activity, inflation and real exchange rate shocks on trade balance adjustments in PNG. The VAR model introduced by Sims (1980) have been widely applied in the literature to capture the dynamic linear interdependencies between dependent and independent variables. With Bayesian inference, it has a strong advantage over conventional frequentist econometric approach as it models shocks by probability distribution over hypothesis depending on the degree of confidence in the chosen prior and the robustness of the findings. In other words, Bayesian inference overcomes the parsimonious specification to incorporate fewer explanatory variables due to limited observations and small datasets (Litterman, 1986). This is particularly relevant for the case of PNG as time-series macroeconomics data is scarce, thus making the BVAR model most suitable for this study. We first disentangle shocks from resource and non-resource activity to capture the heterogeneity within the economy across both sectors. It then follows a standard small-open economy estimation model used by Kim (2001)

[1]The trade composition of countries in the Pacific Island region is characterised by a narrow export base and high import-dependence. It is mainly caused by geographical remoteness from global economic centers and small population, which prevents these countries from exploiting economies of scale and thus lower export competitiveness. See more Chen et al. (2014)

to incorporate inflation, real effective exchange rate and trade balance. The main assumption of this paper is that the resource sector plays the most significant role in the economy, thus it is modelled to have a contemporaneous effect on all the variables in the model. A one-time structural disturbance in resource sector, non-resource sector, inflation and real exchange rate is modelled to examine how each shock affects trade balance using impulse response function. Then, we assess the relative importance of each of these shocks in contributing to trade balance adjustments using historical decomposition analysis suggested by Burbidge and Harrison (1985). To the best of our knowledge, none has studied PNG's trade balance under the same framework as we do in this paper. The contribution of this paper is threefold. First, we build a macroeconomic framework and apply various macroeconomic shocks on trade balance in the context of PNG and such framework is non-existent for the economy. Second, this study bridges the gap of existing literatures by understanding how trade balance adjusts to structural macroeconomic shock especially in a country not only with highly resource exports but also strong import-dependency. Third, the data-scarce environment in PNG has been a major impediment for empirical researchers in the field, which explains the limited literature available for the country. With the econometric techniques that we develop in this paper, it overcomes the problem of working with small datasets which can lead to more future research for evidence-based policy-making in PNG. The policy implications obtained in this paper should not only useful for PNG but also other countries of similar trade characteristics.

This paper yields several interesting results. The impulse response functions show that the overall trade balance will be improved for slightly more than a year only in response to a positive resource activity shock. A one-standard deviation devaluation in real Kina exchange rate however, exerts a positive, longer and larger impact on trade balance than resource shock, suggesting devaluating Kina is a more effective tool in improving PNG's trade balance than a resource boom. An innovation in the non-resource sector and inflation are found to have a positive impact on the trade balance but are mostly statistically not significant. The historical decomposition of trade balance indicates that at different point in time, shocks in the resource sector, non-resource sector and real exchange rate each account for different magnitude. In other words, the resource sector shock is not the sole dominant contributor to the fluctuations of the trade balance during the sample period. For instance, the trade balance deterioration during the global financial crisis between 2008 and 2010 was largely attributed to shocks in the non-resource sector whereas the contribution of resource sector shock was trivial. Our results show that despite the recent resource boom in 2014 accounted for the largest contribution to trade balance improvement, its pass-through effect was short-lived. While the trade balance continued to improve after the resource boom, the increase in surplus was largely driven by shocks in the non-resource sector. Decomposing the model further, we discovered that the improvement in trade balance during this period was actually caused by a severe import compression in the non-resource sector, mirroring the severity of the balance of payment crisis faced by the country.

The rest of the paper proceeds as follows. The next section provides a brief overview of the

PNG economy. Section 3 sets out a detailed discussion of the data and econometric methodology, including model specification and identification strategy. Section 5 presents the main empirical results. Section 6 concludes the paper.

2 Brief Overview of PNG Economy

Papua New Guinea (PNG), the largest country in the Pacific Island region has a trade pattern of narrow export compositions and high import dependence. The country has a dualistic economy characterised by its large labour-intensive agricultural sector and capital-intensive resource sector. The formal sector is mostly made up of extractive mining and petroleum industry, fisheries, forestry, cash-crop agricultural production and a relatively small import-substituting manufacturing sector. The informal sector, on which 85% of the population derives their livelihood, is mostly subsistence farming. While most of the extractive industries are marked by the presence of large foreign-owned enterprise, the agricultural sector, including cash and subsistence crops, is largely dominated by small scale family farmers in rural settings. Like many other commodity-rich countries, PNG has often missed the opportunity to broaden its economic base outside the resource sector. The share of resource sector in total GDP has increased steadily from a negligible 2% in 1975 to 29% in 2016 while the non-resource sector has declined over time. The over-reliance on resource-generated revenues is reflected in its vulnerability to commodity price shocks. The relative strong commodity prices between 2002 and 2013 had seen PNG's registering robust economic growth with an average of 6%. Conversely, PNG experienced almost zero growth from 2014 onward as a result of declining commodity prices (Fox et al., 2018).

PNG is considered one of the world's most resource-dependent country with the exports of metals, oil and more recently liquefied natural gas (LNG) making them the world's top 15 exporting market for such commodities. Despite only accounts for slightly less than a third of the overall economy, Figure 2 shows that the resource sector contributes almost 70% of the country's total exports. The remaining is dominated by primary agricultural sectors such as forestry and fishery exports. One of the most significant developments in recent years has been the $19 billion PNG LNG project. It was the first LNG plant in the country with such unprecedented scale and was projected to export 8 million tonnes of LNG every year upon completion. Since the construction took place in 2010, there had been a constant stream of foreign capital flowing into the economy to fund the current account deficits associated with imports of capital equipments for mining constructions. The completion of the PNG LNG project in 2014 had seen resource share in total exports reaching an unprecedented peak of 86%. In the meantime, it has sparked wide debates as to whether the PNG LNG led resource boom has any spillover to the rest of the economy. During much of this period, the country was bothered by an overvalued currency, balance of payment crisis, a crowding-out non-resource economy, a classical demonstration of the Dutch Disease symptoms (Basu et al., 2013).

On the other hand, PNG is heavily dependent on imports with a highly concentrated composition. The import composition presented in Figure 3 shows that PNG's imports are mainly

made up of machineries and manufactured durables, agricultural foods and fuels. Developments in the resource sector play a huge part in driving the country's imports as costly drilling machines and refinery equipments for processing have to be imported to support mining constructions. The construction of PNG LNG project between 2010 and 2014 had seen an increasing trend in the share of machinery and manufacturing, registering an average of 60% of total imports before falling to slightly above 40% upon completion. Similar to other Pacific Island countries (PIC), PNG is characterised by small and dispersed population which makes it difficult for these countries to exploit economies of scale in manufacturing productions. PNG is further worsened by its geographical remoteness and mountainous terrain which complicate infrastructure developments for transport connectivity. These features lead to relatively high cost of production domestically which not only make PNG dependent on foreign-made goods, but also deprives PNG the advantage to develop export-oriented industrialisation experienced by its East Asian neighbours. Moreover, the prolonged overvalued currency fuelled by resource boom has made foreign goods broadly more affordable.

Like many other commodity-rich developing countries, PNG is not exempted from facing balance of payment crisis in the event of a sudden reversal in capital flow and deterioration of foreign earnings. This is reflected in the ongoing foreign exchange shortages the country is experiencing. From 2003 to 2011, the strong revenue growth aided by high commodity prices and the construction of the PNG LNG Project has enabled the government to achieve modest fiscal deficits despite significant increase in government expenditures. However, the fiscal policy settings began to deteriorate and the budget deficit increased strikingly from 2012. The end of commodity price boom was a contributing factor but it was further worsened by the expansionary fiscal policies adopted by the PNG government to maintain economic activity as the construction phase of the PNG LNG project approached completion. Combined with the slowdown in foreign capital inflows, these factors placed downward pressures on PNG's external accounts. External reserves fell as a result of the intervention of central bank to satisfy unmet demand and further currency depreciation by selling its foreign reserves. Given the widening imbalances in foreign exchange market, the external reserves was eventually exhausted and led to severe balance of payment crisis in the country.

3 Empirical Methodology and Data

3.1 Empirical Methodology

To investigate how the trade balance of Papua New Guinea (PNG) reacts to different macroeconomic shocks we employ a five-variable VAR model. We employ structural representations of the vector autoregressive model (SVAR) with p lag for $t = (1, \ldots, T)$ as follows

$$\mathbf{B_0 y}_t = \mathbf{b} + \mathbf{B}_1 \mathbf{y}_{t-1} + \cdots + \mathbf{B}_p \mathbf{y}_{t-p} + \boldsymbol{e}_t, \quad \boldsymbol{e}_t \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Omega}), \tag{1}$$

where $\mathbf{y}_t = (ry_t, nry_t, inf_t, rer_t, bot_t)\prime$ be a 5×1 vector of observation at time t, $\mathbf{b}$ is a 5×1 vector of intercepts, $\mathbf{B}_i$ is a 5×5 autoregressive coefficient matrix, $\boldsymbol{e}_t$ is a 5×1 vector of

residuals, is assumed to independently follow a standard multivariate normal distribution with $\mathbf{\Omega}$) is 5×5 variance-covariance matrix.

The model modification is motivated by recent empirical studies. The first group of variables includes resource GDP(ry); non-resource-GDP (nry), expressed in log level. Instead of using the overall GDP series, we decompose GDP into resource and non-resource GDP as suggested by Harding and Venables (2016) to capture the heterogeneity within the economy across different sectors. It then follows a standard small-open economy estimation model used in Kim (2001), Jääskelä and Smith (2013), Charnavoki and Dolado (2014), An et al. (2014), among others, to incorporate inflation (inf), real exchange rates (rer). The historical evolution of each variable used in the model is presented in Figure 4. In this benchmark modification, we first examine the adjustment of the trade balance (bot) and then investigate the behaviour of exports and imports through an augmented modification.

The reduced form of VAR is obtained by premultiplying $\mathbf{B_0^{-1}}$ to both side of (1) as

$$\mathbf{y}_t = \mathbf{c} + \mathbf{A}_1\mathbf{y}_{t-1} + \cdots + \mathbf{A}_p\mathbf{y} + \boldsymbol{\epsilon}_t, \quad \boldsymbol{\epsilon}_t \sim \mathcal{N}(\mathbf{0}, \mathbf{\Sigma}). \tag{2}$$

Having estimated the reduced form, we then recover the structural shocks of the model based on the relationship between the reduced-form error ($\boldsymbol{\epsilon}_t$) and the structural shock ($\boldsymbol{e}_t$), which can be written as $\boldsymbol{\epsilon}_t = \mathbf{B_0^{-1}}\boldsymbol{e}_t$. We identify the structural shock by using a Cholesky decomposition of the $\mathbf{B_0^{-1}}$ matrix. In using this strategy, the ordering of the variables in $\mathbf{y}_t$ becomes important. The ordering allows the corresponding shocks for each variable in $\mathbf{y}_t$ to impact the variables that appear below it contemporaneously while only impact the variables above it with a lag. Therefore, given the ordering in vector $\mathbf{y}_t$ of the aforementioned VAR model, it is assumed that shocks stemming from trade balance activity cannot affect on other variables contemporaneously. Similarly, exchange rate shocks also cannot affect other variables within a quarter, except for trade balance as it is ordered below this variable. By placing resource GDP as the first variable of $\mathbf{y}_t$, we rest on the assumption that resource sector plays the most significant role in the economy. Hence, the shocks in resource sector in PNG has a contemporaneous pass-through on all the variables in the model.

The paper uses Bayesian inference to estimate the VAR model. Following Bańbura et al. (2010), we utilize the Normal Wishart prior using dummy observations. Based on the Hannan-Quinn information criterion, the number of lag length, p, is 2.[2] It is also worth noting that the Bayesian estimation involves a Monte Carlo procedure, which is applicable irrespective of whether the variables are nonstationary, thus pre-testing the variables for unit roots is not required (Sims, 1988). To allow for convergence of the Markov chain to a stationary distribution, in the model we obtain 20,000 posterior draws, discarding the first 15,000 draws as a burn-in period. See Appendix A for details.

[2]We follow Hannan-Quinn's criterion as Akaike's information criterion suggests different numbers of lag length for different data compositions. Estimating the model with $p = 4$, the number of lag length often used in the literature, the main results remain virtually unchanged.

3.2 Data Environment

In this subsection, we briefly discuss the data challenges that we faced in this study to caution future researchers who have an interest in conducting macroeconomic research in PNG. Then, we discuss how this paper overcomes these obstacles to reach the data we used in our study.

The biggest problem that regularly bothered us in this study is the absence of consistent and high frequency time-series macroeconomic data in PNG. In particularly, we would like to shed some light on the difficulties surrounding the country's gross domestic product (GDP). Firstly, the GDP data reported for PNG is highly inconsistent across all data sources with almost every source reporting different numbers for the GDP series.[3]. Some may argue that it is trivial to have minor differences across agencies due to various reasons such as the differences in the reporting format, the time of publications and the GDP deflator used in obtaining the real GDP series, but here we are facing not only large, but inexplicable differences. Secondly, there is no quarterly or monthly time series data available for PNG's GDP and we are only left with annual frequency data. Conventional empirical studies in macroeconomics mostly use quarterly or more desirably, monthly data in estimation study as high frequency data better captures the information and boom-bust cycles in the economy. Thirdly, the official GDP series is only available from 2002 onward as the PNG NSO underwent a major revision in its GDP estimation methodology. No effort was carried out to revise the series reported before 2002, thus making them obsolete and inapplicable. This means there are very limited observations available to conduct useful econometric estimations based on a classical statistical approach.

To overcome these problems, it involves two steps. Firstly, we need to determine which data source possesses the most reliable GDP series and it will then be used as an input in our estimation. We collect the annual nominal and real GDP series across all sources between 2002 and 2016 and compare as to which series exhibits the most reliable trend. Data reliability is determined by the conformity of GDP series to past economic events occurred in the country. We also perform simple eye-balling method on the variables across all sources to spot any data anomalies in the series reported[4]. We discovered that the GDP series reported by IMF and NSO share almost similar trend in fluctuations. Both sources demonstrate better conformity with minimal anomalies in their GDP series compared to other sources. In addition, the official data released by PNG NSO provides an additional breakdown of the overall GDP series into resource and non-resource GDP, thus we resort to the official data by PNG's NSO for the annual real resource and non-resource GDP series. Secondly, we interpolate the frequency of the GDP series from annually to quarterly basis. Since all other variables used in our model are measured on a quarterly frequency, analysis of this effect should be performed at the same frequency to work with more observations. Previous studies such as Lahari et al. (2011); Vellodi and Aba

[3]There are currently four main data sources that report on PNG's nominal and real GDP series: PNG National Statistical Office (NSO) which made the series available on PNG Treasury Budget, International Monetary Fund (IMF) International Financial Database, UN Comm Trade, World Bank, each can be found on their websites.

[4]For brevity purpose, we documented the full process of this analysis in a blog post on Devpolicy blog which can be found here http://www.devpolicy.org/pngs-gdps-20190125/.

(2012) have attempted to a establish higher frequency GDP series for the country. However, there have been changes and revisions made in the official GDP series since their studies. Hence, we replicate the same efforts by using Chow-Lin method developed by Chow and Lin (1971), a basic method of temporal disaggregation that entails significant advantages over standard interpolation to convert annually to quarterly frequency.

Domestic inflation is represented by the first difference of consumer price index obtained from the QEB Statistical Tables prepared by the Bank of PNG. We obtain the quarterly data of real effective exchange rate of Kina from IMF International Financial Database. The nominal trade data for exports and imports before 2009 was sourced combined from IMF database and BPNG QEB's Statistical Table as the latter only reports trade data from 2009 onward. Trade balance is expressed as a ratio of GDP by taking the difference between the nominal values of exports and imports and divided by the nominal GDP of every quarter. All variables in the model were seasonally adjusted and converted to domestic currency using the nominal exchange rate on IMF database. All five variables are expressed in natural logarithm level form and inserted into the estimation model.[5] Figure 4 in Appendix depicts the data.

4 Empirical Results

There are two main types of results that we report in this paper. Firstly, we look at the effects of a one-time macroeconomic shock on PNG's trade balance using impulse response functions to assess how trade balance as a whole reacts to different structural shocks. While impulse response functions provide information about the average effect of a one-time shock on trade balance, the historical decomposition looks at the cumulative influence of all shocks. Hence, we move away from impulse response functions and look into the historical decompositions to assess the relative importance of all disturbances in driving the trade balance of PNG and how they evolved over time. To substantiate our results, we also conduct historical decomposition for exports and imports by breaking down trade balance to understand how these trade variables react heterogeneously to the structural shocks identified above.

4.1 Impulse Response Functions to Macroeconomics Shocks

The impulse response functions are plotted over 35-quarter horizon, along with confidence bands constructed from 2000 Monte Carlo draws. Figure 5 reports the mean responses and confidence bands associated with one standard deviation structural innovations in the resource sector, non-resource sector, supply and devaluation shock to the country's trade balance.

Firstly, the result indicates that a one-time unanticipated shock in resource sector improves the country's trade balance for roughly ten quarters before starting to exert a prolonged negative impact on the trade balance. The one standard error band implies statistical significance for

[5] In this paper, our VAR model is analysed using Bayesian inference, which can easily include unit root non-stationary variables without affecting the inference on the parameters of the model, see Sims and Uhlig (1991) for more information. Hence, we model our variables in level form to retain information in the trends.

merely one year, suggesting that resource boom only exerts a statistically significant positive impact in the short-run. Then, the impulse response is followed by a prolonged deterioration in trade balance, albeit mostly statistically not significant. It shows that there is a likelihood that the resource boom may lead to a worsened trade balance in the long run. We argue that this phenomenon is caused by a combination of a rise in resource-related imports and a decline in non-resource exports together outweighing the boom in resource exports triggered by the resource boom. This is consistent with the findings of Harding and Venables (2016) for 41 resource-rich countries including PNG. They found that the impact of resource exports falls most heavily on non-resource exports with a 74 cents contraction per $1 of resource exports whereas imports rise by 23 cents per $1, due to an increase in consumption of imported goods and reduction of import-competing activities.

An unanticipated shock in the non-resource sector exerts a positive impact on the country's trade balance but they are mostly statistically insignificant. The positive trend shown is consistent with our expectation as the non-resource sector is mostly import-substituting oriented. Thus, an expansion in the non-resource sector reduces reliance on imports of foreign goods and improves the overall trade balance. On the other hand, we find it puzzling that an unexpected supply shock characterised by domestic inflation has a statistically significant impact on the PNG's trade balance. The results show that one standard deviation rise in domestic inflation improves trade balance for one quarter before falling to the initial level. This evidence is contrary to findings in the literature where inflation is generally associated with deterioration of trade balance as the rise in domestic inflation relative to foreign inflation gives rise to real currency appreciation and renders domestically produced tradable goods less competitive in the world market, see Chan (2014) work for a variety of countries. We argue that the reverse context applies in the case of PNG. Domestic inflation has little impact on PNG's export competitiveness since most of its domestic productions are import-competing and primary commodities exports are usually priced internationally. We attribute the short-run trade balance improvement to the immediate cutbacks in imports driven by imported inflation. This is explained by Sampson et al. (2006) study which found that foreign inflation is a major determinant of PNG's domestic inflation due to its heavy reliance on imports. Thus, an unexpected shock in domestic inflation which inherits the spillover from foreign inflation prompts domestic market to reduce demand for foreign goods, hence the improvement in trade balance.

Next, we model a one standard deviation shock in Kina real exchange rate to see how devaluation affects PNG's trade balance adjustments. The result reveals that PNG's trade balance improves almost instantaneous with a large magnitude. Its statistical significance lasts more than two years, suggesting currency devaluation has a longer lasting impact on trade balance than resource shock. It shows that the trade balance improves incrementally and peaks in first year before slowing down to its initial value. The impulse response exhibits no sign of J-curve in PNG, a phenomenon commonly associated with the speed of trade balance improvement

after an initial period of deterioration in response to currency devaluation.[6] We consider these findings significant especially at the time of writing , PNG is still facing a balance of payment (BoP) crisis and there has been ongoing discussions within the policymaking community as to whether the currency should be devalued to resolve the problem of foreign exchange shortage Fox et al. (2018). The impulse response confirms that devaluation exerts a longer lasting impact with larger magnitude than resource boom, implying Kina devaluation is a better policy instrument in improving the country's trade balance position. This complements the findings of Nakatani (2018), where he found the Marshall-Lerner (ML) condition holds in PNG. Hence, our result confirms that an exchange rate depreciation indeed affects the trade balance favourably, a condition that usually holds in many advanced countries, but has not been studied rigorously in a small resource-rich open economy such as PNG (Bahmani-Oskooee and Niroomand, 1998).

4.2 Historical Decomposition of the Trade Balance

The impulse responses obtained in the VAR framework depends on a single positive shock in each variable. While IRF analysis is useful to understand the pass-through of a one-time shock on the trade variable in our model, they are not sufficient to capture the trade balance variation as a result of sequence of shocks with varying magnitude. Thus, we move away from impulse responses and examine the historical decomposition of the trade balance to assess the relative importance of identified structural shocks on the trade balance and how these shocks evolved over time.

The next question we aim to answer is to what extent do the shocks in the model explain the ups and downs of the PNG's trade balance over the sample period. The idea is that all time series in the VAR can be fully decomposed into the contribution of different shocks and an exogenous component, which is referred to as the baseline projection. We calculate the baseline projection which mirrors the level of the trade balance that would have been achieved if no shocks were present and the cumulative sum of resource, non-resource, supply and devaluation shock across time. In other words, if we sum up the contribution of all the shocks at any time t, together with the baseline projection, we recover the original time series at time t. Hence, the historical decomposition is counterfactual where one investigates how differently would variables have evolved if particular histories of shocks have instead occurred.

This paper also argues that by interpreting the empirical results in this section solely based on the historical decomposition of trade balance alone is not sufficient as it only allows us to determine which shock plays the most important role in driving the variable for a specific time period. As trade balance is a sum of exports and imports, it implies that the net changes in trade balance can be driven by different directions of exports and imports in response to shocks. For instance, an improvement in trade balance can either be caused by a rise in exports or a decline in imports or both effects taking place simultaneously. Hence, it is important to also

[6] J-curve was first introduced by Magee (1973) where currency devaluation is said to worsen the trade balance first due to lag structure and improve it later resulting in a pattern that resembles the letter J, hence the J-Curve phenomenon. See more Bahmani-Oskooee and Ratha (2004).

incorporate the historical decomposition of exports and imports by breaking down the trade balance to understand the pass through of all structural shocks on each trade variable. The results are presented in Figure 6, 7 and 8.

4.2.1 Trade Balance 2002-2008

The trade balance between 2002 and 2008 was a period of relative calm with minimal volatility. The historical decomposition presented in Figure 6 shows that shocks in resource sector accounted for the largest contribution to trade balance adjustments followed by real exchange rate shock. Both shocks play equally large magnitude in driving the adjustments in trade balance with resource activity shocks explained the most changes between 2002 and 2006 and the real exchange rate shocks accounted largely for the changes between 2006 and 2008. The historical decomposition of exports in Figure 7 corroborates these observations where it shows that the shocks in resource sector and real exchange rate during this period dominated the boost in exports. Along with the historical decomoposition of imports presented in 8, our results show that the rise in exports during this period overshadows the decline in imports. Combining these two trends leads to an improvement in overall trade balance.

The dominance of resource activity in PNG's trade balance adjustment is not unexpected given that this period is characterised by a rising commodity price trend. Considering the sizeable share of mineral resources in PNG's overall export basket, it confirms the significance of resource activity shocks in PNG's trade balance adjustments. On the other hand, our results are also in line with the findings of Fox and Schroder (2017) as Kina real exchange rate during this period was found to be undervalued for more than 10% of its equilibrium rate. The currency misalignment during this period was a result of the 1997 Asian financial crisis and a disastrous drought between 2002 and 2005, which prompted the PNG government to depreciate the nominal exchange rate by more than 30%. The currency devaluation proved to be an effective policy tool in improving trade balance throuhg the channels of exports as shown in our results. Despite the undervalued currency, we did not find any evidence that the depreciated exchange rate contributed significantly to the decline in imports during this period, a result which confirms PNG's heavy reliance on imported goods.

4.2.2 Trade Balance 2008-2012

The trend of resource sector dominance began to reverse between 2008 and 2012. This period is characterised by the global financial crisis which many previous studies have argued that the episode has little spillover to countries in the Pacific Island region due to insulated domestic financial sectors from global capital markets. We argue that this statement is only partially correct, at least for PNG, as this period is also marked by dramatic volatility in food and fuel prices. During this period, the commodity price trend displayed very sharp and rapid prices hike followed by an almost equally sharp decline in a relatively short period. This has resulted in many import-dependent countries such as PNG disrupted with bloated imports and

deterioration of trade balance, an area which has often been overlooked by previous studies. The historical decomposition of trade balance in our model reveals that the shocks in non-resource sector accounted for the largest contribution to the deterioration of PNG's trade balance than all other shocks. Decomposing the historical decomposition of trade balance further, the results in Figure 7 and 8 confirm that the deterioration of trade balance is mainly driven by a decline in non-resource exports and increase in non-resource imports over much of this period.

We attribute this phenomenon to two main factors. Firstly, we argue that the shocks in non-resource sector is driven by the spike in imports associated with skyrocketing food prices. Despite being a net exporter of agricultural primary commodities, PNG remains a net importer of food products where imported food grains, cereal and wheat makes up more than 60% of domestic consumption.[7] The price inelastic nature of food imports further suggests that net food-importing countries such as PNG had to import the same volume of food at a much higher prices amid of a global food crisis led to the rise in total imports values as suggested by Chhibber et al. (2009). Secondly, the rise in non-resource imports can be explained by the strong growth in imports related to PNG LNG construction phase that took place in 2010. Costly construction and capital equipment such as pipelines, heavy drilling and refinery machines all had to be sourced offshore as PNG does not have the manufacturing capacity to support domestic heavy industry. While there is no precise breakdown of the amount of imports attributable to the mining project itself, the share of machinery and manufacturing materials during this period has witnessed a significant growth to 60% of total imports as shown in Figure 3 .

4.2.3 Trade Balance 2012 - 2014

During this period, the historical decomposition of trade balance in Figure 6 exhibited a sharp deteriorating trend driven by real exchange rate shocks. A similar phenomenon is mirrored on the historical decomposition of exports and imports in Figure 7 and 8. The results show that real exchange rate shocks not only accounted for the largest shock in driving the decline of exports during this period, it is also mainly responsible for the spike in imports. Indeed, this period is characterised by an overvalued currency as documented in Fox and Schroder (2017) work. They found that the Kina real exchange was most overvalued in 2012 compared to other years in the sample period . The currency was recorded almost 20% above the equilibrium rate.

We understand that the currency misalignments during this period was a lagged result of the massive inflow of foreign capital associated to the construction of PNG LNG project. While the adverse implications of currency overvaluation on trade balance adjustments are not unexpected as found in this section, we are surprised by the magnitude of real exchange rate shocks found in driving the deterioration of trade balance. All the historical decomposition analyses presented in Figure 6, 7 and 8 simultaneously show that the shocks that real exchange rate elicits on trade balance led to sharpest deterioration in the sample period, a phenomenon that is not observed in other periods of currency misalignments in PNG. This result explains the

[7] See Bourke et al. (2009) work for the precise breakdown of food imports in PNG between 2003 to 2007.

large external imbalances experienced by PNG in this period. It provides important lesson that the currency appreciation fuelled by a sudden massive inflow of foreign capital associated with resource project not only has far-reaching implications but also emerges as the most effective shock in driving the deterioration of trade balance and external imbalances.

4.2.4 Trade Balance, 2014-2016

Lastly, the historical decomposition of trade balance in this period reveals several interesting results. The shocks in resource sector account for the largest contribution in explaining the improvement in trade balance after a prolonged episodes of deterioration since 2008. This result confirms the narrative that the resource boom fuelled by the commencement of PNG LNG productions in late-2014 reversed the decreasing trend with a widened surplus in trade balance. An ardent reader, however, would also notice that the pass-through of resource sector shocks on trade balance in Figure 6 only lasted for a year before it was superseded by shocks in non-resource sector. The historical decomposition of exports and imports as shown in Figure 7 and 8 corroborates these findings and indicates that while resource boom continued to play a positive and significant role in boosting exports, there is a large import compression driven by the non-resource sector. In other words, there has been a decrease in the imports of non-resource sectors and it exerts a larger spillover to the improvement of trade balance than resource boom.

This episode of non-resource import compression during this period is explained by two main factors: the completion of PNG LNG construction and the balance of payment crisis that the country is still currently facing. Upon the completion of the PNG LNG project, the country experienced an immediate halt in the imports of high-valued heavy machineries as we previously discussed in the section above. It has resulted in a decline in the share of machineries imports from 60% at its peak in 2012 to about 40% in 2015. In conjunction with the low commodity prices environment in 2014, the completion of PNG LNG triggered a reversal in capital flow. As a result, the country underwent a severe balance of payment crisis as foreign reserves was exhausted to prevent further depreciation of the exchange rate. While there is no precise breakdown to what extent imports are compressed as a result of the balance of payment crisis, the theoretical work by Nakatani (2018) found that the shortage of foreign reserves earnings led to a reduction in imports and consumer welfare. Our result is in line with previous studies in the literature and more importantly, provides empirical evidence to support the theoretical assessments.

5 Conclusion

This paper examined how macroeconomics shocks in the resource sector, non-resource sector and real exchange rate affect trade balance adjustments for a resource-rich and highly import-dependent economy with a special reference to Papua New Guinea (PNG). The most populated country in the Pacific region has been continuously experiencing turbulence in its trade balance

and current account which has resulted in a severe balance of payment crisis and a shortage of foreign exchange earnings in recent years. We utilised a five-variable Bayesian Vector Autoregressive (BVAR) model with standard Cholesky decomposition identification to examine the pass-through of aforementioned macroeconomic shocks to better understand the response of trade balance and the relative importance of each shock over time. The structural VAR model in this paper is estimated with Bayesian inference to overcome the absence of long time-series observations in PNG and in the meantime, able to capture the linear dependencies between the variables used in our model.

We examined the responses of trade balance to a one-time structural disturbance of each shock using impulse response functions. The results indicate that one standard deviation of devaluation in real exchange rate and boom in resource sector lead to an immediate improvement in trade balance. In addition, we discovered that the devaluation shock exhibits a larger magnitude and longer lasting impact on trade balance improvement than resource boom, a result which provides significant policy information. Meanwhile, shocks in the non-resource sector and domestic inflation are found to have a positive impact on trade balance, but they are largely statistically not significant. We extended our analysis to the historical decomposition of trade balance to understand the relative importance of each shock and provide an empirical account on the recent episodes of trade balance adjustments. In addition, we also calculated the historical decomposition of exports and imports to substantiate our analysis. The main results reveal that resource sector shock is not the sole determinant factor in driving the changes of trade balance. Particularly, the shocks in real exchange rate and non-resource sector account for the largest contribution to the trade balance at different point in time. For instance, the trade balance deterioration during the global financial crisis was caused by a significant rise in imports due to the construction of PNG LNG project and an exorbitant global food prices. We also found that the recent resource boom fuelled by the PNG LNG project only had a shortlived impact on trade balance adjustments before it was overshadowed by import compressions due to severe balance of payment crisis and shortage of foreign exchange earnings.

The paper adds to the scarce literature in the context of a resource-rich and import-dependent economy, by providing an analysis of macroeconomic transmission on trade balance adjustments of PNG. To the best of our knowledge, the results presented in this paper are considered the first to provide an empirical account to the theoretical work of Nakatani (2018), amongst the very few other studies available in the context of PNG. Moreover, the econometric technique and time-series data interpolation method that we used in this paper has far-reaching implications for future macroeconomic empirical research in the country as it provides an alternative with a better specification for estimation than conventional frequentist approach. We consider these as significant contributions as there is hardly any empirical literature conducted in the recent past for PNG. From a policy perspective, we can conclude that continued reliance on the booming resource sector cannot be considered as a permanent remedy to overcome the severity of balance of payment crisis and external shocks. The devaluation of real exchange

rate is found to be a more effective policy instrument in improving trade balance, hence more sustainable external balance. Lastly, each shock in the model accounts for different episodes of trade balance adjustments and it is important for policymakers to identify the contributions and relative importance of each shock before fine-tuning its economic policies.

References

An, L., Kim, G., and Ren, X. (2014). Is devaluation expansionary or contractionary: Evidence based on vector autoregression with sign restrictions. *Journal of Asian Economics*, 34:27–41.

Arezki, R. and Ismail, K. (2013). Boom–bust cycle, asymmetrical fiscal response and the Dutch disease. *Journal of Development Economics*, 101(C):256–267.

Bahmani-Oskooee, M. and Niroomand, F. (1998). Long-run price elasticities and the Marshall-Lerner condition revisited. *Economics Letters*, 61(1):101–109.

Bahmani-Oskooee, M. and Ratha, A. (2004). The J-Curve: a literature review. *Applied Economics*, 36(13):1377–1398.

Bańbura, M., Giannone, D., and Reichlin, L. (2010). Large Bayesian vector auto regressions. *Journal of Applied Econometrics*, 25(1):71–92.

Barnes, S., Lawson, J., and Radziwill, A. (2010). Current Account Imbalances in the Euro Area: A Comparative Perspective. OECD Economics Department Working Papers 826, OECD Publishing.

Basu, S., Gottschalk, J., Schule, W., Vellodi, N., and Yang, S.-C. S. (2013). Natural Resource Extraction and Dutch Disease:Applications to Papua New Guinea. IMF Working Paper 13/138, International Monetary Fund.

Bems, R., Dedola, L., and Smets, F. (2007). Us imbalances: The role of technology and policy. *Journal of International Money and Finance*, 26(4):523 – 545. Financial Globalization and Integration.

Bjørnland, H. C., Thorsrud, L. A., and Torvik, R. (2018). Dutch Disease Dynamics Reconsidered. Working Papers No 4/2018, Centre for Applied Macro- and Petroleum economics (CAMP), BI Norwegian Business School.

Bourke, R. M., Gibson, J., Quartermain, A., Barclay, K., Allen, B., and Kennedy, J. (2009). *Food Production, Consumption and Imports*, pages 129–192. ANU Press.

Burbidge, J. and Harrison, A. (1985). An historical decomposition of the great depression to determine the role of money. *Journal of Monetary Economics*, 16(1):45–54.

Chan, T.-H. (2014). Trade Balance, Foreign Exchange and Macroeconomic Impacts: An Empirical Assessment for China and Malaysia. Technical Report 59539, University Library of Munich, Germany.

Charnavoki, V. and Dolado, J. J. (2014). The effects of global shocks on small commodity-exporting economies: lessons from Canada. *American Economic Journal: Macroeconomics*, 6(2):207–37.

Chen, H., Rauqeuqe, L., raj Singh, S., Wu, Y., and Yang, Y. (2014). Pacific Island Countries; In Search of a Trade Strategy. IMF Working Papers 14/158, International Monetary Fund.

Chhibber, A., Ghosh, J., and Palanivel, T. (2009). The Global Financial Crisis and the Asia-Pacific region. Undp working papers, UNDP Regional Centre for Asia and the Pacific.

Chow, G. C. and Lin, A.-l. (1971). Best Linear Unbiased Interpolation, Distribution, and Extrapolation of Time Series by Related Series. *The Review of Economics and Statistics*, 53(4):372–375.

Corden, W. M. (1984). Booming Sector and Dutch Disease Economics: Survey and Consolidation. *Oxford Economic Papers*, 36(3):359–380.

Corden, W. M. and Neary, J. P. (1982). Booming Sector and De-Industrialisation in a Small Open Economy. *Economic Journal*, 92(368):825–848.

Fox, R., Howes, S., Nguyen, B., Nema, N., and Sum, D. (2018). PNG Economic Survey 2018. Png in the year of apec, Development Policy Centre, Canberra.

Fox, R. and Schroder, M. (2017). After Papua New Guinea's Resource Boom: Is the Kina Overvalued? *Asia and the Pacific Policy Studies*, (201805).

Freund, C. (2005). Current account adjustment in industrial countries. *Journal of International Money and Finance*, 24(8):1278 – 1298.

Gruber, J. W. and Kamin, S. B. (2007). Explaining the global pattern of current account imbalances. *Journal of International Money and Finance*, 26(4):500–522.

Harding, T. and Venables, A. J. (2016). The Implications of Natural Resource Exports for Nonresource Trade. *IMF Economic Review*, 64(2):268–302.

Hausmann, R. and Rigobon, R. (2003). An Alternative Interpretation of the 'Resource Curse': Theory and Policy Implications. NBER Working Papers 9424, National Bureau of Economic Research, Inc.

Jääskelä, J. P. and Smith, P. (2013). Terms of trade shocks: What are they and what do they do? *Economic Record*, 89(285):145–159.

Kaminsky, G., Lizondo, S., and Reinhart, C. M. (1998). Leading indicators of currency crises. *Staff Papers (International Monetary Fund)*, 45(1):1–48.

Kim, S. (2001). Effects of monetary policy shocks on the trade balance in small open European countries. *Economics Letters*, 71(2):197–203.

Lahari, W., Haug, A. A., and Garces-Ozanne, A. (2011). Estimating Quarterly Gdp Data For The South Pacific Island Nations. *The Singapore Economic Review (SER)*, 56(01):97–112.

Litterman, R. B. (1986). Forecasting with Bayesian Vector Autoregressions-Five Years of Experience. *Journal of Business & Economic Statistics*, 4(1):25–38.

Magee, S. P. (1973). Currency Contracts, Pass-Through, and Devaluation. *Brookings Papers on Economic Activity*, 4(1):303–325.

Maria Milesi-Ferretti, G. and Razin, A. (1998). Sharp reductions in current account deficits An empirical analysis. *European Economic Review*, 42(3-5):897–908.

Nakatani, R. (2018). Adjustment to negative price shocks by a commodity exporting economy: Does exchange rate flexibility resolve a balance of payments crisis? *Journal of Asian Economics*, 57(C):13–35.

Sachs, J.-D. and Warner, A.-M. (1995). Natural Resource Abundance and Economic Growth.

Sampson, T., Yabom, J., Nindim, W., and Marambini (2006). Exchange Rate Pass-through in Papua New Guinea. *Pacific Economic Bulletin*, 21(1):20–37.

Sims, C. A. (1980). Macroeconomics and Reality. *Econometrica*, 48(1):1–48.

Sims, C. A. (1988). Bayesian skepticism on unit root econometrics. *Journal of Economic Dynamics and Control*, 12(2-3):463–474.

Sims, C. A. and Uhlig, H. (1991). Understanding Unit Rooters: A Helicopter Tour. *Econometrica*, 59(6):1591–1599.

Straub, R. and Barnett, A. (2008). What drives U.S. current account fluctuations? Working Paper Series 959, European Central Bank.

van Wijnbergen, S. (1984). The 'dutch disease': A disease after all? *Economic Journal*, 94(373):41–55.

Vellodi, N. and Aba, L. A. (2012). Constructing an Output Gap for Papua New Guinea. Bpng working paper series, Bank of Papua New Guinea.

APPENDIX

A Bayesian estimation

Let $\mathbf{y}_t = (ry_t, nry_t, inf_t, rer_t, bot_t)\prime$ be a 5×1 vector of observation at time t. The structure representation of the vector autoregressive model (SVAR) with p lag for $t = (1, \ldots, T)$ can be expressed as

$$\mathbf{B_0}\mathbf{y}_t = \mathbf{b} + \mathbf{B}_1\mathbf{y}_{t-1} + \cdots + \mathbf{B}_p\mathbf{y}_{t-p} + \boldsymbol{e}_t, \quad \boldsymbol{e}_t \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Omega}), \tag{3}$$

where $\boldsymbol{e}_t$ is assumed to independently follow a standard multivariate normal distribution. The reduced form of VAR is obtained by premultiplying $\mathbf{B_0^{-1}}$ to both side of (3) as

$$\mathbf{y}_t = \mathbf{c} + \mathbf{A}_1\mathbf{y}_{t-1} + \cdots + \mathbf{A}_p\mathbf{y} + \boldsymbol{\epsilon}_t, \quad \boldsymbol{\epsilon}_t \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Sigma}), \tag{4}$$

where $\mathbf{c}$ is a 5×1 intercepts, $\mathbf{A}_1, \ldots, \mathbf{A}_p$ are 5×5 VAR coefficient matrices and $\mathcal{N}(\cdot, \cdot)$ denotes the Gaussian distribution with $\boldsymbol{\Sigma}$ as the 5×5 covariance matrix. Compactly, we can rewrite (4) as:

$$\mathbf{y}_t = \mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\epsilon}_t \quad \boldsymbol{\epsilon}_t \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Sigma}), \tag{5}$$

where $\boldsymbol{\beta} = \text{vec}\left([\mathbf{c}, \mathbf{A}_1, \ldots, \mathbf{A}_p]'\right)$ is $k_\beta \times 1$ vector with $k_\beta = 5(5p + 1)$ and $\mathbf{X}_t = \mathbf{I}_n \otimes (1, \mathbf{y}'_{t-1}, \ldots, \mathbf{y}'_{t-p})$. Finally, stacking (5) over t we get

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\epsilon} \quad \boldsymbol{\epsilon} \sim \mathcal{N}(\mathbf{0}, \mathbf{I}_T \otimes \boldsymbol{\Sigma}), \tag{6}$$

where $\mathbf{y} = (\mathbf{y}_1, \mathbf{y}_2, \ldots, \mathbf{y}_T)'$, $\mathbf{X} = (\mathbf{X}_1, \mathbf{X}_2, \ldots, \mathbf{X}_T)'$ and $\epsilon = (\epsilon_1, \epsilon_2, \ldots, \epsilon_T)'$.

To complete the model specification, we assume the following independent prior for the model parameters:

$$\boldsymbol{\beta} \sim \mathcal{N}(\boldsymbol{\beta}_0, \mathbf{V}_0), \quad \boldsymbol{\Sigma} \sim \mathcal{IW}(\mathbf{S}_0, \nu_0),$$

where $\mathcal{IW}(\mathbf{S}, \nu)$ denotes the Inverse Wishart distribution with scale matrix $\mathbf{S}$ and the degree of freedom ν. For known matrices $\boldsymbol{\beta}_0, \mathbf{V}_0, \mathbf{S}_0, \nu_0$ posterior draws are obtained by a 2 block Gibbs sampler that cycles through:

1. $p(\beta|\mathbf{y}, \boldsymbol{\Sigma})$
2. $p(\boldsymbol{\Sigma}|\mathbf{y}, \beta)$

B Figures

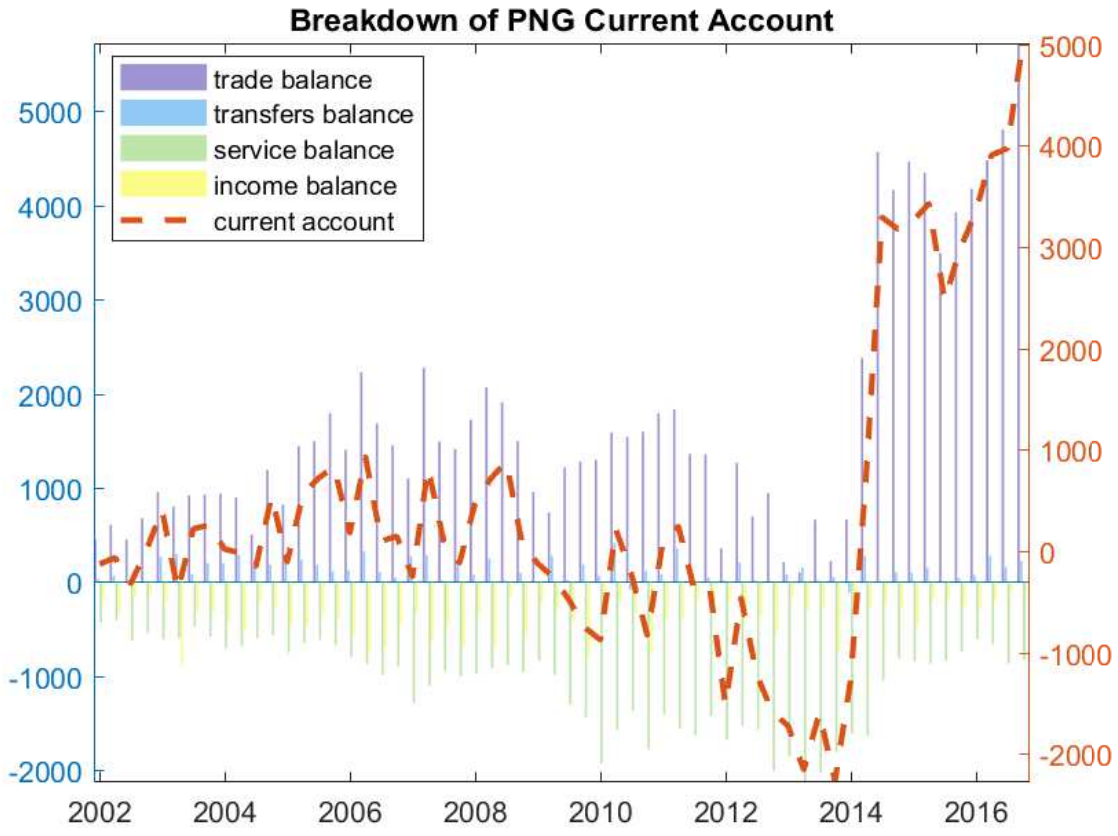

Figure 1: Historical Evolution and Breakdown of PNG Current Account

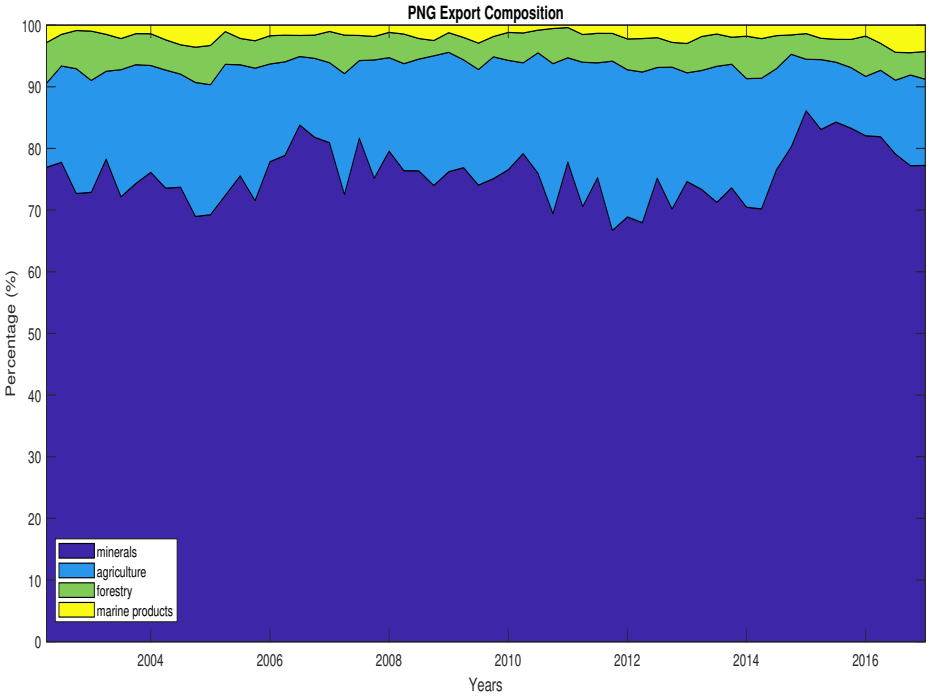

Figure 2: PNG Exports Composition, 2002-2016

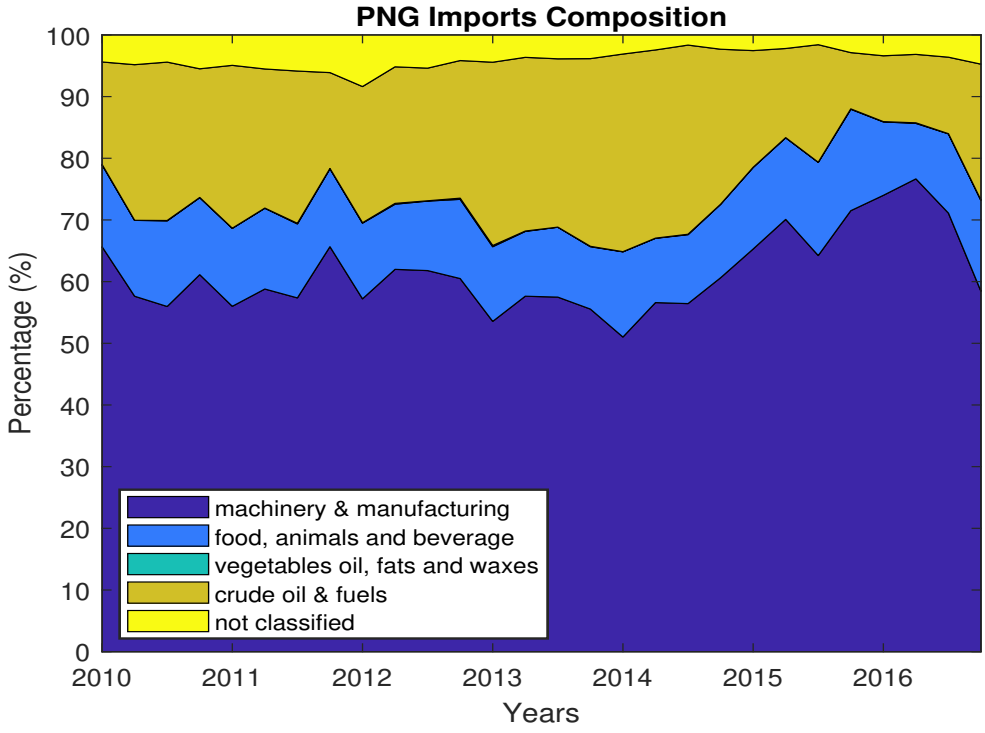

Figure 3: PNG Imports Composition, 2010-2016

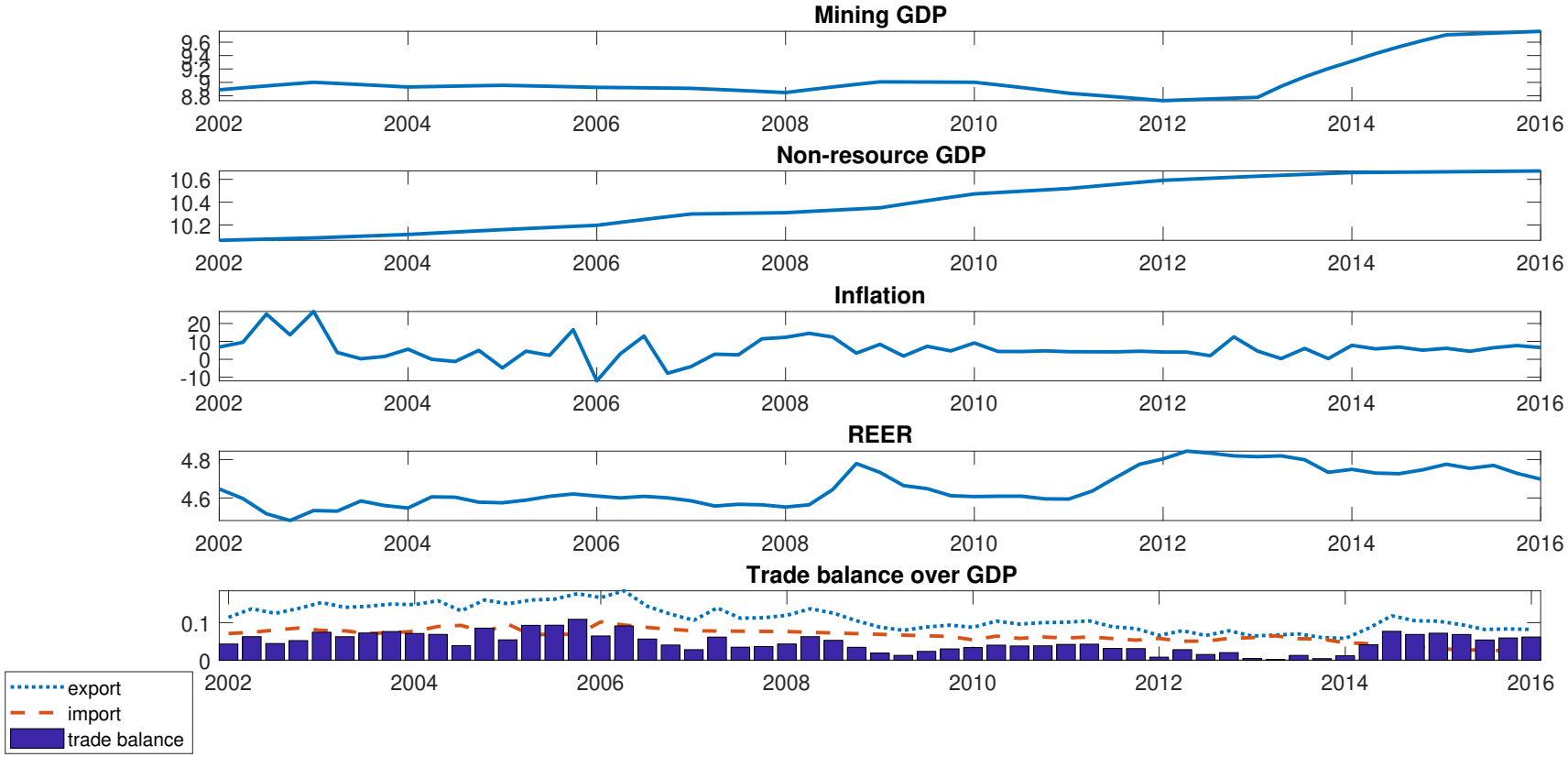

Figure 4: Historical Evolution of the series (2002Q1-2016Q1

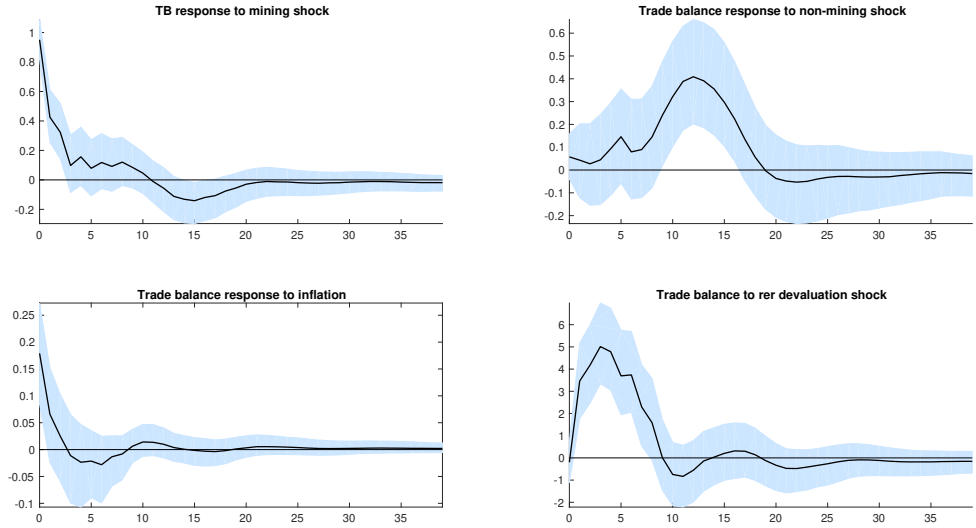

Figure 5: IRF of trade balance to one-standard deviation macroeconomic shocks

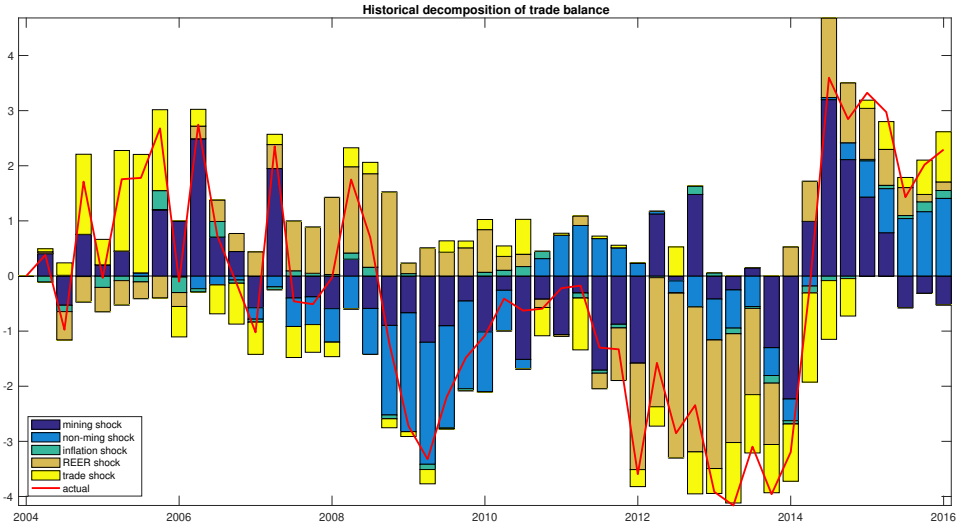

Figure 6: Historical Decomposition of PNG's Trade Balance

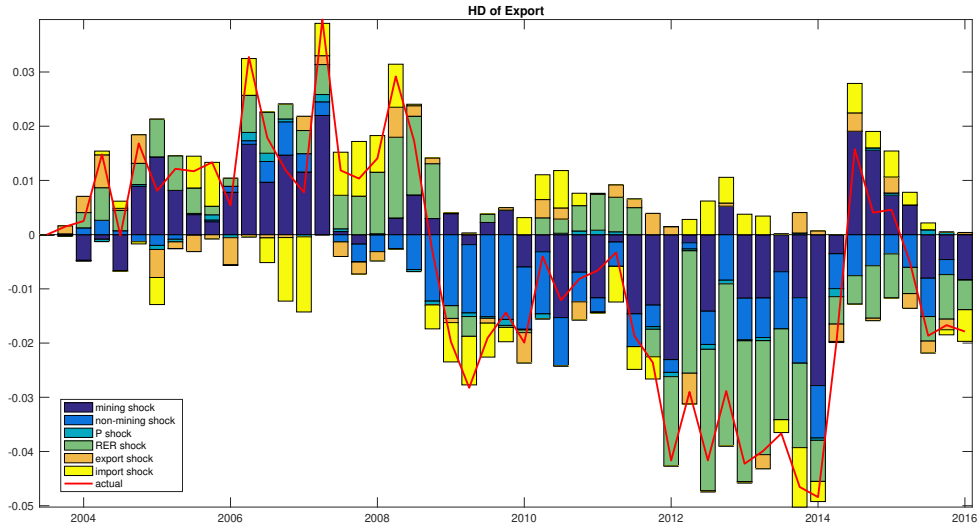

Figure 7: Historical Decomposition of PNG's Exports

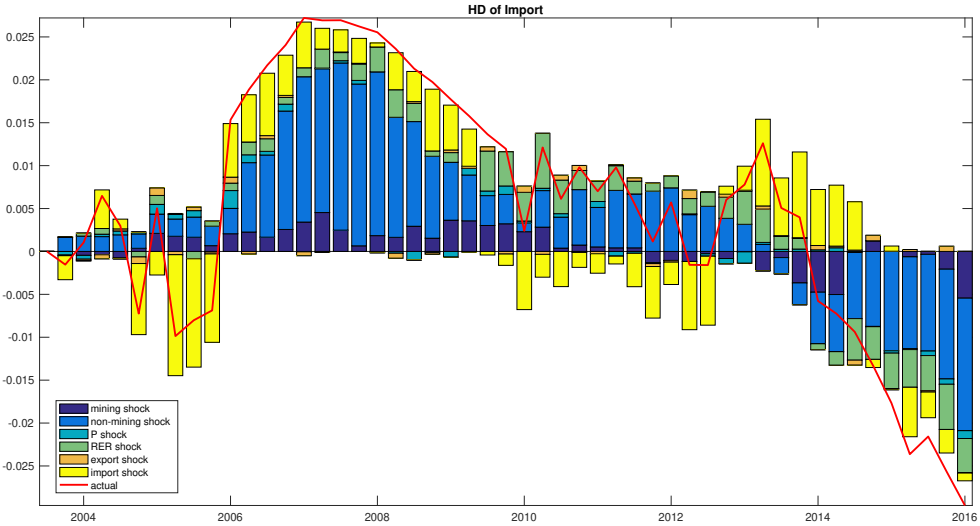

Figure 8: Historical Decomposition of PNG's Imports