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Essays on Domestic and International Spillovers from Macroeconomic Policies

April 2019

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics.

Keio University

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Acknowledgements

First and foremost, I would like to express my heartfelt gratitude, to my academic advisors Professor Yoshino Naoyuki and Professor Sahoko Kaji, for their guidance and mentorship through the Master and PhD programs at Keio University. I would also like to express my thanks and utmost appreciation to the members of my PhD committee, Professor Masao Ogaki, and Professor Colin McKenzie, for their support, guidance, and invaluable comments and suggestions. And of course, my sincere thanks to the MEXT scholarship program, for granting me the opportunity to pursue my graduate studies in Japan.

I would also like to sincerely thank the International Monetary Fund (IMF)'s Regional Office for Asia and the Pacific (OAP), where I received much of my training in policy-oriented research, and guidance and support in respect to finishing my thesis. I would like to particularly thank Mr. Giovanni Ganelli, for granting me such a big opportunity by accepting me as his intern, for becoming my indirect supervisor and mentor, and all his support towards my research and career. I could not have made it without him. I am also very grateful to Mr. Odd Per Brekk, and Mr. Chikahisa Sumi, for granting me the opportunity to pursue my internships at the IMF OAP office, and to continue later as part of the OAP team. Finally, I would like to thank all the staff at the IMF OAP office, for welcoming me so kindly amongst them.

I would also like to thank the anonymous referees and the editor at the Economic Modelling Journal, as well as the referees and the editor at the Japanese Political Economy Journal, for all their invaluable comments and suggestions.

On a personal level, I thank my mother Antoinette, my father Georges, my sisters Bouchra and Tamam, and my extended family for their support throughout this journey, and for helping me in each step of the way. Thank you for your support in this chapter of my life. I thank the friends I made in Japan for their wonderful friendship whilst I lived in Tokyo, and all that they taught me, Nene, Alex, Eman, Sian, Juan, Christian, Luisa. And I thank the friends back home who stayed with me throughout this long journey, especially Leyla.

Finally, I would like to thank Japan, for hosting me all these years, for all that it offered me. Japan inspired me for so much, and taught me to aim high, to stay humble, and to not give up. I thank Tokyo, for being my home, for its safety, for how it challenged me, and for all its never-ending wonders.

Abstract

This dissertation focuses on the quantification of domestic and international spillovers from policies adopted in countries with systemically important financial sectors (also referred to as systemically important countries)[1], namely Japan and China, onto their respective economies, as well as Southeast Asia and the rest of the world. The thesis consists of five original chapters.

Chapter One offers a detailed explanation of the Global VAR (GVAR) model, which is later employed in chapters Two, Three, and Four, as the tool for analysis of spillovers and the propagation of shocks.

Chapter Two presents an empirical analysis to quantifying spillovers from the Bank of Japan's Quantitative and Qualitative Easing (QQE) on emerging Asia. It uses a GVAR model of 29 countries, using monthly data from years 2000 until 2016. This research contributes to the literature by being the first- to the best of our knowledge- to look at the impact of QQE on emerging Asia through unconventional monetary policy's impact on stock prices, otherwise referred to in the literature as the "stock market channel". The contribution of this research to the related literature is by its identification of shocks related to QQE: the model applies sign restrictions to identify a shock to equity prices caused by unconventional monetary policy, from a shock to equity prices caused by a standard financial boom. By doing so, it captures the spillovers of the stock market boom in Japan following QQE, domestically and internationally. Finally, this empirical analysis expands the body of literature regarding the impact of quantitative easing from Japan, which is limited compared to the literature concerning the US' quantitative easing. The exercise shows that despite an appreciation of their currencies vis-à-vis the Japanese yen, the impact on emerging Asia's GDP tended to be positive and significant in the short-run. The results suggest that the positive effect of the increase in equity prices, more than offset any negative exchange rate spillover due to expenditure switching from domestic demand to Japanese goods. They also suggest that spillovers from QQE might have worked mainly through the impact of the stock market channel, rather than through the traditional interest rate channel.

Chapter Three uses a GVAR model for 34 countries spanning from 1979Q1 to 2015Q4, to proxy the impact of China's rebalancing from an investment-driven to a consumption-driven economy, on a global, regional, and country level. Its contribution to the literature is by creating a proxy to the rebalancing, by using country-specific investment and consumption data to simulate the effect of the decline of China's investment, and then the increase of its

[1] Systematically important countries (also referred to as systemic countries in this thesis) are defined as countries with systematically important financial sectors. As of 2013, the International Monetary Fund (IMF) identifies 29 countries as having systematically important financial sectors, based on the size and interconnectedness of each country's financial sector (Viñals et al., 2010). This group of countries covers approximately 90 percent of the global financial system. Included in the list of countries that are deemed systemically important are China, Japan, member countries of the euro area, and the United States.

consumption, on the rest of the world. By doing so, the research differentiates itself from the existing literature, which mainly quantifies the rebalancing through a negative shock to China's GDP. In that context, this research explores the impact of the rebalancing on a country through the changes in both GDP components. Through this exercise, we mainly observe that commodity prices are negatively impacted not only from a negative China investment shock, but also following a positive China consumption shock. The results also suggest that, except for commodity exporters, the losses following a negative shock to China's investment are somewhat offset by a positive shock to China's consumption. The results also show the Asia Pacific region specifically benefits from the rebalancing, due to the relocation of capital flows to industrialized countries, and the overall increase in demand for consumption goods.

Chapter Four extends the models of chapters Two and Three to compare the propagation of shocks from China and other systemic economies to the Middle East and North Africa (MENA). The academic contribution of this chapter consists of building a large GVAR model for 47 economies, including 13 countries in the MENA (and 18 oil exporting countries in total), and extends the coverage of the data until 2014Q4. The chapter then looks at the impact of systemic shocks on the MENA and includes a simplified model which accounts to the demand and supply of oil in the region. It also investigates, using time-varying weights, how the propagation of shocks from systemic countries may have evolved over time. This chapter adds to the limited body of research which analyses spillover shocks to the MENA region, and is the first to offer such an extended and updated dataset, to the best of our knowledge. In addition, this research is the first to use country-specific consumption and investment data to investigate the impact of China's rebalancing on the MENA region. Studies of shocks relating to the MENA region are scarce, mainly because of data availability. Through this study, we hope to offer a dataset which can be used for future research, to study the many aspects of the propagation of shocks in this region. The results suggest that while China's linkages have deepened with the MENA region, negative output shocks from the United States have a larger impact, due to the US' systemic role in the oil market. The findings also suggest the adverse effects of the decline in China's investment demand are less pronounced on oil importers in the MENA, due to the decline in oil prices and an increase in China's consumption demand.

Chapter Five uses prefectural data to explore the potential impact on wage dynamics of the minimum wage increase policy in Japan, which was implemented in 2016 as an indirect means to combat deflation. This study offers a comparative analysis on how a one percent increase in the minimum wage can affect the average wages of full-time working men and women, respectively. This research is the first, to the best of our knowledge, to use a panel dataset on a prefectural level, for both genders, to analyze the impact of an increase in the minimum wage on the wage distribution of both men and women in Japan. By doing so, we highlight the distinct aspects for each gender of the pass-through from the minimum wage to the average wage, as well as different trends in the labor market of each group. The main result is that stepping up minimum wage growth from 2 to the planned 3 percent per year could raise wage growth by 0.5 percent annually. Other results suggest that the pass-through of the minimum

wage to average wages is larger for men than for women, due to other tax and wage policies. The underlying conclusion is that given Japan's need for income policies to generate vigorous wage-price dynamics, reflecting the 2 percent inflation target, one policy implication of this finding is that, while the minimum wage plan will help boost wages, it should be accompanied by other, more "unorthodox" income policies, such as a "soft target" for private sector wage growth through a "comply -or-explain mechanism" for wage growth and increases in public wages in line with the inflation target.

Introduction

This thesis focuses on the spillover effects of macroeconomic policies and shocks from economies with systemically important financial sectors (or systemic economies in short), namely Japan and China, to the rest of the world. The motivations for carrying out such a research project are two-fold: first, the analytical exercises aim to show the diverse ways by which emerging and developing economies can be affected when a systemic economy adopts a new monetary or macroeconomic framework, while highlighting the different linkages through which shocks can propagate. The second motivation comes from the observation that the study of the effects of systemic shocks and spillovers generally focuses only on a certain number of countries, due to several reasons, but namely data availability. Therefore, this dissertation makes efforts to extend the coverage of empirical analysis to more regions and emerging countries which may not be generally looked at in the study of the propagation of shocks but are nonetheless highly affected by the fluctuations in the business cycles of systemic economies.

There is a vast body of literature which examines the synchronization of business cycles linkages among major economies, and the co-movements of macro-economic variables across them. The channels through which business cycles are transmitted are many, and are often unobserved: from financial linkages, through stock prices and capital flows, to global factors, like commodity prices and technology breakthroughs. Examining the propagation of shocks gained increased attention following the Global Financial Crisis (GFC), when much was uncovered regarding how shocks- and policies – can propagate between countries. More specifically, the impact from the policies adopted by the fiscal and monetary authorities in the

United States in the aftermath of 2008, highlighted the magnitude of the spillover effects domestically and internationally.

At the forefront of this research is the Global Vector Auto-Regressive (GVAR) model, innovated by Pesaran, Smith and Weiner, and further developed by Dees, DiMauro, Pesaran and Smith[2]. The Global VAR model was derived as an approximation to a global unobserved factor model, where countries can be linked together through country-specific vector-error correcting models (VECM). The practicality of the model comes from the inclusion of domestic and foreign variables in each country VECM. These financial and global variables, often interrelated, relate the co-movements among the integrated regions' business cycles. For example, the inclusion of variables such as stock prices, exchange rates, and interest rates, could capture the financial linkages among countries, whereas variables such as oil prices and prices of other commodities, could relate the impact of global macro shocks on the world economy. In addition, the use of the Global VAR model solved the issue of unobserved factors in factor models, which were made popular by the contributions of Stock and Watson[3]. These factor models, which rely on principal components, are widely used for forecasting exercises, but can be problematic when it comes to the identification of shocks, given that factor components are typically difficult to interpret.

Although the Global VAR is a flexible model that can be used to analyze various issues in spillovers and transmission of shocks, the existing contributions to the literature tend to focus on the impact of financial and monetary shocks from the United States and the Euro Area. In

[2] Pesaran, Smith and Weiner (2004), and Dees, DiMauro, Pesaran and Smith (2006)

[3] Stock and Watson (2002a)

addition, the existing literature predominantly makes use of the dataset offered by the GVAR toolbox, thus limiting the studies of spillovers to a pre-determined sample of countries. Therefore, the pre-specified data in the toolbox makes it only possible to explore the linkages through the offered variables only.

Keeping the above observations in mind, the rest of this introduction will mainly focus on summarizing the contents of five original chapters presented in the thesis, while highlighting their contributions to the body of literature. The chapters study the topic of spillovers from policies, and while there is a logic to the order in which they are presented, following the development of the models and the data, each chapter can be considered as an independent analytical exercise, tackling a certain topic. Both in this introduction and the respective chapters we will also try to highlight the motivation and the contributions of each analytical exercise, as well as the connections with other chapters in thesis, when relevant.

In chapter One we present the framework to how the Global VAR model is derived. This chapters offers no analysis or empirical exercise for the propagation of shocks. Rather, the framework of the GVAR is introduced at the beginning of the thesis for practical purposes: given that it is the model used in chapters Two, Three and Four, it is laid out in a simplified way, for the understanding of the reader. And while various aspects of the model, and different datasets, are used in each chapter, the Global VAR remains the tool for analysis.

In chapter Two we investigate the spillover effects on emerging Asia and on Japan, from the Bank of Japan's (BOJ) Quantitative and Qualitative Easing (QQE) program. QQE, which was launched by Prime Minister Shinzo Abe, (henceforth referred to as "Abenomics") to combat deflation, brought on a considerable improvement in the stock market performance, and a weakening of the Japanese Yen. The motivation behind this exercise was to explore whether

the linkages of Japan with emerging Asia and ASEAN countries had remained strong enough to carry spillover effects, despite the changes in trade and financial patterns throughout the years. Given the importance of Japan in the region, it was not non-logical to assume that economies in emerging Asia may have been affected by the large quantitative easing program of Abenomics. For that purpose, a Global VAR model dataset is built for 29 countries including Japan, other systemic countries, and ASEAN economies, spanning from January 2000 until September 2016.

In carrying this exercise, we fill a certain gap in the literature, by being the first to attempt to quantify the spillovers from QQE internationally, but specifically through QQE's impact on stock market prices, on different real and financial variables, to the best of our knowledge. Kawai (2015) looks at the impact of QQE on emerging Asia through a historical comparison of the fluctuation of the exchange rates of said economies after the launch of QQE. Other existing papers which analyze the impact of QQE tend to focus on its domestic impact in Japan, and mainly on inflation (for example, Fujiwara (2014)). More importantly, the main contribution of this research is in its identification of monetary shocks in an Unconventional Monetary Policy (UMP) setting. Specifically, we apply sign restrictions to an equity price shock to discern it from a standard financial shock, so that we can identify the impact of QQE through the stock market channel. The stock market channel infers to the channel of transmission of monetary policy to financial markets, investors' expectations and their perception of the riskiness of markets[4]. We argue that this channel is important for quantifying spillovers in an unconventional monetary policy context. This is because the prospects of

[4] Bernanke (2003), opening remarks at the Banking and Finance Lecture, Widener University, Chester Pennsylvania.

identifying monetary policy shocks from a central bank where the interest rates had been at the zero-lower bound for many years (before breaking the zero bound in 2016) is challenging. In fact, at the zero-lower bound, monetary policy cannot operate through its traditional tools, and can only be successful by raising future expectations of higher growth, which by themselves are difficult to proxy[5]. Therefore, one must look at the impact of monetary policy through other transmission channels. As such, shocks from monetary policy on stock prices are identifiable, and are important, given how large fluctuations in equity prices spill over to other assets classes. Therefore, this research is the first, to the best of our knowledge, to identify QQE by detangling a monetary shock from a financial shock through the stock price channel, and thus capturing the stock market channel of QQE on a large-scale GVAR model. Using equity prices also adds the advantage of matching stylized facts (equity prices increased significantly during both first and second QQE periods in Japan). We also test the propagation of shocks using the shadow short-term interest rate as an unconventional monetary policy tool, and argue that it may be better suited for capturing domestic spillovers, but that it does not capture the impact of UMP on the stock market.

Our results show that the implementation of QQE in Japan, when estimated by a positive shock to Japanese equity prices identified by sign restrictions as a monetary shock, caused temporary spillovers, namely, a temporary increase in equity prices across emerging Asian countries, an appreciation of the currencies of some, a temporary increase in output for some countries, and capital inflows for the first few months. A negative shock to the shadow interest rate only captures spillovers domestically, and has a significant impact on the exchange rate, GDP and

[5] Krugman (2015)

inflation for Japan, but it does not capture the significant increase in equity prices. In line with our results, we find evidence in the literature where the shadow interest rate is used, but international spillovers are not registered from the United States to other economies[6]. In chapter Two, we therefore argue that the transmission channel of unconventional monetary policy is through not only interest rates, but also through the stock market channel. In that context, we argue for the necessity to perform an exercise where the impact of the monetary shock on the financial markets is identified, to capture all the spillover effects from monetary policy.

Chapter Three of this dissertation studies the possible spillovers from the rebalancing of China from an investment-driven economy to a consumption-driven one. This is deemed a relevant exercise, given the magnitude of the spillovers which were registered when China embarked on its rebalancing transition, from capital outflows, to the weakening of the Renminbi, and decreases in commodity prices. Economic research has vastly focused on the effects of this rebalancing, on China and other countries. Cashin, Mohaddes, and Raissi (2016) tested whether financial volatility in the global market could be affected by China's rebalancing, using a GVAR model. Dzioli *et al* (2016) also employed a GVAR model to look at the spillovers from China to emerging Asia. However, studies of the rebalancing mostly focus on GDP-to-GDP spillovers. More specifically, the proxy for China's rebalancing generally comprises of a negative shock to China's GDP. However, China's systemic importance in trade and in the global value chains asks the question of whether this switch in growth models may

[6] Chen *et al*, (2015).

also affect investment and consumption patterns in other parts of the world. In that context, the novelty of this research is by its identification of the rebalancing shocks, as opposed to the current literature, which studies the rebalancing by focusing on GDP-to-GDP spillovers from China to the rest of the world. Specifically, the main contribution of this chapter is its simulation of a proxy for the rebalancing of China, by using country-specific investment and consumption data instead of real GDP data. Using a proxy which looks at both the effects of the decline in investment demand in China and the increase in the consumption demand offers a more elaborate way to view how the impact of the rebalancing might be borne on other countries. To this extent, our research is the first to the best of our knowledge to investigate potential spillovers from the change in GDP components for China and other countries. In addition, this chapter exploits the variability of the GVAR model by modeling the impact of this rebalancing exercise on a global, regional, and country level. By using a global model for 34 countries, some of the potential impact of China's rebalancing on the rest of the world is illustrated. To the best of our knowledge, this has not been done yet in the literature, mainly to the restricted availability of investment and consumption data. Indeed, the large effort of this chapter is in the construction of the dataset, which spans from 1979Q1 to 2015Q4. China's switch from an investment driven model to a consumption-driven one is then modeled as a 1 percent decline in China's investment, followed by a 1 percent increase in its consumption. This exercise also tests the propagation of China investment and consumption shocks through trade, commodity prices, and financial linkages. However, given that the actual rebalancing of China is an ongoing process, it is important to note that this exercise may not be able to capture the full impact of the rebalancing process on the rest of the world.

The results show that the adverse effects of China's decline in investment demand are somewhat offset by the positive spillovers from the increase of its consumption demand for some countries. However, the findings mainly suggest that the substantial impact of this transition is on commodity prices. Specifically, oil prices drop by 2-3 percent, and metals prices by 1-2 percent following a negative 1 percent investment shock, exacerbating adverse effects on commodity exporters. On a global scale, an increase in consumption raises global investment and global consumption by enough to offset some of the decline incurred by the negative investment shock. However, the impact of a one percent positive consumption shock remains largely negative on commodity prices, also depressing them by 2-3 percent. Therefore, a positive consumption shock does not offset the incurred losses on countries that export commodities and investment goods. However, region specific spillovers point that some regions benefit from the rebalancing exercise. For instance, the Asia Pacific region, supplier of consumption goods, gains from the rebalancing of China and the increase of its consumption demand. This implies that other regions may offset losses incurred by the decline in investment demand, through the diversification of their exports.

In Chapter Four, we compare the impact of shocks from systemic economies on commodity prices, and their subsequent spillover effects on commodity exporters and importers. Namely, we focus on the outcome of systemic shocks from China, the United States, and the Euro Zone, on the Middle East and North Africa (MENA) region, including the Gulf Cooperation Council countries (GCC). The motivation behind this exercise is the following: despite the systemic role of the region in the oil market, few studies have addressed the impact of systemic shocks on the MENA region. A notable exception is the paper by Cashin, Mohaddes and Raissi (2012),

where they build a GVAR model for spillovers and spillbacks to the MENA region with data up to 2008. However, we could not, to the best of our knowledge, find reference in the literature to papers which, study the impact of the rebalancing of China, or of a systemic shock from the United States after the GFC, on the MENA region. We therefore choose to look at the impact of shocks on the GCC, given its systemic role in the supply of oil and natural resources to the world market, and given the dependence of other countries in the MENA on the region. By using a GVAR model, we can capture direct spillover effects from systemic shocks, and then spillovers through secondary channels (for example, commodity prices), and finally, third-round spillovers on the MENA commodity importing countries (for example, economic distress in the GCC caused by systemic shocks can also affect the MENA).

Our research contributes to the literature by adding to the limited body of research which studies the impact of systemic shocks on the MENA region. It also contributes to the GVAR literature by extending the coverage of the GVAR model to 47 countries, of which 13 are countries in the Middle East and North Africa (MENA) region. The model includes a total of 18 oil exporting countries, 11 of which are member countries of the Organization of the Petroleum Exporting Countries (OPEC). The dataset spans from 1979Q1 to 2014Q4, thus also extending the coverage of Cashin, Mohaddes and Raissi (2012)'s model, and offering insight on the impact of systemic shocks beyond the GFC. The GVAR is then modeled in a simplified way to account for the demand and supply of oil. In addition, we compare the evolution of linkages between the regions and the three systemic economies in the last two decades. This is done as a visualization exercise as to show how trade linkages have changed, subsequently causing an evolution in the propagation of shocks. Finally, this chapter applies the rebalancing

proxy of China, innovated in Chapter Three, to the MENA region, and is the first research to do so, to the best of our knowledge.

Our results show, when estimating our GVAR for the two fixed trade weight years 1996-1998 and 2012-2014, that China's linkages with the MENA have grown, bringing about a larger propagation of its shocks. Meanwhile, the same exercise shows that the linkages between the USA, the Euro Area, and the MENA have shrunk, allowing for the impact of the shocks to be of smaller magnitude. However, the results show that a negative output shock from the United States is still larger in magnitude than a China shock or a Euro shock. We attribute this to the US' systemic role in the oil market and its impact on oil prices. Finally, the results of the rebalancing proxy exercise show that a decrease in investment in China also lowers investment in the MENA region through the oil channel, by pushing down oil prices. However, an increase in consumption demand somewhat offsets the adverse effects of the rebalancing, especially for oil importers, who benefit from the now-cheaper imports, and the increase in China's import demand for consumption goods.

Finally, the research in chapter Five is carried with regards to spillovers from the annual minimum wage increase of 3 percent in Japan, which was implemented in October 2016 with the intent to raise the minimum wage to 1000 Japanese Yen per hour by year 2020. The last chapter of this dissertation does not make use of the GVAR model. Instead, it employs a prefectural dataset for Japan to study domestic spillovers from the structural reforms implemented on the labor market in Japan. Specifically, we investigate the pass-through of the minimum wage (which is typically the earning wage of part-time workers), to average wages of full-time workers. Chapter Five therefore relates to the other chapters in this thesis through

the topic of spillovers, given that the literature concerning minimum wages typically decrees that changes in the level of minimum wage have "spillover" or "ripple" effects on the wage distribution, on employment and on inequality. To that extent, this research presents a framework which explains how an increase in the minimum wage could affect the wages of workers who earn at and above the minimum wage. This chapter is also written within a policy context: its main motivation is to investigate whether increasing the minimum wage could lead to a growth in nominal wages, which is considered a key factor for breaking the deflationary cycle in Japan[7].

Studies related to the impact of the minimum wage on the labor market in Japan are scarce. A notable contribution is by Kambayashi, Kawaguchi, and Yamada (2013), who use women's wage percentile data on a national level to assess the impact of a minimum wage increase in a deflationary period between 1994 and 2003. We contribute to the literature by measuring the pass-through of the real minimum wage on total wages, men's wages, and women's wages in Japan using an updated panel dataset from 1997 to 2014. This study is the first, to the best of our knowledge, to look at the spillovers from an increase in the minimum wage on the wage distribution on a gender-based level, for men and women in Japan respectively, and on an average total level. By looking at spillovers from an increase in the minimum wage on the wage distribution for each gender group, we highlight the difference in pass-through between men and women in Japan. Our research is also the first, to the best of our knowledge, to employ a panel dataset of Japan's 47 prefectures: it takes advantage of the availability of prefectural data for male and female earners respectively to demonstrate how the pass-through from the

[7] Everaert and Ganelli (2016).

minimum wage to average wages is different for each gender group, but also to identify labor trends in the Japanese work-force. A panel dataset allows us to control for random and time-invariant effects. It also allows us to make use of a Two-Stage-Least-Squares (2SLS) Instrumental Variables regression to control for endogeneity which may arise in the prefectural dataset. Additionally, we contribute to the 2SLS literature by offering a novel instrument (to the best of our knowledge) for controlling endogeneity in the dataset, which complies with the theoretical condition that it should lead to a change in the regressor without affecting the dependent variable, but also passes the technical tests for instrument validity.

The results indicate that an increase in the minimum wage would help increase average wages in Japan. The regression results suggest that a 1 percent increase in the hourly minimum wage could increase the hourly average wage by as much as 0.48 percent. They also show that wages for men could increase by 0.6 percent as well, while women's wages could increase by 0.4 percent. However, the findings imply that while the increase in the minimum wage planned by the government can help stimulate average wage growth, the quantitative impact might fall short of the vigorous wage dynamics that Japan needs to escape deflation.

Our results also capture some labor trends in the Japanese work-force: the regression reveals that women's average age is negatively correlated to their wages, while for men, their age has a positive impact on their wages. This is indicative of the traditional seniority wage system in Japan, where workers' wages grow in accordance to the length of their period of their employment in their workplace, rather than by their productivity. On additional way to interpret these results is that women may be left out from the seniority based pay increase because many of them drop out of the work force after bearing children. Another implication from the results, namely the lower pass-through of the minimum wage to average wages for

women, is that factors such as the tax deduction for spouses, which places an income cap on the second earner in a Japanese household (typically the woman), may be discouraging women from working longer hours or re-entering the work force. Other discouraging factors could be the lack of support with regards to childcare facilities to women when they are working.

Together, these chapters try to illustrate in a comprehensive manner the implications of a policy shock both on a domestic and international level. When relevant, policy recommendations are also given in accordance to the results obtained, in such a way that countries affected by spillovers can take advantages of the opportunities brought by the changing of economic conditions, while mitigating whatever adverse effects from the spillovers.

Keeping all the above in mind, we are ready to provide a detailed presentation of the contents of this thesis.

CHAPTER 1. THE GLOBAL VAR MODEL

1.1 The GVAR Model Framework

In this chapter, we discuss the econometric framework of the GVAR model, which is used for empirical estimation in chapters 2, 3 and 4. This model was first proposed by Pesaran, Schuermann and Weiner (2004, hence PSW), and further developed by Dees, diMauro, Pesaran and Smith (2007, henceforth DdPS). The GVAR framework is well suited to examining spillovers because it allows us to model country-specific dynamics, while also allowing for cointegration among variables. This chapter provides a detailed explanation to the GVAR model.

Assume an N number of countries $i = 0, 1 \dots N$ to be included in the model. For each country, a t number of domestic variables $t = 1, 2 \dots t$ such as GDP, inflation, equity prices, etc… are collected into a $x_{it}: k_i \times 1$ vector of domestic variables. Accordingly, an $x_{it}^*: k_i^* \times 1$ vector of foreign variables is built for each x_{it}, where:

$$x_{it}^* = \sum_{j=0}^{N} w_{ij} x_{jt} \, , w_{ii} = 0 \tag{1}$$

With $w_{ij}, j = 0,1, \dots, N$ a set of weights such that $\sum_{j=0}^{N} w_{ij} = 1$

Then for each country, a VARX*(2, 2) structure will be constructed, where:

$$x_{it} = a_{i0} + a_{i1}t + \Phi_{i1}x_{i,t-1} + \Phi_{i2}x_{i,t-2} + \Lambda_{i0}\,x^*_{it} + \Lambda_{i1}\,x^*_{i,t-1} + \Lambda_{i2}\,x^*_{i,t-2} + u_{i,t} \qquad (2)$$

With the $u_{i,t}$ cross-sectionally weakly correlated such that $\hat{u}_{it} = \sum_{j=0}^{N} w_{ij}u_{jt} \xrightarrow{p} \infty$ ($\xrightarrow{p}$ denotes convergence in probability).

We therefore can write the error correction form of the VARX*(2,2) specification as such:

$$\Delta x_{it} = c_{i0} - \alpha_i \beta'_i\left[z_{i,t-1} - \gamma_i(t-1)\right] + \Lambda_{i0}\Delta x^*_{it} + \Gamma_i\,\Delta z_{i,t-1} + u_{it}\,, \qquad (3)$$

where $z_{it} = (x'_{it}, x^{*'}_{it})$,

$\alpha_i$is a $k_i \times r_i$ matrix of rank r_i

and β_i is a $(k_i + k^*_i) \times r_i$ matrix of rank r_i.

β_i is then partitioned as $\beta_i = (\beta'_{ix}, \beta'_{ix*})'$ conformable to z_{it},in order to write the r_i error correction terms as

$$\beta'_i(z_{it} - \gamma_i t) = \beta'_{ix}x_{it} + \beta'_{ix}x_{it} + \beta'_{ix*}x^*_{it} - \left(\beta'_i - \gamma_i\right)t\,, \qquad (4)$$

The foreign variables x^*_{it} and the global variables are estimated to be I(1) weakly exogenous variables: they are treated as 'long-forcing' with respect to the domestic variables of the VARX* model, i.e. there is no long-run feedback from the domestic variables to the foreign variables. All variables are tested for the presence of unit root by using the weighted symmetric ADF tests. With the use of the weak exogeneity test, we can check which foreign variables to include in our estimation.

Next, reduced rank regression is used in order to obtain the number of cointegrating relations r_i , the speed of adjustment coefficients α_i, and the cointegrating vectors β_i for each country's VARX*. The rank orders are obtained by Johansen's trace statistic. Thus, each VARX* is estimated, allowing for cointegrating within the domestic variables x_{it} , and between the domestic and foreign variables x_{it} and x_{it}^* .

Once β_i is estimated, the remaining parameters of each country's VARX* can be obtained by OLS, using the following equation:

$$\Delta x_{it} = c_{i0} + \delta_i ECM_{i,t-1} + \Lambda_{i0}\Delta x_{it}^* + \Gamma_i \Delta z_{i,t-1} + u_{it}, \quad (5)$$

With $ECM_{i,t-1}$ as the model correction terms according to the r_i cointegrating relations of the i^{th} country model.

The lag order for domestic variables (p_i) and foreign variables (q_i) that are included in each country's VARX* model is selected using the Akaike Information Criterion (AIC), subject to a maximum lag order of p_i that we chose (with $p_i = 4$ for chapter 2 and p_i= 2 for chapter 3 and 4)

Once each country-specific VARX* model is estimated, we can solve the GVAR model for the world as a whole: when the GVAR is solved for the world as a whole, all the variables become endogenous to the system, i.e. the GVAR model is expressed in terms of a $k \times 1$ global variable vector, $k = \sum_{i=0}^{N} k_i$

By calling on $z_{it} = \binom{x_{it}}{x_{it}^*}$, we can rewrite each economy's VECMX model as:

$$A_{i0}z_{it} = a_{i0} + a_{i1}t + A_{i1}z_{it-1} + \cdots + A_{ip_i}z_{it-p_i} + u_{it}\,, \tag{6}$$

Where

$$A_{i0} = \left(\mathrm{I}_{k_i}, -\Lambda_{i0}\right), \quad A_{ij} = \left(\Phi_{ij}\,, \Lambda_{ij}\right) \text{ for } j = 1, \ldots, p_i$$

We then use the weights w_{ij}, which we obtained from the trade or financial flows, in order to create the link matrix W_i . Using the link matrix W_i , we obtain the identity:

$$z_{it} = W_i x_t\,, \tag{7}$$

Where $x_t = (x'_{0t}, x'_{1t}, \ldots, x'_{Nt})$' is the $k \times 1$ vector of all endogenous variables of the system, and W_i is the $(k_i + k_i^*) \times k$ matrix that captures all bilateral exposures between the countries in the dataset.

Finally, the individual models are stacked together to make the global model x_t , which contains all the variables and is given by:

$$G_o x_t = a_0 + a_{1t} + G_1 x_{t-1} + \cdots + G_p x_{t-p} + u_t \tag{8}$$

where,

$$G_0 = \begin{pmatrix} A_{00}W_0 \\ A_{10}W_1 \\ \vdots \\ A_{N0}W_N \end{pmatrix}, \; G_j = \begin{pmatrix} A_{0j}W_0 \\ A_{1j}W_1 \\ \vdots \\ A_{Nj}W_N \end{pmatrix}, \text{ for } j = 1, \ldots, p$$

$$a_0 = \begin{pmatrix} a_{00} \\ a_{10} \\ \vdots \\ a_{N0} \end{pmatrix}, \; a_1 = \begin{pmatrix} a_{01} \\ a_{11} \\ \vdots \\ a_{N1} \end{pmatrix}, u_t = \begin{pmatrix} u_{0t} \\ u_{1t} \\ \vdots \\ u_{Nt} \end{pmatrix}$$

with $p = \max(\max p_i\,, \max q_i)$

Premultiplying Equation 8 by G_0^{-1} , the GVAR(p) model can be expressed as

$$x_t = b_0 + b_1 t + F_1 x_{t-1} + \cdots + F_p x_{t-p} + \varepsilon_t \,, \tag{9}$$

where

$$b_0 = G_0^{-1} a_0 \,, b_1 = G_0^{-1} a_1,$$

$$F_j = G_0^{-1} G_j \,, j = 1, \ldots, p \,, \quad \varepsilon_t = G_0^{-1} u_t$$

Equation (9) can be solved recursively and impulse response and variance decomposition analysis can then be performed.

1.2 GVAR Estimation

We use the GVAR toolbox by Vanessa Smith and Alesandro Galesi[8] to estimate our model. The order of integration for foreign and domestic variables is obtained by testing for unit root. All variables are tested with the Augmented Dickey-Fuller test as well as the Weight Symmetric ADF test on levels, first and second differences.. We find that for most the variables used in this thesis, the hypothesis of unit root cannot be rejected. All variables are tested for weak exogeneity, and most of the foreign variables are weakly exogenous. Choosing to exclude

[8] The GVAR toolbox is available for download from wwwcfap.jbs.cam.ac.uk/research/gvartoolbox/index.html.

non-exogenous variables from the VARX* specification has no statistically significant impact on the results. Results for the weak exogeneity test are provided as supporting material.
The trend coefficients are restricted to lie in the cointegrating space, and the intercepts are left unrestricted. (This is case IV in the GVAR toolbox).

In addition, our model satisfies the additional requirements indicated by PSW (2004):

- The GVAR is stable: the eigenvalues of the F matrix in (9) lie on or inside the unit circle.
- The weights are relatively small: PSW states that the weights must be small such that $\sum_{j=1}^{N} w_{ij}^2 \to 0$ as $N \to \infty$. Most of our weights satisfy this condition.
- The idiosyncratic shocks are weakly correlated. We can check for weak correlation by calculating the average pair-wise cross-section correlation between residuals and variables. The VECMX* residuals show low correlation among almost all variables.

CHAPTER 2. SPILLOVERS FROM JAPAN'S UNCONVENTIONAL MONETARY POLICY[9]

2.1 Introduction

This chapter focuses on the spillover effects of Japan's unconventional monetary policy on emerging Asia. The main motivation for the analysis is that, while several papers have looked at the domestic and global impact of Quantitative Easing (QE) in the U.S., and at the domestic impact of Japan's unconventional monetary policy, studies of the spillovers from the latter are scarce. Given the importance of Quantitative and Qualitative Monetary Easing (QQE) in Japan's current macroeconomic policy framework, and the strong financial and trade linkages between Japan and neighboring countries, an analysis of spillovers from QQE is a highly relevant exercise.

After Prime Minister Abe came into power in late 2012, Japan had been emerging from two decades of deflation and low growth, as the ambitious policy framework of Abenomics—including macroeconomic stimuli and structural reforms—was put in place. However, with

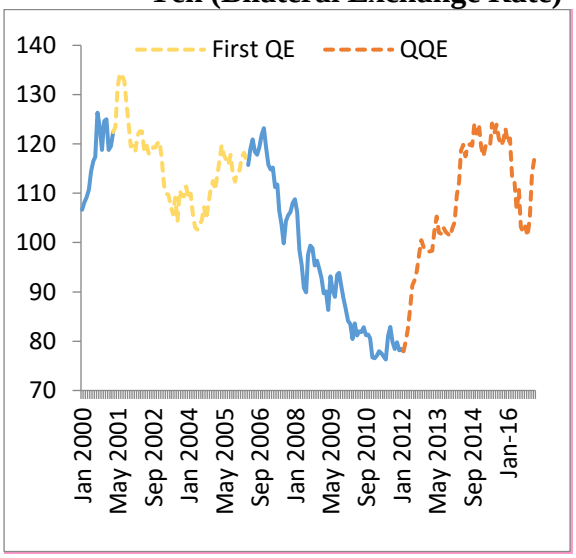
[9] The work discussed in this chapter has been published in the Economic Modelling journal in October 2017, accepted as 'Spillovers from Japan's Unconventional Monetary Policy: A Global VAR Approach', by Nour Tawk and Giovanni Ganelli (gganelli@imf.org). The author of this thesis undertook the data collection, the econometric analysis for the research, and wrote the manuscript. Mr. Ganelli designed and supervised the research. Both authors edited the published manuscript. Prior to that, a working paper related to this chapter was published as an IMF working paper WP/16/99 in May 2016, entitled "Spillovers from Japan's Unconventional Monetary Policy to Emerging Asia: A Global VAR approach", by Nour Tawk and Giovanni Ganelli (gganelli@imf.org)). However, the analytical work in the initial paper relied on orthogonalized shocks to calculate spillovers, while this chapter differs by using two alternative methods for the identification of monetary policy shock, including the use of sign restrictions.

interest rates at the zero lower bound, the power of traditional monetary policy tools had become limited. Consequently, the Bank of Japan (BoJ) embarked on new QE policies, which included the purchase of both risky assets and government securities. In April 2013, the newly appointed BoJ Governor Kuroda announced that QQE "… will double the monetary base and the amounts outstanding of Japanese government bonds (JGBs) as well as exchange traded funds (ETFs) in two years, and more than double the average remaining maturity of JGB purchases." (Figure 2.1.D)

Since the beginning of QQE and the launch of Abenomics, Japan has witnessed a strong depreciation of its currency (Figure 2.1.A), a significant surge in its equity prices (Figure 2.1.B), and a pick-up in inflation (Figure 2.1.C). By the end of 2016, the Japanese yen had depreciated from 82 Yen/USD in 2012 to 117 Yen/USD. Similarly, the Japan MSCI index's value had risen from 450 points in 2012, closing at 914 points by December 2016, while both underlying inflation and inflation expectations came close to one percent. Meanwhile, compared to the first QE program in Japan that was launched in March 2001 and ended in March 2006, one can see that, though both QEs led to an increase in equity prices, the current QQE had a larger impact on inflation and the exchange rate.

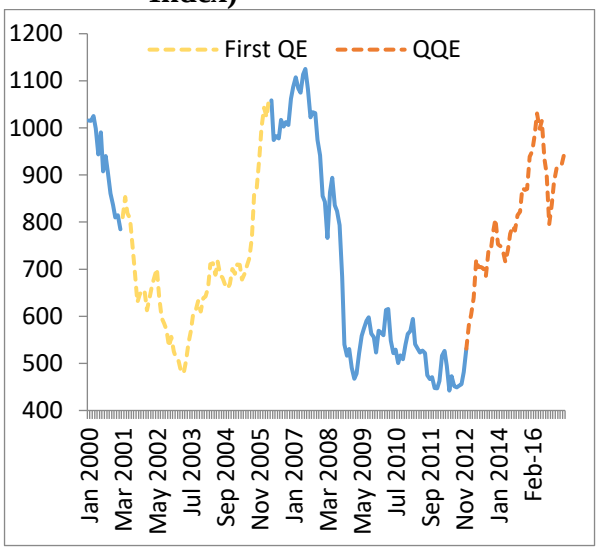
Figure 2.1: The Japanese Economy through Abenomics and the First QE

A. Depreciation of the Japanese Yen (Bilateral Exchange Rate)



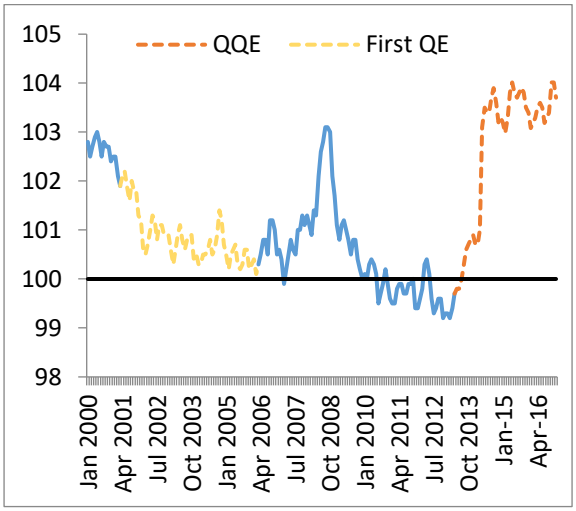
Source: IMF IFS

B. Surge in Equity Prices (MSCI Index)



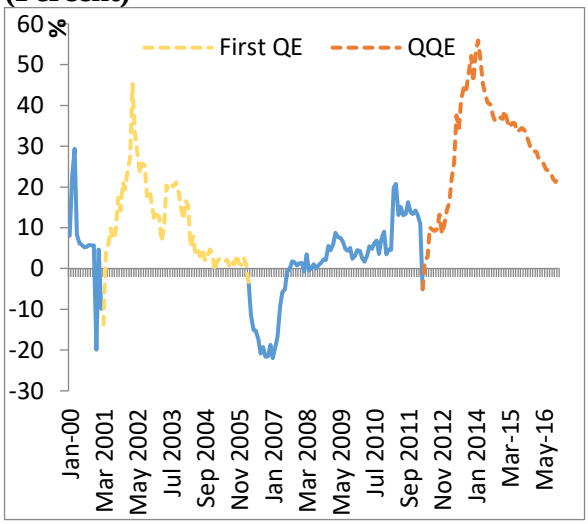
Source: IMF IFS

C- Modest Increase in the CPI Index



Source: IMF IFS[10]

D- The Expansion of the Monetary Base (Percent)



Source: IMF IFS

[10] The consumer price index includes the temporary impact of the consumption tax increase.

The main interest of this research is to study how these developments in Japan may have affected emerging Asia. To do this, we assess potential spillover effects from QQE using a multi-country dataset to set up a Global VAR (GVAR) model. The GVAR framework, developed by Pesaran, Schuermann, and Weiner (2004), allows examining the propagation of shocks through various macroeconomic linkages between countries. The methodology involves setting up country-specific individual VARs, and then linking them through the inclusion of foreign variables. The latter are weighted averages of the other countries' variables, and they augment the individual country-specific VARs to capture the propagation of shocks.

In addition to Japan, we include in our sample five ASEAN economies, namely Indonesia, Malaysia, the Philippines, Singapore, and Thailand, as well as China and Korea. The choice of countries is dictated by the availability of data. We also include other countries including the U.S. and several European countries to control for the global impact of their respective policies, and because they are important trade and financial partners to Japan. Our GVAR model is therefore estimated for 29 countries, using monthly data on real GDP, CPI inflation, the exchange rate, bank credit to the private sector, equity prices, capital inflows, and short-term interest rates, from January 2000 up to September 2016.

We carry out two exercises to identify the impact of QQE domestically and on the rest of the countries in our dataset. Given the challenge of identifying a monetary policy shock when interest rates are zero or negative, we look for other proxies that could identify spillovers from a monetary policy shock from Japan. More specifically, we look at the impact of QQE through different transmission channels: the conventional interest rate channel, and the stock market

channel. We first consider a shock to Japan's shadow interest rate as a conventional monetary policy proxy. We then model the impact of unconventional monetary policy on stock prices through an increase in equity prices, identified via sign restriction. Using equity prices has the advantage of matching stylized facts (equity prices increased significantly during both first and second QQE periods in Japan) and of capturing the transmission channel of QQE on the stock market. In addition, to disentangle it from a regular financial shock, we use sign restrictions that are consistent with the existing literature for modeling a monetary policy shock.

The main contribution of this research is to be the first to our knowledge to systematically quantify the spillovers from Japan's QQE on emerging Asia. As mentioned above, studies of Japan's QQE tend to focus mainly on the impact on Japan only. In addition, this research attempts to identify the effects of monetary policy on the stock market channel, by discerning the impact of equity price fluctuations caused by monetary policy shocks.

Our results show that a negative shock to the shadow interest rate has a significant impact on the exchange rate, GDP and inflation for Japan, but it does not capture the significant increase in equity prices. We argue that this transmission channel is not likely to capture the effect of monetary policy on financial markets, and find evidence in the literature where the shadow interest rate is used, but significant spillovers are not found. On the other hand, a positive shock to Japanese equity prices identified by sign restrictions caused a temporary increase in equity prices across emerging Asian countries, as well as an appreciation of their currencies. Most ASEAN countries experienced a temporary increase in output. Capital inflows also rose for many countries in the first few months. Further, one way to interpret these results is that

international propagation of the effects of QQE worked broadly through its transmission to financial markets.

The rest of the chapter is organized as follows. Section 2.2 reviews the relevant literature. Section 2.3 explains the GVAR model's setup and the data. Section 2.4 presents the impulse response analysis and an interpretation of the results. Section 2.5 discusses the counterfactual analysis for Japan's QQE. Section 2.6 concludes.

2.2 Literature Review

From a theoretical point of view, we expect a priori that unconventional monetary policy (UMP) impacts the domestic economy through its effect on the stock market, exchange rates, portfolio flows, and interest rates. The increased liquidity in the market contributes to both lowering interest rates and depreciating the domestic currency, which could stimulate capital outflows as domestic investors search for higher yields abroad. At the same time, the transmission of monetary policy to financial markets, working through changed expectations of financial conditions due to the monetary stimulus, raises stock prices. The latter effect can also be magnified by domestic portfolio rebalancing away from bonds toward riskier assets.

We expect these channels to also determine the international spillovers of UMP. Specifically, we expect QQE in Japan to generate spillovers to emerging economies through capital flows, currency appreciation, bond yields and increased stock price effects. Emerging Asian countries are expected to receive capital inflows as Japanese investors rebalance their portfolios in search of higher yields. Such inflows, as well as the yen depreciation due to monetary expansion in

Japan, contribute to exchange rate appreciation in emerging Asia, with possible negative effects on their net exports. The latter negative effect, however, could be more than offset by the increased confidence associated with QQE, which could boost stock prices in Japan but also in the region as a secondary effect. The variables which we include in our GVAR estimation are meant to capture these channels.

There is a growing body of literature which analyzes spillovers from the U.S. and Europe's UMPs. Most studies find cross-border spillover effects in the form of large capital inflows, currency appreciation, an increase in prices and interest rates, raised equity prices and temporary increases in output. In fact, several studies have shown that, in the aftermath of the subprime financial crisis, the Fed's large-scale asset purchase program (LSAP) had a strong impact on the global economy: Bauer and Neely (2014) show that the Fed's unconventional monetary policy announcements had a strong impact on international bond yields. Gambacorta, Hofman and Peersman (2014) use a panel structural VAR to show that the expansion in central bank balance sheets at the zero lower bound caused a temporary increase in prices and economic activity. They identify an unconventional monetary policy shock by imposing sign restrictions which dictate that shocks to the central banks' balance sheet increase volatility in the market. Glick and Leduc (2012) present evidence on the depreciation of the US dollar and British pound, as well as of a decline in long-term interest rates, after announcements of LSAP. Ree and Choi (2014) examine the effects of Japan's QQE on Korea and find that there was little impact on trade and capital flows. Ree, Hong and Choi (2015) find that the depreciation of the Japanese Yen could increase Japan's price competitiveness in the long run, and may be detrimental to South Korean companies in case of an appreciation of the Won. IMF (2015)

highlights the appreciation of currencies of several countries in emerging Asia due to changes in monetary policies in Japan, Europe and the United States.

Concerning UMP spillovers from Japan, several studies focus on the domestic impact of QQE: Fujiwara, Nakazono and Ueda (2014) examines the effect of QQE on inflation in Japan, and finds that inflation expectations rose modestly in the short run. Lam (2011) looks at financial indicators such as equity prices, sovereign and corporate bond yields, exchange rates and inflation, to assess the impact of QE by the BoJ in the 2000s. He finds that these policies had no effect on raising the inflation rate or depreciating the exchange rate, but did cause stock prices to rise strongly.

Global VAR models have been widely used for the study of propagation of international shocks: Chen, Filardo, He, and Zhu (2015) employ a Global VAR model and find that U.S. QE contributed to an overheating of certain economies, as well as to currency appreciation and strong capital inflows to emerging countries. They also try to identify spillovers from US monetary policy using the Fed shadow interest rate, but their results show that the shadow interest rate only captures domestic spillovers. Dees, DiMauro, Pesaran and Smith (2007) provide the theoretical framework of the GVAR model to test the transmission of shocks from the U.S. to the rest of the world. They demonstrate that financial shocks were transmitted rapidly, and usually had a larger impact on equities and bond markets compared to GDP and inflation. Galesi and Sgherri (2009) use financial weights based on cross-border bank lending data to quantify the financial spillovers across Europe through a shock to U.S. equity prices. They find strong co-movements of equity prices across Europe, but heterogeneous responses

to bank credit that were country-specific. Sun, Heinz and Ho (2013) construct foreign variables from the combination of bilateral trade flows and banking exposures, to better capture the cross-country linkages between the Central Eastern and Southeastern Europe (CESEE) and advanced Europe countries.

A large majority of the research uses sign restrictions for the identification of shocks: Eickmeyer and Ng (2011) use a GVAR to assess the impact of a tightening of credit in the US, Japan and Europe on the rest of the world by employing sign restrictions that specify a credit shock from a monetary one. Georgiadis (2016) employs a GVAR model to estimate the impact of a US monetary contraction. He imposes sign restrictions on short-term rates and inflation, following Eickmeyer and Ng (2011)' identification method. Anaya, Hachula, and Offermanns (2017), using a GVAR, specify that a monetary expansion (defined by changes in the central bank's balance sheet) would either decrease or not affect market volatility, whereas a negative financial shock would increase the volatility in the market. Feldkircher and Huber (2016) also investigate the impact of a US contractionary shock by imposing sign restrictions on output, price dynamics and interest rates.

Finally, we reference the body of literature which explores the stock market channel, aka the channel which carries the transmission of monetary policy to financial markets. Neri (2004) explains that fluctuations in interest rates can impact stock prices and households' wealth, and that this impact therefore creates "an additional channel, besides the traditional interest rate and credit one, through which monetary policy can affect output and inflation". He employs a structural VAR with sign restrictions to disentangle monetary policy shocks from money

demand shocks on credit supply. Specifically, he identifies shocks to credit supply which are caused by monetary policy actions which are "orthogonal to the policy rate", and dubs them as "unconventional monetary policy shocks". Cooley and Quadrini (1999a) use a dynamic stochastic general equilibrium model to investigate the effect of monetary policy through the stock market channel on firms. They find that a contractionary monetary shock had a negative impact on the stock market index. Lastrapes (1998) and Rapach (2001) employ structural VARs with sign restrictions and come to similar findings. Fornari and Stracca (2013) use sign restrictions on a panel VAR to distinguish financial shocks from demand shocks, monetary policy shocks, and non-financial shocks, and find different impulse responses to each exercise.

2.3 Data and VARX Setup

2.3.1 Data

Our dataset comprises monthly data, from January 2000 up to September 2016. The following country-specific variables are used for the construction of the variables that are used in the GVAR model: real GDP (GDP_{it}), equity prices (EQ_{it}), CPI inflation (CPI_{it}), bank credit (BC_{it}), the short-term interest rate (SR_{it}), the exchange rate (E_{it}), and capital inflows (CF_{it}). However, only in the case of Japan, we replace the data series for the short-term rate by the shadow interest rate [11]. Further details on the shadow interest rate are provided in section 2.3.4. Finally, the price of oil and the index price of metals are used as global variables. GDP data

[11] Data for the shadow interest rate are publicly available on the Federal Bank of New Zealand website, on the following link: http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy/comparison-of-international-monetary-policy-measures.

refers to real GDP index data, obtained from the IMF IFS on a quarterly basis. Therefore, as conventional in the literature, we converted real GDP to monthly frequency by using the Chow-Lin interpolation method (with the industrial production index as a reference). Table 2.1 lists the countries that are included in our estimation.

Table 2.1 Countries and regions included in the GVAR model

Asia and Pacific	**North America**	**Europe**
Australia	Canada	*Austria*
China	Mexico	*Belgium*
India	United States	*Finland*
Indonesia		*France*
Japan	**South America**	*Germany*
Korea	Brazil	*Italy*
Malaysia	Chile	*Netherlands*
New Zealand	Peru	Norway
Philippines		*Spain*
Singapore		Sweden
Thailand		Switzerland
		Turkey
		United Kingdom

Note: The countries in Italics are included in the Euro area block.

For all countries except the United States, the exchange rate variable used is the bilateral rate vis-à-vis the United States Dollar, obtained from Bloomberg. We used the IFS consumer producer index (CPI) for all items (with 2010 as the index year). For equity prices, the MSCI index specific to each country is used. Finally, we use gross capital flows at month end as a proxy for capital inflows. The series are then seasonally adjusted.[12] We constructed the variables for study as follows:

[12] Further details about the data are included in the data appendix.

Real GDP: $y = \ln \frac{GDP_{it}}{CPI_{it}}$

Inflation: $dp = \ln(CPI_{it}) - \ln(CPI_{i,t-1})$

Equity prices: $eq = \ln(\frac{EQ_{it}}{CPI_{it}})$

The exchange rate: $ex = \ln(\frac{E_{it}}{CPI_{it}})$

The short − term interest rate: $r = 0.25 * ln(1 + SR_{it}[13]/100)$

Bank credit: $bc = \ln \frac{BC_{it}}{CPI_{it}}$

Price of oil: $poil = \ln Poil$

Price of metal: $metal = \ln Pmetal$

Capital inflows: $cf = \ln \frac{CF_{it}}{CPI_{it}}$

2.3.2 The Weighting Schemes of the GVAR Model

A key step of the GVAR model is the inclusion of the foreign variables. For each domestic variable of each country in our sample, the corresponding foreign variable is built based on a weighted average of the corresponding variables of its partners. The weighting scheme is usually chosen to highlight the economic relationship of a country with another country. The weights on which the foreign variables are built are based on the countries' financial and trade exposures vis-à-vis the other countries, and therefore determine their respective importance towards one another. For instance, if the trade weights between Japan and Indonesia are large,

[13] When calculating r for Japan's VECM, the shadow interest rate is used instead of the short-term interest rate.

then the foreign variable for Japan's GDP in Indonesia's specific VARX will have a larger weight. A shock to Japan's output will therefore have a higher impact on the Indonesia VARX.

Concerning the choice of transmission channels, we followed the common literature and use trade flows for building our weights. To examine spillovers through the trade channel, we combined imports and exports from the IMF's Direction of Trade Statistics. As a robustness check, we also created weights using Foreign Direct Investment (FDI) flows from the IMF's Coordinated Direct Investment Survey (CDIS) and ran the GVAR with trade weights and FDI weights separately. This exercise yields comparable results to our findings when we combined the trade and FDI channels together , which suggests that the choice of weights is of secondary importance.[14]

The bilateral trade weights are computed from the sum of imports and exports between each country. We opted to construct fixed weights for 2012-2014. We found that changing the time frame for the construction of weights does not lead to significant changes in the results.

2.3.3 Unconventional Monetary Policy Shock Identification

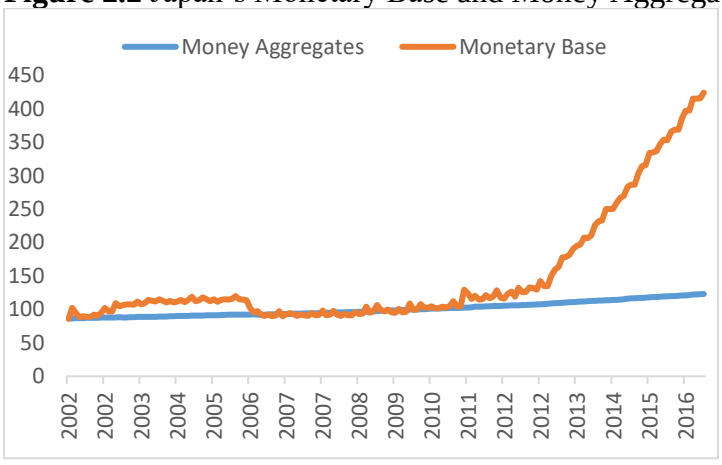
The existing literature on the impact of QE typically uses reductions in interest rates as a proxy for monetary policy shocks. For example, Chen *et al.* (2015) use the US term spread (between the 10-year and 3-month Treasury yields) and the US corporate spread (between the Bank of of America-Merrill Lynch US corporate AAA bond yield and the effective federal funds rate)

[14] Cashin, Mohaddes, and Raissi (2016), also test the propagation of shocks using trade weights and FDI weights, and find that the choice of weights is not of high importance.

to examine the impact of the Fed's QE on the rest of the world. Dees *et al.* (2007) compute the monetary policy shock as a cut to the US short-term interest rate. The idea behind this modeling choice is that, with an increase in the supply of money pushing down interest rates, the demand for money will be stimulated.

However, if both the long-term interest rate and the short-term interest rate are already at or close to the zero lower bound, using the term spread or the corporate spread as a monetary policy indicator is not a viable strategy. As noted by Eggertsson (2008), with conventional monetary policy, a higher money supply increases demand only through lower interest rates. Therefore, at the zero lower bound, a decline in the interest rate creates no significant impact on the money supply. Rather, unconventional monetary policy must work through the expectation of future money supply, and thus future interest rates, so that the money supply affects spending. Krugman (2015), elaborates that in a liquidity trap, the expansion of the monetary base itself will not have an inflationary impact as it will not affect the current liquidity (Figure 2.2), but that future inflation is dependent on whether investors believe that the central bank will continue its easing even as the economy begins to recover.

Figure 2.2 Japan's Monetary Base and Money Aggregates (Base year 2010=100)



Source: The Federal Reserve of St. Louis and Author's estimations

Therefore, studies of UMP spillovers for advanced economies have increasingly relied on other proxies for monetary policy shocks, when interest rates became at the zero lower bound. For instance, there is a vast literature that employs the short-term shadow interest rate as a proxy for unconventional monetary policy at the zero lower bound. Krippner (2013,2015) measures the stance of monetary policy at the zero lower bound by calculating the shadow interest rate for Japan and the United States. Wu and Xia (2013,2015) calculate the shadow interest rate for the federal funds rate, and employ it in a factor-augmented VAR to measure the effects of monetary policy at the zero lower bound. Chen *et al.* (2015) employ short-run sign restrictions on Wu and Xia's Federal Funds shadow interest rate to identify monetary policy shocks from the Fed. However, their estimation could only capture the domestic impact of UMP, and they did not observe international spillovers. Lombardi and Zhu (2014) calculate the shadow interest rate for the US economy and use it in a structural VAR model to identify monetary policy shocks. Kucharcukova *et al* (2016) calculate spillovers from the ECB's monetary policy stance to outside the euro area, creating an index equivalent to the shadow interest rate for the ECB.

We therefore choose to model the shock of Japan's QQE through two alternative proxies: a negative shock to the shadow interest rate, and an equity price shock identified through sign restrictions.

One way to identify unconventional monetary policy is through a negative shock to the shadow interest rate, a method which has been widely adopted in the literature for monetary policy at the zero lower bound.

Another way to identify a monetary policy shock is through the stock market channel, as it highlights the transmission mechanism of monetary policy on stock prices. The stock market

channel can also somewhat capture investors' positioning on financial markets, given that fluctuations in stock prices also are largely driven by investors' perception of expectations. Additionally, Japan's quantitative easing programs highlight the stock market channel, as Japan experienced a significant increase in equity prices during both quantitative easing programs. For example, Hosono and Isobe (2014) employ an event study approach using daily data to analyze the impact of monetary policy announcements on financial variables. They find that the BOJ's QQE policies had a substantial prolonged effect on stock prices. Ueda (2012) analyses the long-term effects of the BoJ's announcements on the stock market, 10-year JGB yields and the JPY/USD exchange rate. He also finds that the announcements of the BOJ had a significant and permanent impact on asset prices.

As above-mentioned, an equity price shock also captures the stylized fact that, during both the first QE and the current QQE of Japan, there was a noticeable surge in equity prices in Japan. Further, by applying sign restrictions, we can disentangle a monetary-driven shock from a financial shock. Finally, by disentangling the monetary policy shock of QQE, we can observe whether there were any consequent spillovers via the stock market channel.

2.3.4 Identification Via the Shadow Interest Rate

The shadow interest rate became widely used after the global financial crisis to track the policy rate, after the US Federal Reserve lowered the fed funds rate to zero, bounding the traditional monetary policy instrument to the "zero lower bound". After the federal funds rate reached zero, the traditional policy rate instrument could no longer be used in econometric models, and the impact of the policy rate on other macro and financial variables could no longer be observed.

As a result, researchers developed a "shadow rate" to the policy rate, which has the characteristic that it can decline below the zero lower bound, into negative territory. Essentially, the shadow interest rate exhibits the time-series properties of the short-term interest rate and is equal to it when the latter is positive. However, when the short-term rate is at the zero lower bound, the shadow interest rate can become negative to indicate a more accommodative stance of monetary policy than a zero-policy rate.

A popular approach to estimating the short-term rate is using a dynamic structure model. Studies as such include Ichiue and Ueno (2006,2007,2013,2015), Krippner (2012,2013,2015, 2016), and Wu and Xia (2016), Kim and Singleton (2012), and Bauer and Rudebusch (2013). Such research applies nonlinear filtering techniques to the shadow interest rate term structure models, first proposed by Black (1995). Black (1995) was the first to propose a shadow interest rate short-term structure model (SRTSM), which creates a shadow interest rate which is linear in Gaussian factors, that is bound by zero and the short-term interest rate. Wu and Xia (2013, 2016) offer a SRTSM using bond prices to track the federal funds rate that can breach the zero lower bound, which they find is excellent at tracking the behavior of interest rates. They use the shadow interest rate in a factor-augmented vector autoregression (FAVAR) to measure the effects of monetary policy at the zero-lower bound.

Krippner (2012, 2013, 2015) uses a continuous-time Gaussian affine term structure model which imposes the zero lower bound by using a call option on shadow bonds to calculate the shadow interest rate for the federal funds rate. The model reproduces Black's SRTSM framework for modeling the lower bound mechanism, and then uses an arbitrage-free Nelson

and Siegel (1987) model (ANSM) with two-state variables (level and slope) to represent the shadow yield curve. Krippner explains that the ANSM model can provide a parsimonious approximation to any Gaussian affine term structure model, regardless of the model's specification. He also states that choosing two factors for the model delivers robust results for the shadow interest rate estimates which are also less volatile, more comparable between economies, and available at a daily frequency[15]. Krippner (2015) provides frequently updated estimates of the shadow interest rate for Japan's policy rate on the central bank of New Zealand website, while Wu and Xia (2013,2016) publicly provide their updated estimates of the Federal funds rate shadow interest rate on the reserve bank of Atlanta website. Both estimates are widely used in the literature, whether for deriving a shadow interest rate, or for estimating unconventional monetary policy at the zero lower bound. Christensen and Rudebusch (2014) calculate the shadow interest rate based on derivations from the Krippner (2012,2013,2015) method. Wu and Xia (2013), independently derive a bond-price approximation that is equivalent to the Krippner method. Francis *et al*. (2017) test whether Krippner (2015) and Wu and Xia (2016)'s shadow interest rates can be considered substitutes for policy rates in standard VARs and find them good proxies for monetary policy instruments. McCoy and Clemens (2017) also apply Krippner's shadow interest rate model to derive a shadow interest rate model

[15] The ANSM is specified by Krippner with a fixed lower bound parameter of 12.5 basis points, and homoscedastic residuals.

for the euro area. Therefore, and based on the wide usage of the Krippner method, we rely on his publicly available estimates of Japan's shadow interest rate for our GVAR estimation.

2.3.5 Identification Via Sign Restriction

Identification of UMP in the case of Japan is a challenging task. First and foremost, negative inflation expectations have been so entrenched in the Japanese market, that it would be debatable to impose sign restrictions on inflation. In addition, as shown in figure 2.2, given that Japan was already in a liquidity trap with interest rates at the zero bound, the changes in the BOJ's balance sheet did not have an impact on the monetary aggregates in the economy, and thus would not be a suitable proxy[16]. Fluctuations of equity prices, however, are driven by prospects of growth. In the absence of a bubble, large increases in equity prices- not-withstanding exogenous shocks that are not domestically driven - can be explained by investors' positive expectations of future profits, or increased interest rates, or higher inflation expectations. In the absence of long-term inflation expectation swaps series, we can measure the impact of QQE on financial markets by identifying it from the equity price boom.

In terms of identifying the shock from QQE to equity prices, we follow the identification method of Fornari and Stracca (2013), who differentiate between a monetary and financial shock. They argue that in addition to its positive impact on stock prices, a positive financial shock would lead to higher demand for credit by the private sector and higher investment,

[16] In addition, if in the case of the US economy, the literature argues that volatility in the market should decrease following a monetary expansion, data for the Nikkei volatility index shows that at the contrary, volatility increased around the time of the launch of Abenomics. This discourages us from including volatility in our analysis, and applying to it sign restrictions.

therefore pushing up interest rates. They thus distinguish a financial shock from an expansionary monetary shock by imposing that the reaction of interest rates to an equity price shock be non-negative.

A monetary expansion, on the other hand, pushes down short-term rates as it increases liquidity in an economy. Therefore, short-term rates are expected to have a negative reaction to a positive monetary shock. However, we do not impose any restrictions to credit to the private sector, as it may increase, or remain unchanged.

To that extent, Table 2.2 illustrates how sign restrictions could be used to differentiate a monetary shock from a financial shock. We apply the sign restrictions referring to the monetary policy shock in Table 2.2 to Japan's cointegrating vectors. The results are reported in the following section. [17]

Table 2.2. Sign Restrictions on Japan's Cointegrating Vectors

	Monetary Policy Shock	Financial Shock
GDP		
Inflation		
Equity Prices	>0	>0
Exchange Rate	>0	
Credit to Private Sector		>0
Interest Rate	<0	>0
Capital Flows		

[17] As a robustness check, sign restrictions per a financial shock are also applied and impulse responses are computed, yielding predictably different results.

2.3.6 VARX Setups

Except for Japan and the U.S., each country's VARX model includes the 8 domestic endogenous variables: GDP (y), CPI inflation (dp), equity prices (eq), bank credit (bc), short-term interest rates (r), the exchange rate (ex), and capital inflows (cf). The VARs are then augmented with the set of foreign (weakly exogenous) variables built on the flows channel, e.g. y* or dp*, and our global variables, the price of oil, and the price of metal. All foreign variables except the price of oil are built as the weighted averages of the respective variables of the rest of the countries, with the weights determined through the flows channel.

The U.S. VARX vector includes all the domestic variables except for the exchange rate. However, only y* and ex* enter as foreign variables in the U.S. VARX* setup. As conventional in the literature, foreign variables are not included to reflect the dominant role of the U.S. in the world economy: the U.S. affects foreign economies but is not affected by them. As for the Japan VARX*, it is set up like all the other VARX* in the model, except that the time-series used for the short-term rate is the shadow interest rate. Finally, the price of oil is specified as an endogenous variable in the U.S. VARX*, while the price of metals is specified as endogenous to the China VARX*. The lag orders for the domestic and foreign variables are determined using the Akaike Information Criterion (AIC). Consistent with GVAR literature, we set the maximum lag orders to $p_{max} = 4$ and $q_{max} = 2$. The number of cointegrating relations is next determined for each country VARX*, and the rank orders obtained using

Johansen's trace statistics. The estimated VARX* orders and their corresponding ranks are reported in Table 2.3.

Table 2.3. Lag Orders of the Country-Specific VARX*(p,q) Models Together with the Number of Cointegrating Relations (r)

Country	VARX* Order		Cointegrating Relations (r_i)	Country	VARX* Order		Cointegrating Relations (r_i)
	p_i	q_i			p_i	q_i	
Australia	3	1	3	New Zealand	4	1	2
Brazil	2	1	3	Norway	1	1	2
Canada	1	1	2	Peru	1	1	4
Chile	1	1	2	Philippines	1	1	2
China	4	2	5	Singapore	4	1	3
Euro	2	1	2	Sweden	3	2	3
India	1	1	1	Switzerland	4	1	2
Indonesia	2	1	4	Thailand	4	1	3
Japan	3	2	4	Turkey	4	1	2
Korea	3	1	5	United Kingdom	3	1	2
Malaysia	4	1	3	United States	4	1	2
Mexico	1	1	3				

Note: p_i and q_i refer to the lag order of the domestic and foreign variables respectively and are determined using the Akaike Information Criterion (AIC), with the maximum lag for order for the domestic variables set to 4, and the maximum lag order for foreign variables set to 2. The number of cointegrating relations (r_i) are determined using the trace statistic based on the 95% critical values from MacKinnon (1991) for all countries. Source: Author's estimations

2.4 Dynamic Analysis

2.4.1 Structural Impulse Response

To estimate orthogonal impulse responses, we identify a shock to the shadow interest rate using a recursive Cholesky scheme. Dees *et al*. (2007) employed structural impulse responses through a Cholesky factorization schemes for the specification of shocks. Following Dees *et al*. (2007), we chose one possible identification scheme by adopting the following ordering

of the variables in the Japan bloc: short-term shadow interest rate, equity prices, the exchange rate, bank credit, capital inflows, inflation, and output. We experimented with several variable orderings (we placed equity prices as the last variable in the bloc, and then second in the ordering) and our results are largely robust. [18] The country ordering is invariant for the GVAR model[19], when using structural impulse responses. Further, we employ the short-run sign restrictions shown in Table 2.2 when we compute a shock to equity prices.

2.4.2 Impulse Response Results

2.4.2.1 One Negative Standard Deviation Shock to Japan's Interest Rates

We first modeled our monetary policy shock using the shadow short-term rate, given that the short-term interest rate was had been around zero for years before breaking the lower bound into negative rates in 2016.

The results, reported in Figure 2.3, show that a one percent decrease in the shadow interest rate has a statistically significant positive impact on Japan's GDP, and causes a depreciation of the exchange rate, as well as a slight increase in inflation. The impact on equity prices and capital inflows however is not statistically significant, which suggests that this proxy may not be capturing all the impact that QQE had on the domestic market. In addition, we report no

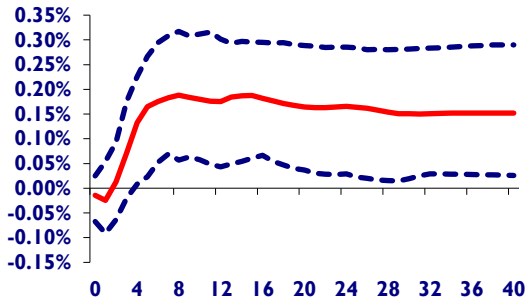
[18] We also try the alternative ordering described in Dees *et al*. (2007) by placing the policy variable as the last in the ordering block, and the results consistent with our first ordering. We also tried placing equity prices as the second variable in the ordering block.

[19] The GVAR code can only be run using the toolbox provided by Smith and Galesi, which comes with a detailed guide and an Excel template, which must be filled with much precision, for the code to run smoothly. When referring to the listing of countries using a SGVAR, in the toolbox guide, on page 88, the authors state that structural impulse responses can be run with only one country listed in the code column. To that extent, we cannot list other countries in any order when using the SGVAR. In addition, we cannot use the dominant unit function, as it is recommended for use only for the United States economy.

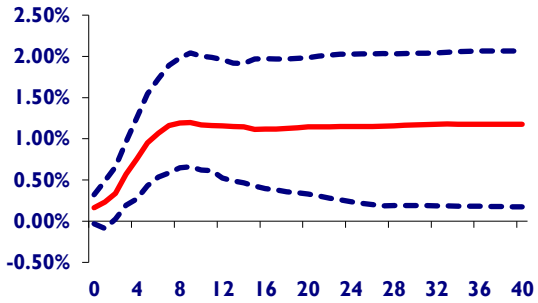
statistically significant impulse responses on other countries in the dataset. Given that other studies which have used the shadow short term interest rate as a proxy for UMP in the United States have also reported that this proxy did not seem to capture international spillovers, we consider the additional exercise of identifying a monetary policy shock through sign restrictions.

Figure 2.3: Structural generalized impulse responses of a Negative One Standard Deviation shock to Japan's shadow short-term interest rate, (Bootstrap mean estimates with 90 percent confidence bounds)

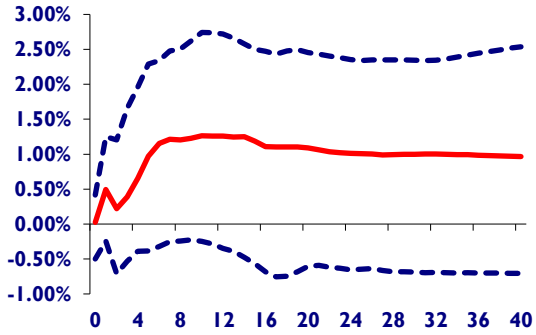
GDP



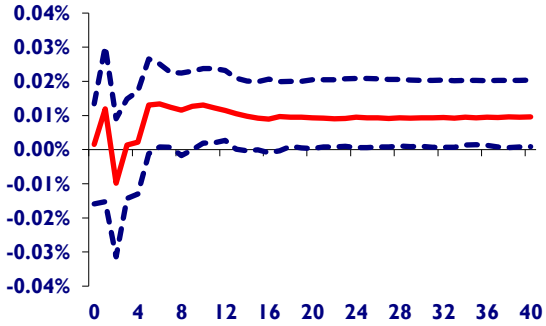
Exchange Rate



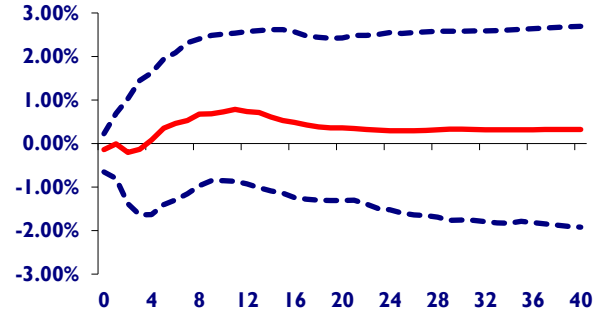
Equity Prices



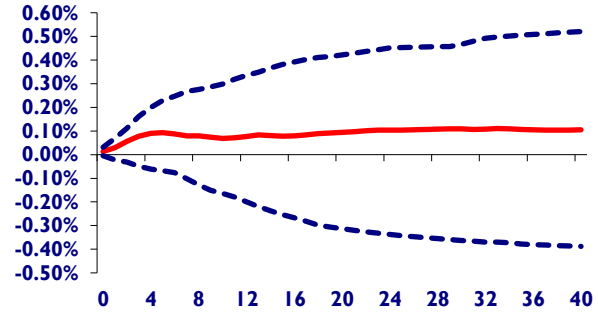
Inflation



Capital Inflows



Credit to the Private Sector



Note: Figures are median structural generalized impulse responses to one negative standard deviation shock in Japan's short-term shadow interest rate, with the corresponding 90th percent confidence bounds. The impact is in percentage and the horizon is monthly.

2.4.2.2 One Positive Standard Deviation Shock to Japan's Equity Prices

Figure 2.4 shows the responses of one positive standard deviation shock to Japan's equity prices, identified from a standard financial shock via sign restrictions. The median estimates are reported in solid lines, while dotted lines show the 90 percent confidence bands.

Regarding the domestic impact of Japanese QQE, our results suggest that it caused a temporary equity price boom, an economic recovery, depreciation of the yen, but with limited impact on inflation. GDP increased by 0.1 percent. Equity prices rose approximately by 0.5 percent.[20] Inflation picked up slightly by 0.05 percent, with the increase not being statistically significant. Bank credit was largely unmoved. The exchange rate depreciated by 0.6 percent, and remained at those levels for the remaining periods. The strongest short-term impact was in terms of capital inflows, which in the first two periods increased by about 2 percent in Japan. This increase in capital inflows can be interpreted as a short-run impact of Abenomics on investor confidence, as the significant monetary stimulus, with higher equity prices, may have affected expectations of higher future earnings and driven in foreign investors.

Turning to spillovers, our results suggest that QQE had a short-term impact on emerging Asia, and caused statistically significant increase in equity prices in the first few periods. For China, Indonesia, Korea, the Philippines, Singapore, and Thailand, the increase was in the 1-2 percent range. This highlights the financial linkages between financial markets in emerging Asia and in Japan, through which positive spillovers would have propagated.

[20] All variables are in natural logarithm, and are first adjusted to inflation.

Figure 2.4 also shows that, most of the countries in emerging Asia experienced appreciation of their currency on impact. Per the traditional expenditure switching effect, this should result in an increase in Japan's net exports to the other countries. Despite this, the impact of QQE on growth in the GDP of the other countries was generally positive, and for Korea, Singapore, the Philippines, and Thailand, statistically significant, suggesting that the switching away from domestic goods toward Japanese ones did not happen. This result is consistent with recent evidence that, due to off-shore production of Japanese products, Japanese exports have become less sensitive to the exchange rate (see Kang 2015). Indeed, Japan's net exports only changed from -117 to -120 billion U.S. dollars from 2013 to 2014. Furthermore, higher equity prices could also have boosted consumption through a wealth effect in emerging Asia by raising the outlook for future growth.

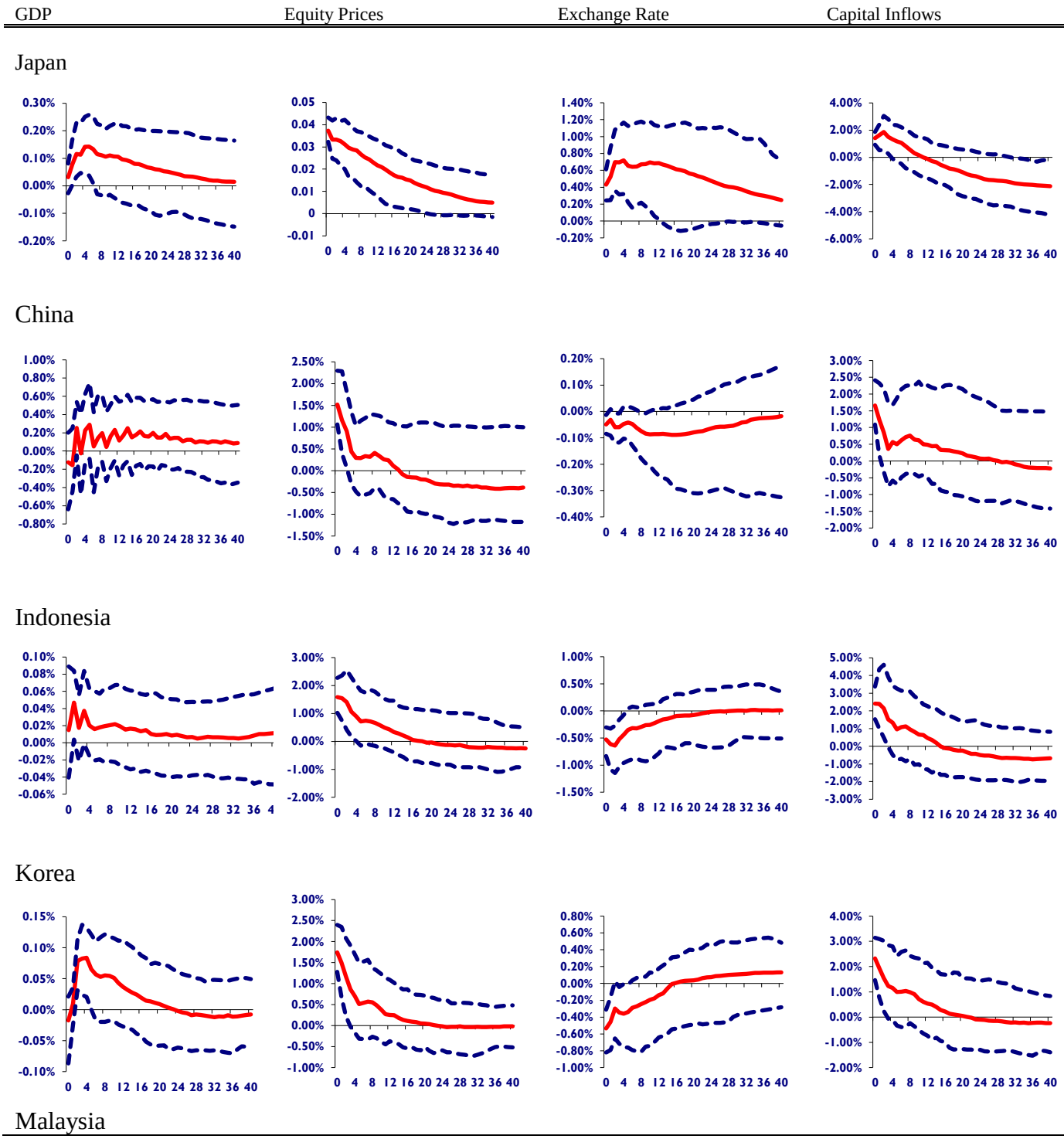
One way to interpret our results is that the positive spillovers from QQE more than compensated the negative expenditure switching effect, by stimulating growth in other countries. We expect that the positive effect of QQE on Japan's GDP to have positively affected growth in other countries through higher demand for their exports.

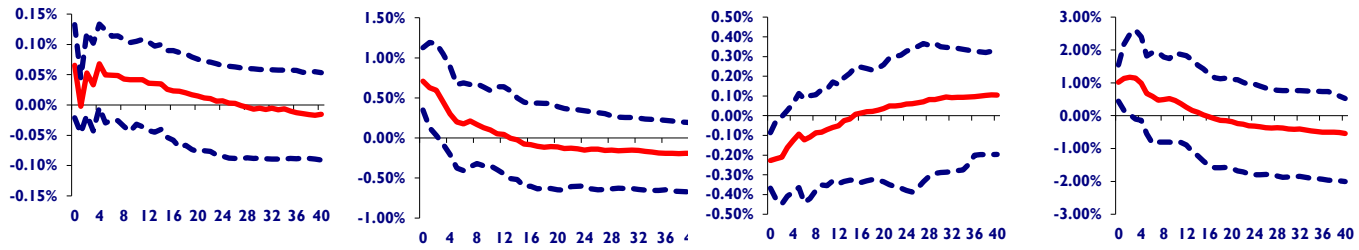
The impact on China illustrates how the confidence channel can dominate the exchange rate channel. The trade and financial linkages between Japan and China are amongst the strongest in the sample, but, even though China experienced an appreciation of its currency, the effect on GDP was positive, though not significant. In fact, the Japanese Yen depreciation and corresponding RMB appreciation brings a benefit of lower import costs of intermediate inputs

given that Japan is one of the most important intermediate input suppliers for China in the global value chain. In other words, despite the depreciation of the Yen and the appreciation of the RMB, the overall spillover impact of QQE on China's GDP was not negative, due to increased confidence as illustrated by the increase in equity prices, and a reduction in import costs.

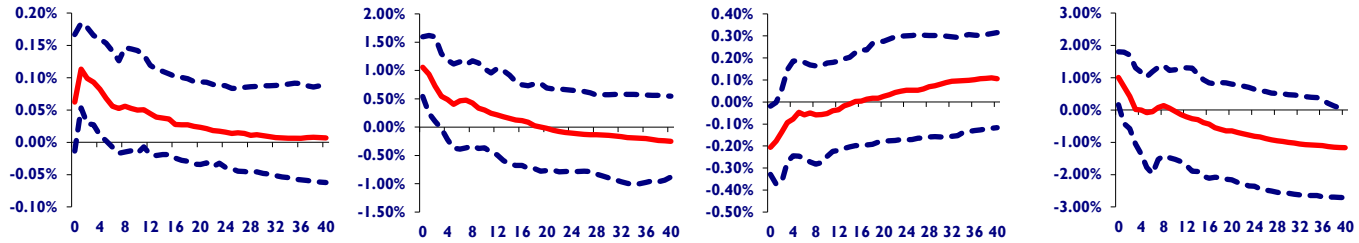
Effects on capital inflows were less heterogeneous. For most countries, we observed a spike in the already present influx of flows to emerging Asia in the first month after Abenomics. Capital inflows tended to peak in the first two periods, between 1-2 percent in most countries, before going back to close to their original levels. This increase was statistically significant for most countries only for the first period, suggesting that the impact of Abenomics on capital flows was limited. As for China, we registered a gradual decline in capital flows. This could be because foreign investors were redirecting their investments towards Japan. Moreover, the large presence of Japanese companies in Indonesia and Thailand could explain a spillover of capital inflows into those countries

Figure 2.4: Structural generalized impulse responses of a Positive unit (+1σ) shock to Japan's equity prices, (Bootstrap mean estimates with 90 percent confidence bounds)

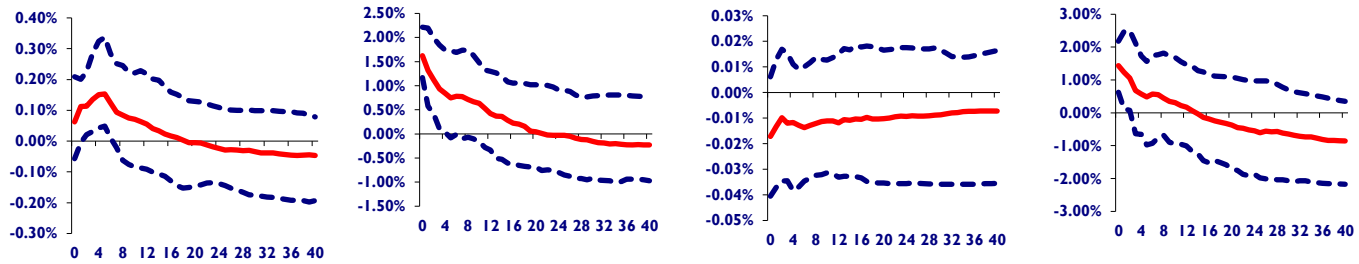




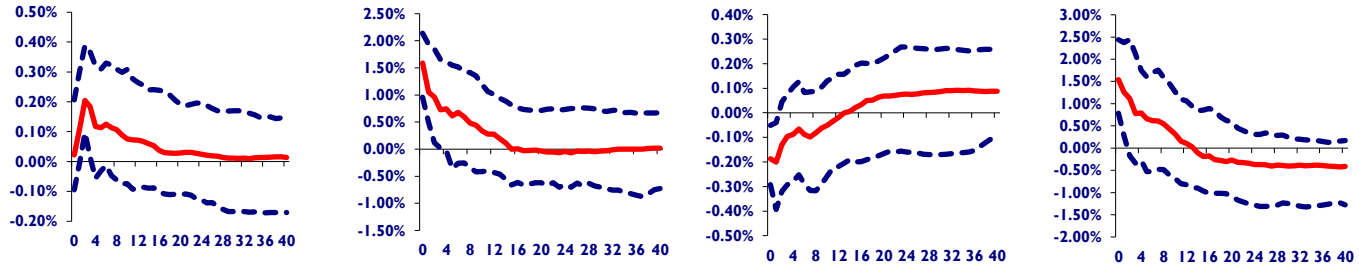
Philippines



Singapore



Thailand



Note: Figures are median structural generalized impulse responses to one positive standard deviation shock in Japan's equity prices, identified by sign restrictions, with the corresponding 90th percent confidence bounds. The impact is in percentage and the horizon is monthly.

2.5 Counterfactual Analysis

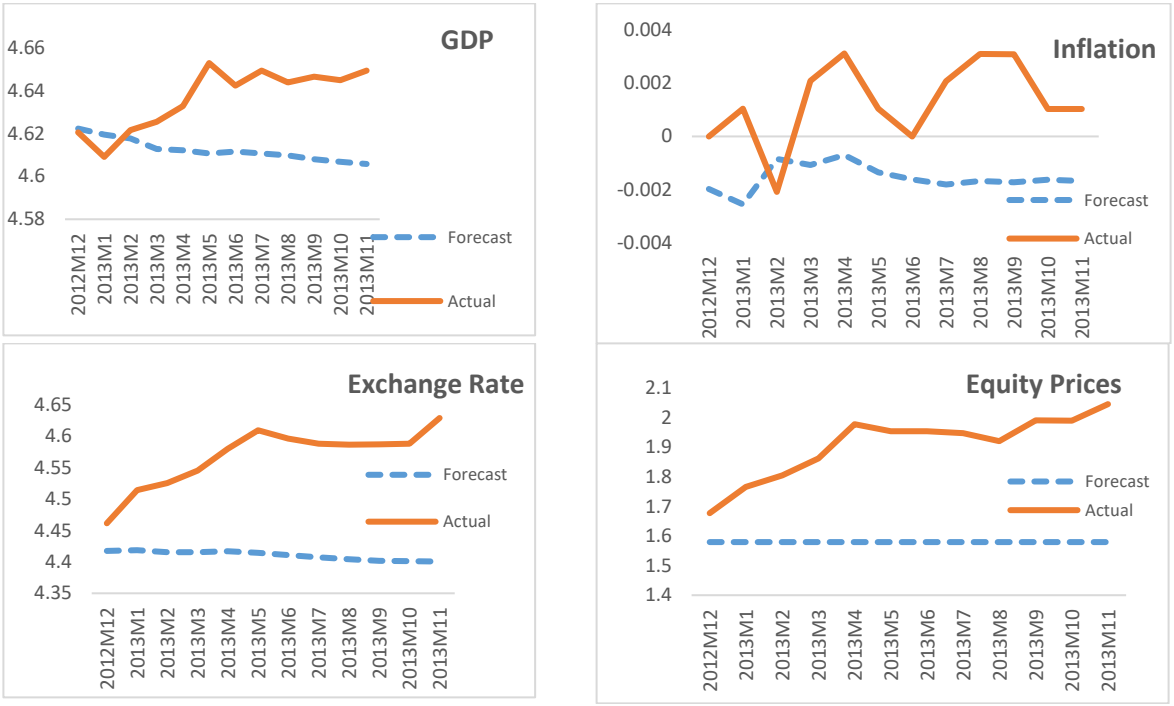
We conduct counterfactual analysis to assess the spillovers of Japanese QQE on Asia. The purpose of this exercise is to visualize the growth path of our variables had QQE not been implemented. In other words, given that our data sample spans from the year 2000 up to 2016, the impulse response results may be capturing fluctuations not relevant to QQE. To that extent, the counterfactual analysis allows us to look at the period of the launch of UMP. We forecast our variables based on the condition that Japan's equity prices would have remained the same. We also experiment with keeping the shadow interest rate constant. When we compare our forecasts to the original data, we can evaluate the magnitude of the spillovers from Japan's QQE. The conditional forecasts rely on the GVAR's one-step-ahead projections: Equation 8 from Chapter 1 shows that the endogenous variable x is equal to the summed lag of the domestic and foreign variables and residuals. Therefore, we can conduct our counterfactual analysis from time t, to estimate a future value of x, on the estimate that equity prices had remained constant.

We choose to report the results of the counterfactual analysis on the ASEAN countries and China and Korea only, on output, the exchange rate and equity prices because these variables were the most affected by a standard deviation shock to Japan's equity prices. As for Japan, we include the counterfactual analysis on inflation.

Figure 2.5 presents the results of our counterfactual analysis on Japan if equity prices had not changed since the first quarter of 2013. Our counterfactual analysis suggests that Japan's QQE had a significant impact on equity prices, the exchange rate and GDP. For Japan, inflation was

also significantly affected by the increase in equity prices. Results show that had it not been for the growth in equity prices, Japan would not have experienced a depreciation of the exchange rate, nor an increase in inflation. Output was also positively affected.

Figure 2.5: Counterfactual Analysis of QQE on Japan:



Figures 2.6-2.12 report the results of our counterfactual analysis, keeping equity prices constant from 2013M1[21][22]. We see that for some countries, output is higher than it would have been without the quantitative easing. Moreover, most countries record equity prices higher than the forecasted equity prices. Finally, the counterfactual analysis reveals a currency

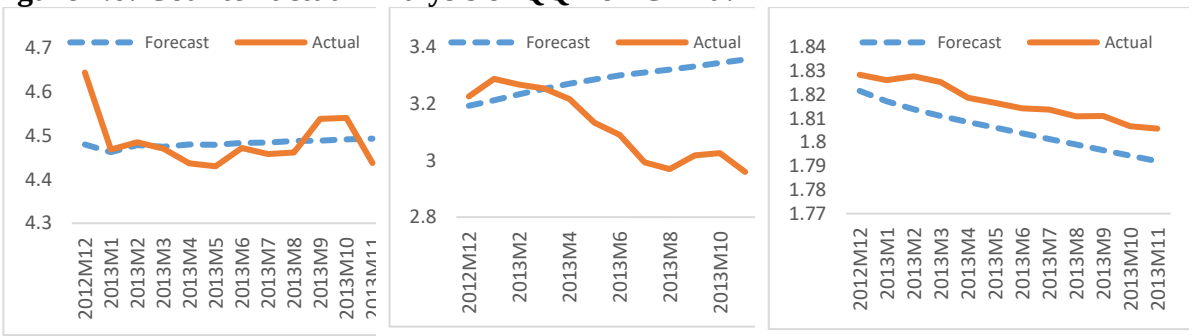
[21] We also ran different scenarios as robustness checks, such as keeping the monetary base constant from 2103M1, 2013M2, and keeping equity prices constant in 2013M2 as well. Then, we also tested to see if results are homogeneous with the monetary base and equity prices kept constant simultaneously for 2013M1 and 2013M2. Results are strongly robust.

[22] While Abenomics' QQE was effectively launched in April 2013, it started having an impact on expectations in the first quarter of the year.

appreciation in the region for many countries, that also would have been lower if equity prices had remained low. It is worth noting that for countries that experience currency appreciation, output is lower than the forecasted values, while other countries where the appreciation is not so pronounced, output is not so affected.

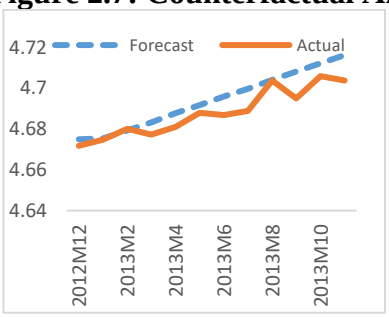
Of course, it is important to keep in mind that the actual values reflected in these graphs were also subject to other shocks, such as the June 2013 "taper tantrum" as well the decline in oil prices (which can be seen by the distinctive dip in equity prices in 2013M06 for most countries). These external shocks can also be responsible for the decline in output and equity prices. Nonetheless, the results indicate that spillovers from Japan's QQE were present in some ASEAN economies, and could have possibly reduced the impact of the "taper tantrum" and price shocks in the region.

Figure 2.6: Counterfactual Analysis of QQE on China:

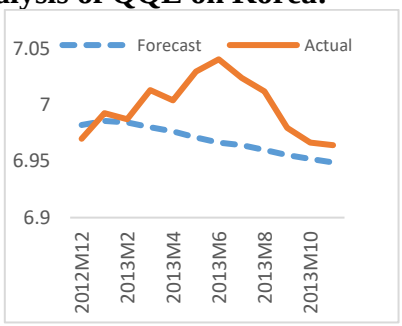


GDP Equity prices Exchange Rate

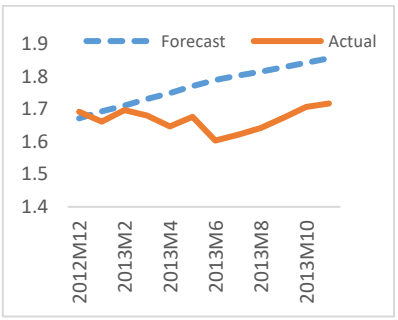
Figure 2.7: Counterfactual Analysis of QQE on Korea:



GDP

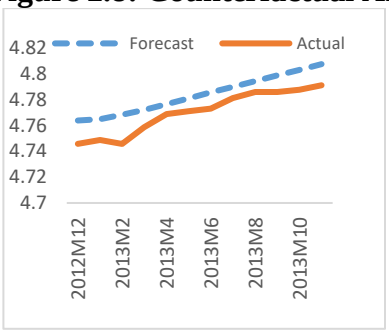


Equity prices

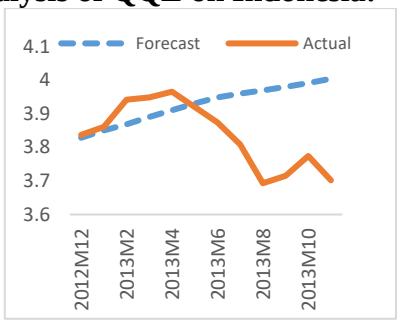


Exchange Rate

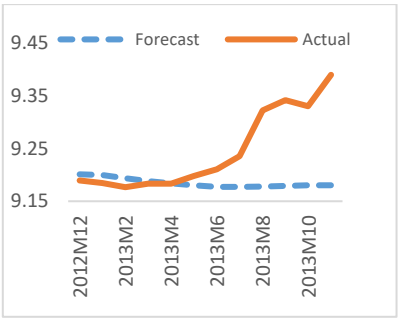
Figure 2.8: Counterfactual Analysis of QQE on Indonesia:



GDP

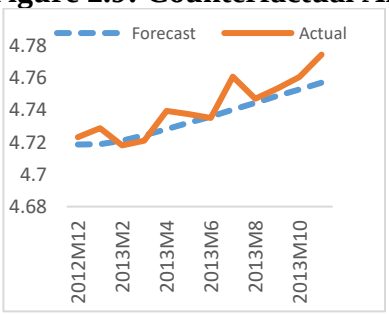


Equity prices

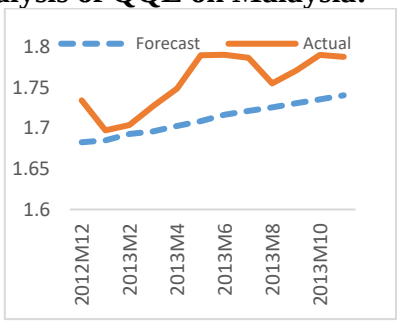


Exchange Rate

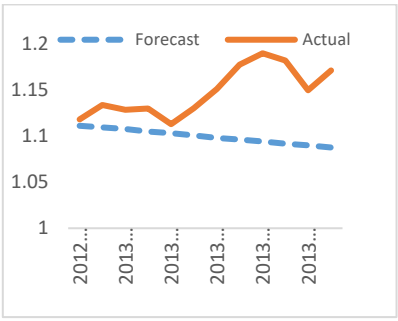
Figure 2.9: Counterfactual Analysis of QQE on Malaysia:



GDP

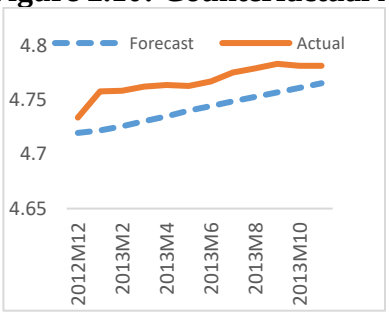


Equity prices

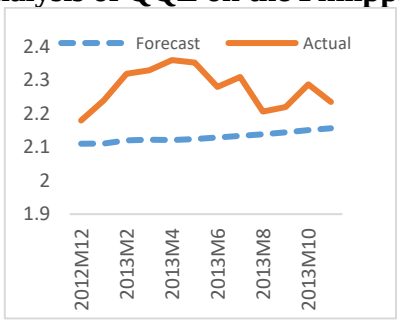


Exchange Rate

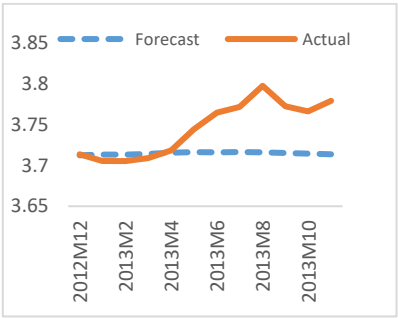
Figure 2.10: Counterfactual Analysis of QQE on the Philippines:



GDP

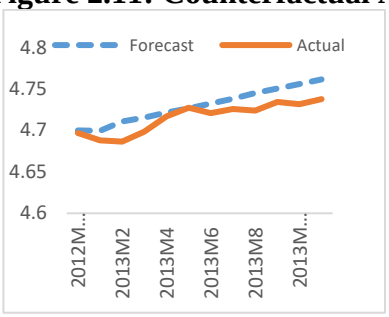


Equity prices

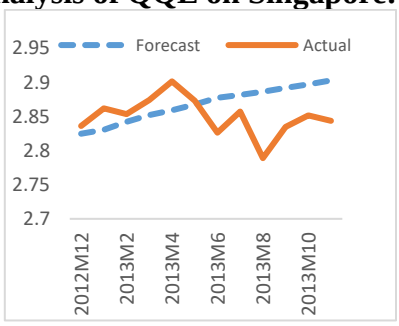


Exchange Rate

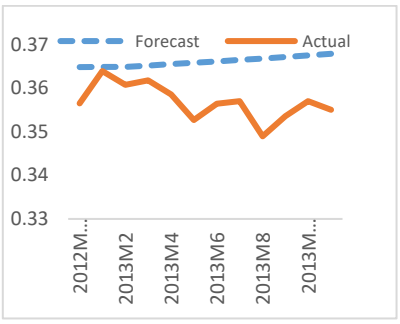
Figure 2.11: Counterfactual Analysis of QQE on Singapore:



GDP

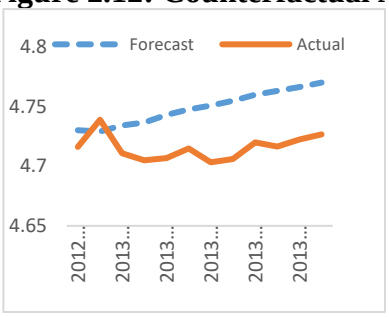


Equity prices

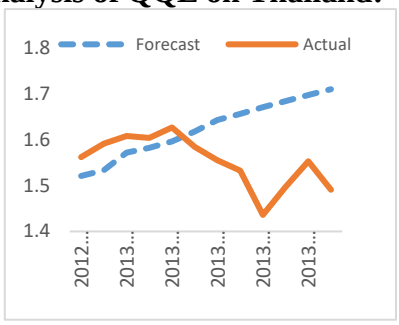


Exchange Rate

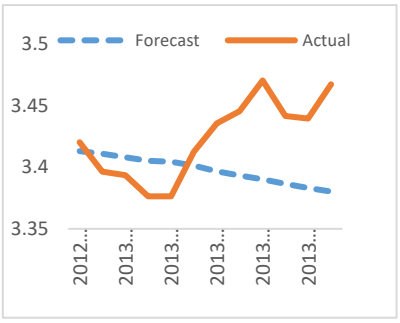
Figure 2.12: Counterfactual Analysis of QQE on Thailand:



GDP



Equity prices



Exchange Rate

2.6 Conclusion

This research has analyzed spillovers from Japan's Quantitative and Qualitative Easing (QQE) on emerging Asia. We employed the Global VAR model, which captures the financial and economic relations of economies across trade and financial channels. We combined financial and trade channels to build weights to link the countries together and we explored spillovers through the bilateral trade channel and the foreign direct investment channel.

Countries included in our sample in addition to Japan were China, Indonesia, Malaysia, the Philippines, Singapore, and Thailand. We also included the U.S., the Euro area and advanced European countries, because of the importance of their trade and financial links to Japan, and their dominant role in the world economy. Given that Japan's interest rates have been close

to zero for long time, we chose to proxy QQE through a monetary policy-induced increase in equity prices, and through a decrease in the shadow interest rate. Shocks to Japan's equity prices were identified by using sign-restrictions on structural impulse responses, while the shock to Japan's shadow interest rate was solved through a recursive Cholesky scheme.

Our analysis points to two conclusions. First, estimating the model by proxying QQE with changes in the shadow interest rate (rather than with an increase in equity prices) does not yield strong nor significant spillovers, suggesting that QQE affected other countries in Asia mostly through spillovers through the stock market channel. Results suggest that spillovers from financial linkages between stock markets, captured by the equity price variable, were larger than through balance sheet adjustments, which might have been captured by movements in the interest rate.

The second, and in our view, main result is that spillovers from QQE to emerging Asian countries tended to be positive. Despite an appreciation of domestic currencies vis-à-vis the yen, the impact on emerging Asia GDP was positive and significant. This suggests that the positive effect of QQE on expectations of future wealth through higher stock prices, by improving investor confidence, has more than offset any negative exchange rate spillover due to expenditure switching from domestic to Japanese goods. Emerging Asia also experienced limited spillovers in terms of higher inflation and, on average, increased capital inflows.

2.7 Appendix

Table A2.1: Chapter 2, Trade and Weights Matrix, Averaged over 2012-2014

Country	Australia	Brazil	Canada	Chile	China	Euro	India	Indonesia	Japan	Korea	Malaysia	Mexico	New Zealand	Norway	Philippines	Singapore	Sweden	Switzerland	Thailand	Turkey	UK	USA
Australia	0.00	0.01	0.00	0.01	0.05	0.01	0.04	0.03	0.06	0.04	0.02	0.00	0.12	0.00	0.02	0.01	0.00	0.00	0.02	0.01	0.01	0.00
Brazil	0.00	0.00	0.01	0.08	0.04	0.03	0.03	0.01	0.01	0.02	0.11	0.02	0.00	0.01	0.00	0.12	0.03	0.04	0.10	0.02	0.03	0.06
Canada	0.01	0.02	0.00	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.00	0.04	0.17	0.03	0.11	0.00	0.00	0.01	0.00	0.01	0.02	0.15
Chile	0.00	0.03	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.02	0.00	0.01
China	0.31	0.25	0.09	0.27	0.00	0.16	0.17	0.17	0.28	0.31	0.12	0.16	0.15	0.05	0.13	0.10	0.10	0.03	0.14	0.12	0.08	0.19
Euro	0.09	0.24	0.06	0.15	0.17	0.00	0.19	0.08	0.10	0.09	0.16	0.13	0.14	0.32	0.14	0.17	0.56	0.52	0.10	0.42	0.50	0.17
India	0.03	0.03	0.01	0.03	0.03	0.04	0.00	0.06	0.01	0.03	0.02	0.01	0.01	0.00	0.01	0.03	0.02	0.05	0.02	0.06	0.03	0.03
Indonesia	0.03	0.01	0.00	0.00	0.03	0.02	0.05	0.00	0.04	0.04	0.12	0.01	0.02	0.01	0.05	0.09	0.01	0.02	0.11	0.01	0.01	0.04
Japan	0.15	0.05	0.03	0.08	0.13	0.04	0.04	0.15	0.00	0.13	0.09	0.04	0.06	0.01	0.09	0.09	0.02	0.02	0.17	0.02	0.03	0.08
Korea	0.07	0.04	0.01	0.06	0.11	0.02	0.04	0.08	0.08	0.00	0.03	0.03	0.03	0.00	0.08	0.06	0.01	0.00	0.03	0.04	0.01	0.03
Malaysia	0.04	0.01	0.00	0.00	0.04	0.02	0.04	0.08	0.04	0.03	0.00	0.01	0.04	0.00	0.05	0.09	0.01	0.00	0.05	0.01	0.01	0.01
Mexico	0.01	0.03	0.04	0.03	0.02	0.02	0.01	0.00	0.01	0.02	0.01	0.00	0.02	0.12	0.03	0.01	0.00	0.00	0.01	0.00	0.00	0.12
New Zealand	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Norway	0.00	0.01	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.05	0.01
Philippines	0.01	0.00	0.00	0.00	0.02	0.01	0.00	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.02	0.02	0.01	0.01
Singapore	0.05	0.01	0.00	0.00	0.03	0.02	0.05	0.14	0.03	0.05	0.09	0.02	0.04	0.02	0.07	0.00	0.01	0.01	0.03	0.01	0.02	0.01
Sweden	0.01	0.01	0.00	0.01	0.01	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.03	0.00	0.00	0.02	0.00	0.01	0.02	0.00
Switzerland	0.01	0.02	0.01	0.01	0.02	0.09	0.07	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.00	0.03	0.06	0.03	0.02
Thailand	0.04	0.01	0.00	0.01	0.03	0.01	0.02	0.06	0.05	0.02	0.06	0.01	0.03	0.01	0.06	0.04	0.01	0.02	0.00	0.05	0.02	0.02
Turkey	0.00	0.01	0.00	0.01	0.01	0.07	0.01	0.01	0.00	0.01	0.07	0.01	0.03	0.24	0.01	0.06	0.06	0.07	0.08	0.00	0.01	0.01
UK	0.03	0.02	0.03	0.01	0.03	0.15	0.04	0.01	0.02	0.02	0.01	0.01	0.03	0.04	0.01	0.02	0.05	0.10	0.01	0.03	0.00	0.02
USA	0.09	0.19	0.69	0.21	0.21	0.16	0.16	0.08	0.19	0.15	0.06	0.48	0.09	0.03	0.11	0.09	0.03	0.06	0.05	0.06	0.09	0.00

Notes: Trade weights are calculated as shares of the sum of exports and imports, and should be read vertically. (Each column should sum up to 1, however, some countries have been removed from the weights matrix for space allocation). Source: Direction of Trade Statistics, IMF.

Table A2.2: Chapter 2, F-Statistics for Testing the Weak Exogeneity of the Country-Specific Foreign Variables, Oil Prices, and the Price of Metals

Country	F test	Fcrit_0.05	Y*	Dp*	Eq*	Ex*	R*	Bc*	Cf*	Poil*	Pmetal*
Australia	F(3,169)	2.66	0.36	0.53	0.78		0.20	0.90	2.10	0.81	0.76
Brazil	F(3,168)	2.66	0.22	2.08	0.57		3.63	2.10	0.39	1.80	0.81
Canada	F(2,179)	3.05	0.84	1.20	1.04		0.43	1.44	0.58	0.57	1.66
Chile	F(2,170)	3.05	1.08	3.14	2.51		0.07	0.20	1.28	1.60	0.15
China	F(5,175)	2.27	3.12*	6.08*	2.20		2.10	0.33	1.45	1.67	
Euro	F(2,169)	3.05	1.04	0.35	0.48		4.76*	0.26	0.63	0.76	1.58
India	F(1,171)	3.90	2.13	2.32	1.38		0.22	1.63	1.36	0.67	4.45*
Indonesia	F(4,167)	2.43	1.68	0.67	1.18		1.03	1.98	1.90	1.86	0.60
Japan	F(4,167)	2.43	1.42	7.14*	0.16		0.86	0.32	0.50	1.82	3.04*
Korea	F(5,166)	2.27	0.45	4.78*	0.48		1.53	2.38*	0.35	0.92	0.65
Malaysia	F(3,177)	2.66	0.17	1.57	0.40		2.27	1.93	0.24	1.22	0.55
Mexico	F(3,168)	2.66	0.87	0.05	0.87		3.44*	0.21	0.07	0.06	0.80
New Zealand	F(2,171)	3.05	1.23	1.30	0.30		1.14	0.21	1.98	0.87	0.56
Norway	F(2,178)	3.05	0.33	0.19	0.59		1.84	2.27	0.66	0.28	0.18
Philippines	F(4,167)	2.43	1.37	0.48	0.46		0.09	0.87	0.65	0.96	0.62
Singapore	F(2,179)	3.05	0.06	4.50*	1.13		0.50	2.27	0.95	0.46	0.46
Sweden	F(3,177)	2.66	1.97	5.31*	1.53		1.38	0.14	0.81	1.75	0.51
Switzerland	F(3,178)	2.66	3.25*	13.16*	0.14		1.43	0.21	0.31	0.83	0.39
Thailand	F(2,178)	3.05	0.19	4.19*	3.91		2.30	0.53	2.71	2.85	0.03
Turkey	F(3,168)	2.66	0.29	2.59	0.70		1.78	0.10	0.28	0.82	0.70
United Kingdom	F(2,178)	3.05	0.81	5.63*	0.91		0.33	1.08	0.93	0.46	1.68
United States	F(2,180)	3.05	0.03			3.89					2.13

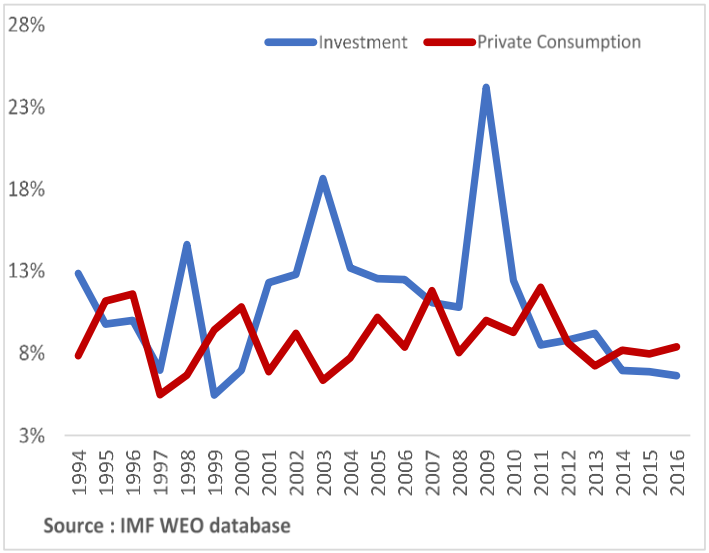
Note: * denotes statistical significance at the 5% level.

CHAPTER 3. EXPLORING THE IMPACT FROM CHINA'S TRANSITION TO A CONSUMPTION-DRIVEN MODEL

3.1 Introduction

During the decade of 2000-2014, China grew at the pace of almost 10 percent GDP per year. Its remarkable investment growth bolstered trade and boosted commodity prices, and its global share of GDP rose to about 13 percent in 2015. However, as investment grew exponentially higher, it dragged down efficiency, created overcapacity, contributed to the rise of inequality, and led to the degradation of environment quality. Thus, China started moving from an investment-driven economy to a consumption-driven one. In 2015, consumption growth exceeded investment growth (Figure 3.1).

Figure 3.1: Consumption and Investment Growth in China



This was not without consequences for the rest of the world, due to the strong linkages with China. Trade growth made China a main source of exports demand for more than 80 percent of world GDP. As GDP dropped to below 7 percent in 2016, trade slowed by 7-8 percent, and financial volatility increased. Negative spillovers extended to commodity exporters who had

previously benefited from the high demand for commodities (namely metals) for infrastructure investment. In this context, as China's investment growth slowed and import demand for commodities subsequently declined, this created strong downward pressures on commodity prices. The slowdown in investment and increase in market uncertainty also triggered capital outflows and relocation of investment.

Our main interest is to study how China's transitioning may affect investment and consumption in other parts of the world. For that purpose, we build a multi-country dataset and set up a GVAR model approach,[23], which allows for the examination of the propagation of shocks from systemic countries to the rest of the world. In addition, through the model, we can examine the indirect effects of a shock, through secondary and tertiary channels. The methodology involves setting up country-specific individual VARs, and then linking them through the inclusion of foreign variables. The latter are weighted averages of the other countries' variables, and they augment the individual country-specific VARs to capture the propagation of shocks. The weights on which the foreign variables are built are the countries' financial and trade exposures regarding the other countries.

Given the systemic importance of China, its slowdown and rebalancing have been widely researched, with the GVAR model a popular tool of study. The IMF World Economic Outlook (2016) considers the effects of China's transition on global growth using a panel VAR model. Cashin, Mohaddes, and Raissi (2016) test China-induced financial volatility in the global market using a GVAR model. Dzioli and al (2016) also employ a GVAR model to look at the

[23] Pesaran and Smith (2004)

spillovers from China to the ASEAN 5 economies. Kireyev and Leonidov (2016) look at international spillovers from a decline in China's imports. However, these studies focus on GDP-to-GDP spillovers from China. Our contribution to the literature is by using a novel dataset to model the rebalancing of China. Specifically, the main contribution of the research is to use country-specific investment and consumption data instead of real GDP data to look at the rebalancing effects of China on each country, and draw corresponding policy implications. China's switch from an investment driven model to a consumption-driven one is modeled as a 1 percent decline in China's investment, followed by a 1 percent increase in its consumption. We then look at their respective impacts on consumption and investment for all other countries, and their net effect in total. We test the propagation of China investment and consumption shocks through trade, commodities, and financial linkages. We add to the literature by considering: the domestic and international impact of rebalancing to consumption from investment, the inter-linkages between different regions and China, and by examining the propagation of shocks through different channels. This, to the best of our knowledge, has not been yet explored in the literature.

Our results show that China's decline in investment reduces global investment and commodity prices. Specifically, a 1 percent shock to China's investment decreases global investment by 0.15 percent in the first year. Global consumption is only marginally reduced. Its most significant impact is on commodity prices: oil prices by 2-3 percent, and the price of metals by 1-2 percent. However, we find that the impact on the financial market (equity prices, interest rates, and exchange rates) is not statistically significant. In addition, we test whether the shift into a consumption-based growth model would have positive spillovers on the global economy.

The results indicate that an increase in consumption raises global investment by 0.12 percent and global consumption by a mere 0.05 percent, thus offsetting some of the decline incurred by the rebalancing. However, the impact of a positive consumption shock remains largely negative on commodity prices, as they continue to decline by 2-3 percent. Therefore, a positive consumption shock does not offset the incurred losses on countries that export commodities and investment goods.

Region-specific spillovers are overall negative, though heterogeneous in magnitude: we find that while growth in China's consumption would generate positive spillovers for the Asia region and offset some of the adverse effects of the decline in investment, other positive spillovers are negligible for the rest of the world, and commodity prices would remain dampened by low investment. Specifically, Asia Pacific is the only region which mainly gains on a net level from China's transition: in the first year following a 1 percent negative investment shock and a 1 percent positive consumption shock, investment increases in total by 0.17 percent in Southeast Asia and 0.22 percent in Australia and New Zealand, consumption increases respectively by 0.12 percent. In Japan, the currency experiences an appreciation against the US dollar. Commodity exporting regions like Latin America experience almost a 1 percent drop in investment upon the China investment shock. Meanwhile, exporters of investment goods in the Euro area are also affected by the slowdown in import demand, and investment generated by an increase in consumption in China is not enough to offset the decline in total investment. Finally, safe-haven currencies like the British Pound and the Swiss Franc appreciate against the US dollar.

The rest of this chapter is organized as follows. Section II presents the GVAR model, the data used and the model specifications. Section III presents empirical results from a reduction in China's investment and an increase of consumption. Section IV concludes.

3.2 A Proxy for the Rebalancing of China

3.2.1 Data

The original GVAR model written by Dees and Al (2004)[24] included the following six domestic variables: Real GDP, CPI inflation, the exchange rate , equity prices , short-term interest rates , and long-term interest rates.

However, to study directly the impact of shifting from investment to consumption, we choose to replace the real GDP series by two sub-series: Investment and total consumption. Investment consists of the gross capital formation in each country, while total consumption is the sum of public and private consumption. For countries where quarterly data is not available, we interpolate investment using the Chow-Lin interpolation method, based on high-frequency indicators. Investment is interpolated based on the corresponding country's industrial or manufacturing production index, as is conventional in the literature. As for consumption, it is interpolated based on total sales. In case sales data is not available, we base the interpolation on total credit to households. The series are then seasonally adjusted. Data for consumption and investment are obtained from the IMF's World Economic Outlook (WEO) database, while high frequency indicators data are obtained from the IMF IFS, the CEIC, and Haver Analytics.

[24] The GVAR toolbox is available for download from https://sites.google.com/site/gvarmodelling/gvar-toolbox.

Our dataset thus comprises of quarterly data, from 1979Q1 up to 2015Q4. The following country-specific variables are used as domestic variables in the GVAR model: investment (Inv_{it}), consumption ($Cons_{it}$), equity prices (EQ_{it}), CPI inflation (CPI_{it}), the short-term interest rate (SR_{it}), and the nominal effective exchange rate ($NEER_{it}$)[25][26]. In addition, the price of oil per barrel in US dollars ($Poil$) is included as a global variable, as well as the price of metals index ($Pmetals$)[27]. Data for inflation, exchange rates, short-term interest rates, and for the price of oil and price of metals are obtained from the IMF IFS database. As for the equity prices data, it is based on the MSCI index, and obtained from Bloomberg. We construct the domestic variables as follows:

Investment: $INV_{it} = \ln\frac{Inv_{it}}{CPI_{it}}$

Consumption: $CONS_{it} = \ln\frac{Cons_{it}}{CPI_{it}}$

Inflation: $dp_{it} = \ln(CPI_{it}) - \ln(CPI_{i,t-1})$

Equity prices: $eq_{it} = \ln(\frac{EQ_{it}}{CPI_{it}})$

The exchange rate: $ex_{it} = \ln(NEER_{it})$

The short − term interest rate: $r_{it} = 0.25 * ln(1 + R_{it}^{s}/100)$

As for the global variables, they are also used in log terms:

Price of oil: $poil = \ln(Poil)$

Price of Metals: $Pmetals = \ln(Pmetals)$

[25] Further details are provided in the Data appendix on the data.

[26] We opt to omit the long-term interest rates series as it is not publicly available for many countries, and it is recommended to include only six domestic variables for each country vector for the GVAR to remain stable.

[27] The metal price index (base year 2005=100) includes copper, aluminum, iron ore, tin, nickel, zinc, lead, and uranium price indices.

3.2.2 Model Specification and VARX Setup

Our model includes 34 countries, each of which are listed in Table 3.1. As consistent with GVAR literature, we group 8 of the European countries that joined the Euro area in 1999 into a Euro block. The following countries are: Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, and Spain. The Euro block time-series data is then constructed as weighted averages of the country-specific time-series data, using the Purchasing Power Parity GDP weights, averaged for the years 2009-2011.

Table 3.1. Countries and Regions Included in the GVAR Model

Asia and Pacific	**North America**	**Europe**
Australia	Canada	*Austria*
China	Mexico	*Belgium*
India	United States	*Finland*
Indonesia		*France*
Japan	**South America**	*Germany*
Korea	Argentina	*Italy*
Malaysia	Brazil	*Netherlands*
New Zealand	Chile	Norway
Philippines	Ecuador	*Spain*
Singapore	Peru	Sweden
Thailand	Venezuela	Switzerland
		Turkey
	Africa	United Kingdom
	South Africa	

Note: The countries in Italics are included in the Euro area block.

Except for the United States model, all other countries' VARX* are built as such:

Each country-specific model includes the following country-specific 6 domestic (endogenous) variables: Investment (Inv_{it}) , consumption ($Cons_{it}$) CPI inflation (dp_{it}) , equity prices (eq_{it}), the exchange rate (e_{it}), and short-term interest rates (r_{it}). Using the desired bilateral

flows channel (please see next section), the following 6 foreign (weakly exogenous) variables are constructed and included in each country VARX*: inv_{it}^{*} , $cons_{it}^{*}$ eq_{it}^{*} , dp_{it}^{*}, and r_{it}^{*}. The foreign exchange rate variable e_{it}^{*} is not included.

We follow the literature and set up the model as following: the US country model is set up to reflect the dominance of the US economy on the rest of the world. The US VARX* vector includes all the domestic variables except for the exchange rate. As for the foreign variables, only inv_{it}^{*} , $cons_{it}^{*}$ and ex_{it}^{*} are included. Finally, the price of oil variable enters the US VARX* as an endogenous variable, given that the US is the single largest consumer of oil and subsequently impacts world oil demand and prices. On the other hand, China accounts for 40 percent of global metals demand. We therefore can make the assumption that the price of metals global variable is endogenous to China, and that we can include it as a domestic variable in the China vector model.

3.3 Dynamic Analysis

Our GVAR model thus counts 26 country-specific VARX* models and 1 region-specific VARX* model. As previously explained, each VARX* model includes domestic variables p_i and foreign variables q_i. The lag orders for the domestic and foreign variables are determined using the Akaike Information Criterion (AIC). Consistent with GVAR literature, we set the maximum lag orders to $p_{max} = 2$ and $q_{max} = 1$. The number of cointegrating relations is next determined for each country VARX*, and the rank orders obtained using Johansen's trace statistics. The estimated VARX* orders and their corresponding ranks are reported in Table 3.2.

To orthogonalize the impulse response shocks, we employ structural impulse responses through a Cholesky factorization scheme. We choose one possible identification scheme by adopting the following ordering for the variables in the China bloc: price of metals, short-term interest rate, the exchange rate, inflation, investment, and consumption. We experiment with other variable orderings and find the results largely robust.

Table 3.2 Lag Orders of the Country-Specific VARX*(p,q) Models Together with the Number of Cointegrating Relations (r)

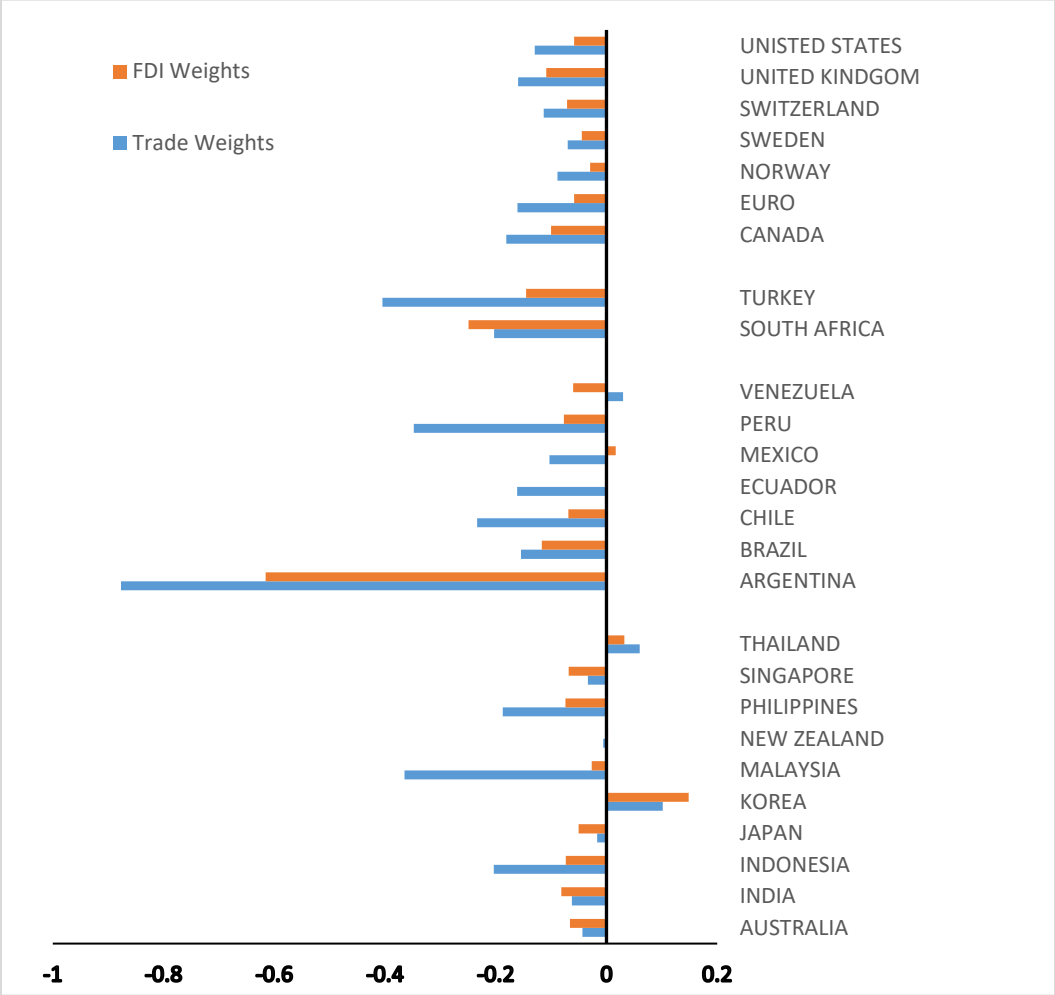
Country	VARX* Order		Cointegrating Relations (r_i)	Country	VARX* Order		Cointegrating Relations (r_i)
	p_i	q_i			p_i	q_i	
Argentina	2	1	2	New Zealand	2	1	2
Australia	2	1	2	Norway	2	1	3
Brazil	2	1	4	Peru	2	1	3
Canada	2	1	2	Philippines	2	1	4
Chile	2	1	3	Singapore	1	1	3
China	2	1	2	South Africa	2	1	2
Ecuador	2	1	2	Sweden	2	1	4
Euro	2	1	4	Switzerland	2	1	3
India	2	1	1	Thailand	2	1	4
Indonesia	2	1	4	Turkey	2	1	2
Japan	2	1	4	United Kingdom	1	1	3
Korea	2	1	3	United States	2	1	3
Malaysia	2	1	2	Venezuela	2	1	4
Mexico	2	1	2				

Note: p_i and q_i refer to the lag order of the domestic and foreign variables respectively and are determined using the Akaike Information Criterion (AIC). The number of cointegrating relations (r_i) are determined using the trace statistic based on the 95% critical values from MacKinnon (1991) for all countries. Source: Author's estimations based on GVAR calculations

We also test the robustness of our results by using two bilateral flows channel. The first channel is the traditional trade channel, constructed as the sum of imports and exports between each country. The second channel is the Foreign Direct Investment (FDI) channel, and the weights

are constructed based on direct investment inflows and outflows, procured from the IMF's Coordinated Direct Investment Survey (CDIS). Figure 3.2 reports the average investment elasticities over the first year following a negative investment shock to China.

Figure 3.2 Response of Global Investment to a Negative China Investment Shock, Four Quarters Cumulative (Using Different Weights)



Note: The graph above depicts the percent change in investment following a 1 percent negative investment to China, cumulated over four quarters (1 year).

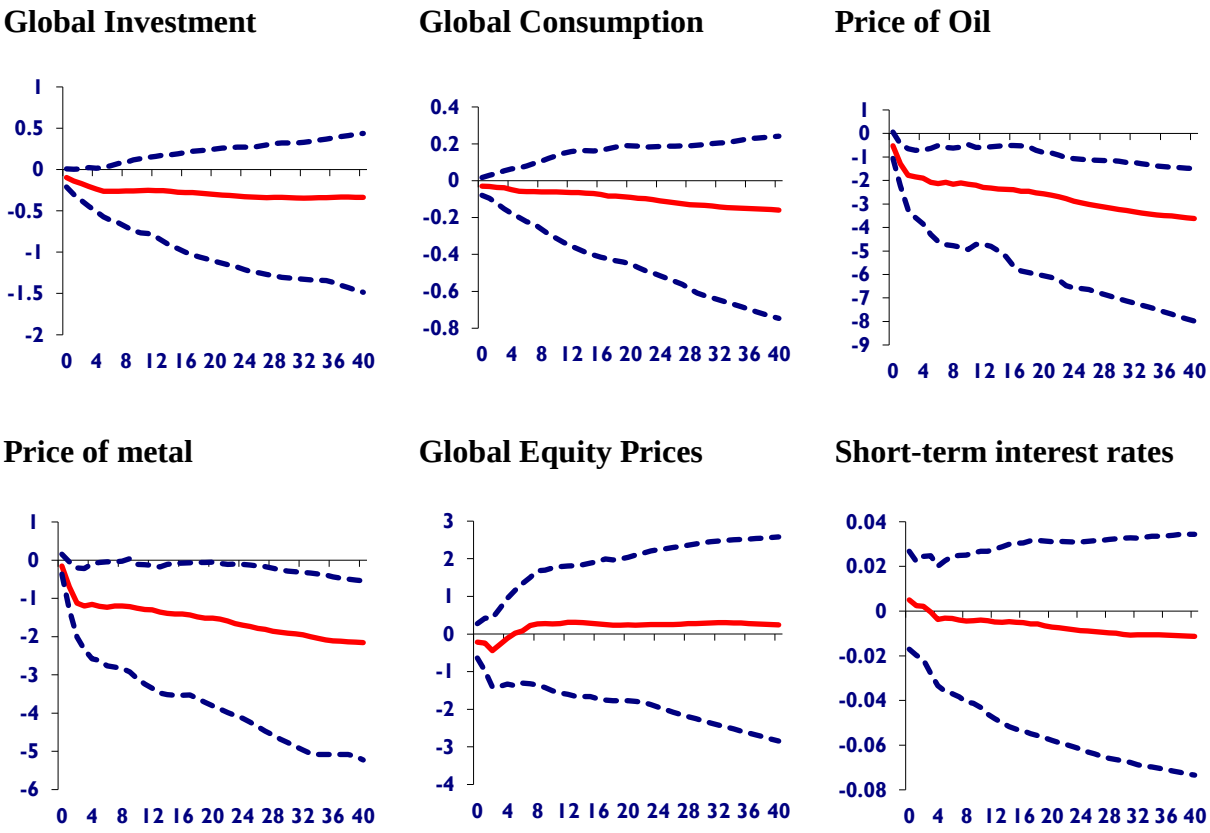
The results show that the magnitude and impact of the shock to China's investment are similar whichever through both channels. Trade shocks are predictably stronger than FDI shocks,

given the importance of China in the global trade chain. We thus opt to use the trade flows channel to report our remaining results.

3.3.1 Negative Shock to Investment

China's switch in growth models starts with a decline in investment, and a shift towards consumption. We first examine the impact of a negative China investment shock on real and financial variables, and commodity prices. Figure 3.3 depicts the structural generalized impulse responses to a percent negative reduction in China's investment.

Figure 3.3. Implications of a Negative China Investment Shock for the Global Economy



Note: Figures are median structural generalized impulse responses to one standard deviation reduction in China's investment, together with the corresponding 90th percent confidence bounds. The impact is in percentage and the horizon is quarterly. The "global" economy VAR is constructed through the GVAR, using GDP-PPP weights.

Results suggest that global investment would drop by about 0.2 percent in the first quarter, leading up to 0.5 percent aggregate decline in global growth in the first year. Global consumption also declines, though minimally. In addition, China's shock is transmitted to commodity prices, where the price of oil declines by 2 percent in the first quarter, leading up to 3 percent by the second year. On the other hand, metal prices drop by 1 percent in the first quarter, and cumulate to 2 percent the following year. We can also note that the impact on financial markets is limited, with global equity prices dropping by a minor 0.5 percent the first quarter before rebounding (and the drop is not statistically significant). Short-term interest rates as well are not affected.

Moving on to regional spillovers, we look at the impact of the negative investment shock from China to Asia, Europe and the Americas.[28] Figure 3.4 reports the impact of one negative percent shock to China's investment on selected regions. We find that Southeast Asia is not as negatively affected as the rest of the world, indicating that the region is indeed offset by the relocation of capital flows and investment[29]. The relocation of capital and investment following the rebalancing of China offsets Japan and Singapore's losses, and increases investment in Korea and Thailand. We also see currency appreciation for safe-haven currencies, like the Japanese Yen, the Korean Won, and the Singaporean dollar (see figure 3.5). Investment declines for commodity exporters in the region, like Australia, Indonesia, and Malaysia, while

[28] The "Southeast Asia" bloc includes Indonesia, Korea, Malaysia, the Philippines, Singapore, and Thailand. The "Latin America" bloc includes Argentina, Brazil, Chile, Ecuador, Mexico, Peru and Venezuela. The "Rest of the World" bloc groups Canada, India, and South Africa. Finally, the "Rest of Europe" bloc includes Norway, Sweden, Switzerland and Turkey.

[29] Capital flows data up to 1979 is not available, and therefore we could not look directly at the relocation of capital flows in Southeast Asia.

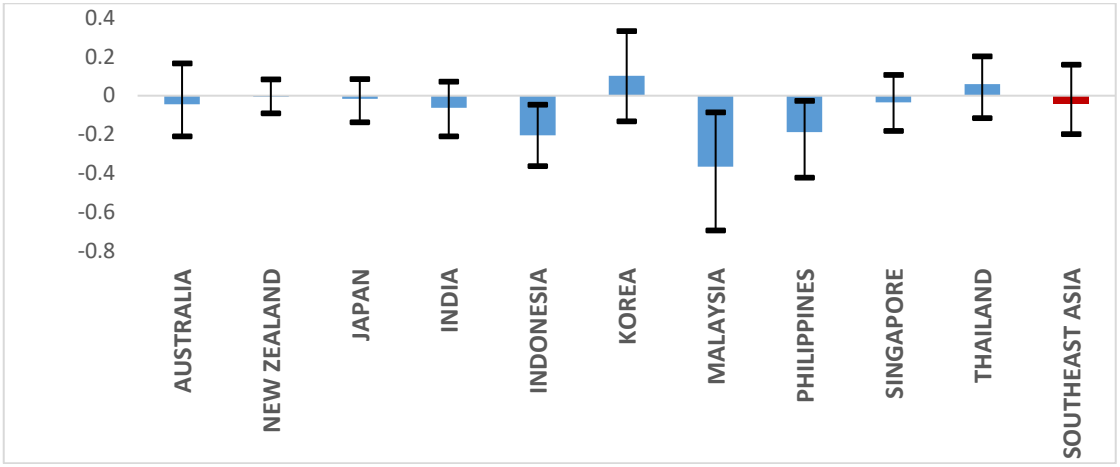
the Philippines also registers losses, as it mainly exports investment goods. However, New Zealand, an exporter of consumption goods, slightly benefits from the shift towards consumption. On an aggregate level, we see that the drop is almost zero in total in the first year for Asia Pacific. In addition, while not reported here, following the second year after the shock, the impulse response results show investment rebounds in many countries. This may be in line with predictions that as China moves up the global-value-chain into production of intermediate goods, labor-intensive production and investment would relocate to Southeast Asia.

Turning to North and Latin America, we see that the impact through commodities prices dominates. For instance, investment in the United States drops by 0.1 percent following the 1 percent negative China investment shock, while it declines by 0.2 percent for Canada. This drop should largely be due to the decrease in oil prices. As for Latin America, we note that the region is the most affected by the decline in investment. Given that countries in Latin America trade primarily with China and export both metals and oil, they become twice affected: once by the fall in commodity prices, and once by the decline in trade.

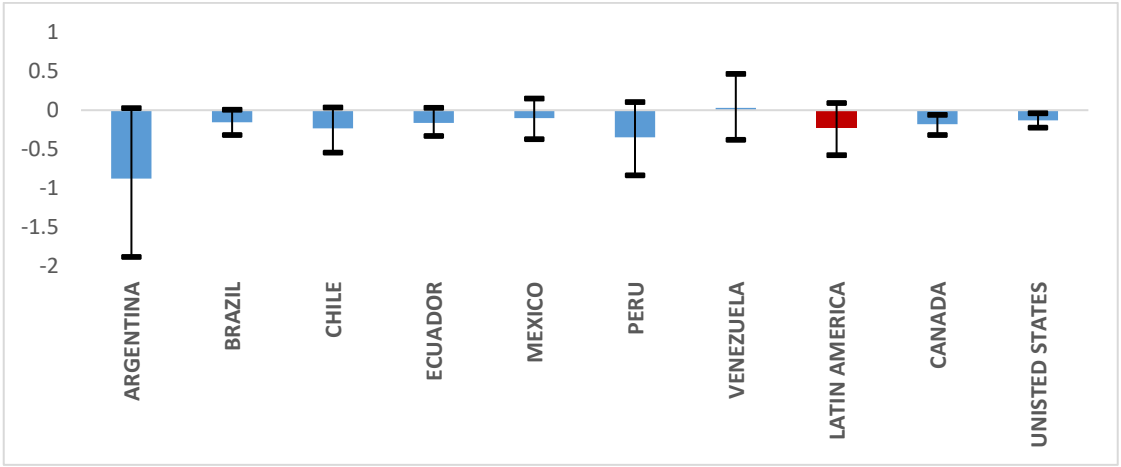
Spillovers also extend to the Europe, where investment in the Euro area declines by 0.5 percent, versus a 0.2 percent investment decline in the United Kingdom, amounting to a total 1 percent decline of investment in the rest of Europe by the second year following the shock. The decline in investment in the Euro area can be attributed to the decrease in demand for investment goods. Finally, countries in the rest of Europe like Norway register a decline in investment due to the decline in oil prices and demand for commodities.

Figure 3.4. Implications of a Negative China Investment Shock on Regional Investment

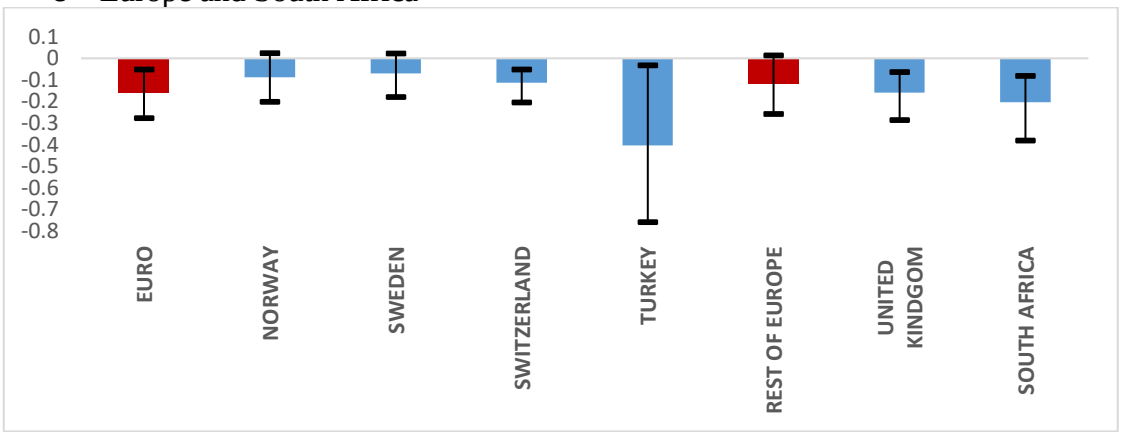
a- Asia Pacific



b- Latin and North America



c- Europe and South Africa

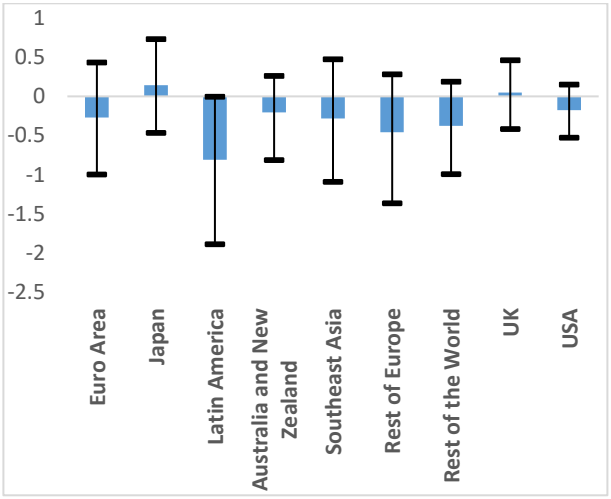


Note: Graphs show the impulse response results to a one percent reduction in China's investment cumulated over four quarters (one year), together with the corresponding 90th percent confidence bounds. The impact is interpreted in percentage.

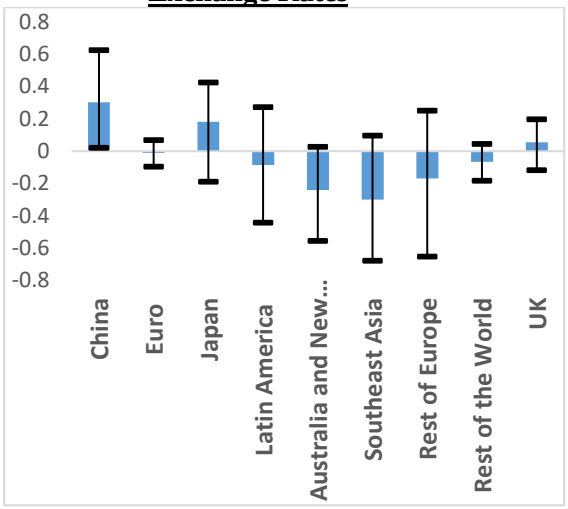
In addition to the impact on investment, financial markets are affected following China's rebalancing. Figure 3.5 reports the impact of the negative China investment shock on both equity prices and exchange rates.

Figure 3.5. Implications on Equity Prices and Exchange Rates Following a One Percent Negative China Investment Shock (Cumulative Over Four Quarters)

a. Implications on Equity Prices



b. Implications on Nominal Effective Exchange Rates



Notes: Graph shows impulse response results to a one percent negative China Investment structural shock, with the corresponding 90th percent confidence bounds. The results are cumulated over four quarters (one year) and the impact is in percentage. [30]

Results show that China's nominal effective exchange rate (NEER) appreciates against the US dollar by 0.3 percent in the first year[31], against a backdrop of deflation induced by lower commodity prices and subsequently lower producer prices.. Looking at Japan, we note that China's decline in investment did contribute to the appreciation of the Japanese NEER by 0.2

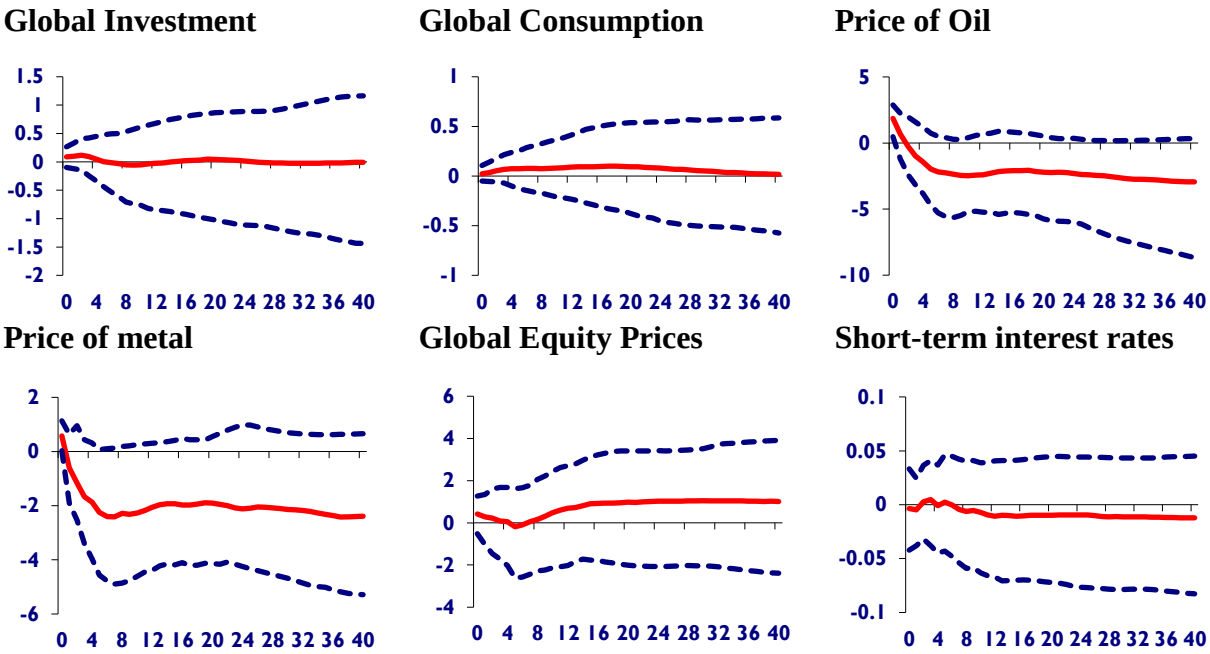
[31] The data used is up to 2015Q4, and thus only includes the surprise switch to a floating exchange rate regime by China data for the last quarter, starting August 2015. Prior to the rebalancing, China's exchange rate was consistently considered undervalued due to its large current account surplus, creating appreciating pressures.

percent in the first year, though the result is not statistically significant. Currency appreciation is also registered in the United Kingdom, another haven currency, as well as Singapore, Korea, and Thailand. In Southeast Asia, despite currency appreciation in Singapore, Korea and Thailand, the overall effect is negative on the country-specific exchange rates, particularly on Indonesia (an oil exporter). Again, in the "Rest of Europe" bloc, results are overall negative due to the depreciation of the nominal effective exchange rate in Norway, another oil exporter. As for equity prices, we note that while there is change is stock markets, this change is not statistically significant to almost all countries (and regions). Japan again benefits with a slight increase in equity prices, while stock markets worldwide are negatively affected. The decrease in equity prices is likely to be due to an increase in financial volatility and instability after the beginning of China's transition and the subsequent capital flight. However, the impact on financial markets remains not statistically significant, which further proves that China's spillovers mainly transmit through the trade channel and commodity prices.

3.3.2 Positive Shock to Consumption

We then look at the implications of China's shift to a consumption demand-driven economy. Results seem to suggest that while this growth strategy switch may slow down global growth in the short-run, spillovers from consumption shocks are less systemic. Figure 3.6 reports the results to one positive percent structural shock to China's consumption on the global economy.

Figure 3.6. Implications of One Positive China Consumption Shock for the Global Economy



Note: Figures are median structural generalized impulse responses to one positive standard deviation shock in China's consumption, with the corresponding 90th percent confidence bounds. The impact is in percentage and the horizon is quarterly. The "global" economy VAR is constructed through the GVAR, using GDP-PPP weights.

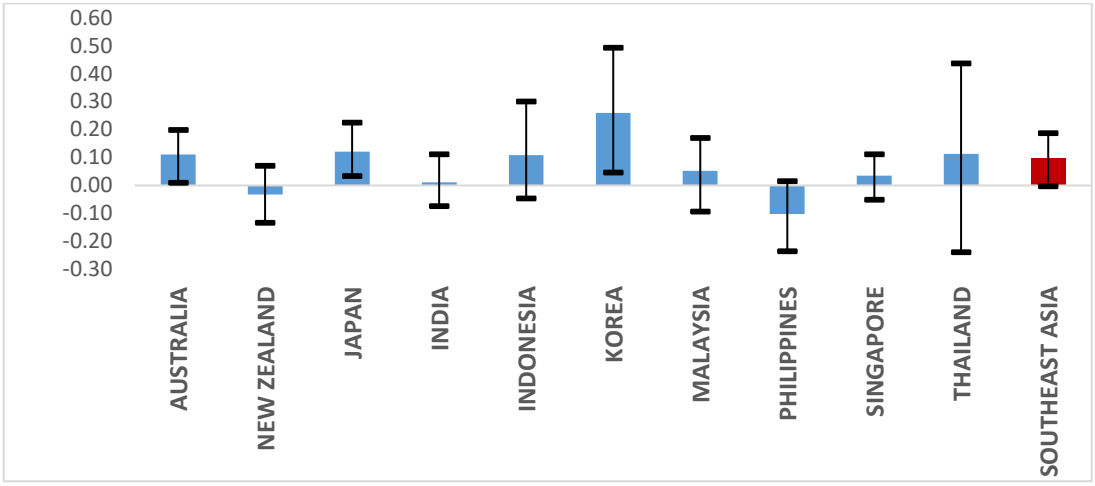
Looking at Figure 3.7, we can see that a consumption-driven shock has a limited impact on global consumption, global investment, and global financial markets. Moreover, though the impulse response graphs report a decline in oil and metals prices, this decline is not statistically significant.

Turning to regional spillovers, we again note that positive spillovers are registered in Asia, but are minimal for the rest of the world. A 1 percent positive consumption shock in China increases consumption in Japan by 0.12 percent in the first year, versus a 0.3 percent increase in Korea. Given that both countries are exporters of industrial goods and electronics, and key

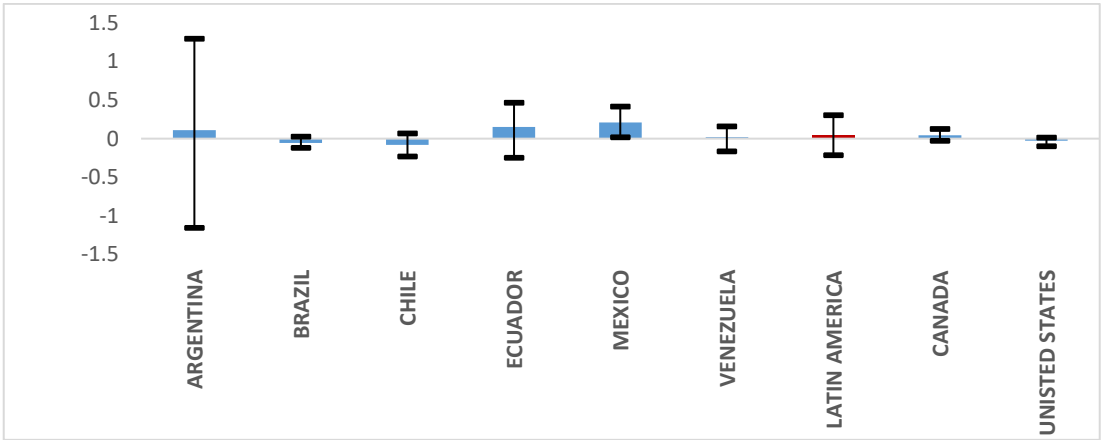
trade partners to China, the increase in consumption could induced by higher sales and gains from the increase in China's consumption demand. Consumption also increases by 0.1 percent in Australia, who is an exporter of animal and vegetables products. Overall, except for the Philippines, consumption in Asia Pacific increases, by about 0.1 percent. However, the remaining regions in the world are not particularly affected by the positive consumption shock, as the results for Latin America, North America, and Europe show that the impulse responses are not statistically significant.

Figure 3.7. Implications of a Positive China Consumption Shock on Regional Consumption.

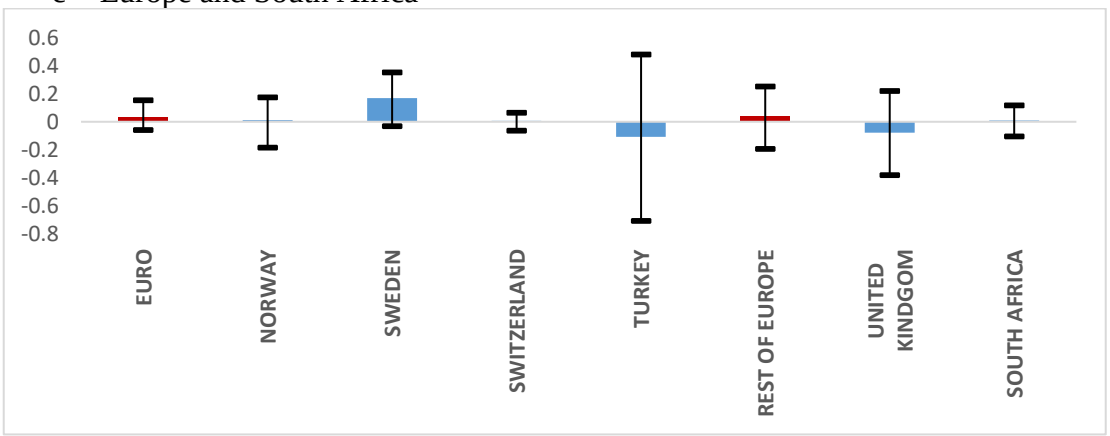
a- Asia Pacific



b- Latin and North America



c- Europe and South Africa



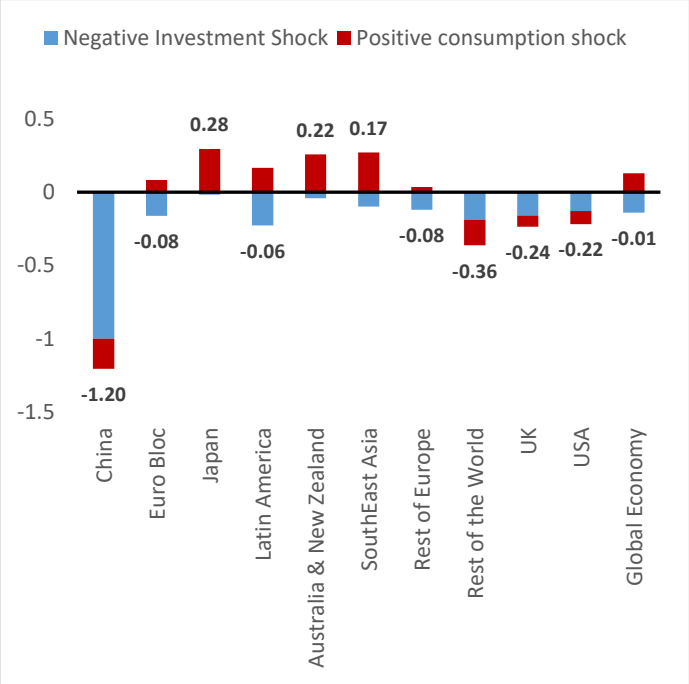
Note: Graphs show the impulse response results to a one percent increase in China's consumption cumulated over four quarters (one year), together with the corresponding 90th percent confidence bounds. The impact is interpreted in percentage.

3.3.3 Net Effects of the Transition to a Consumption-Driven Economy

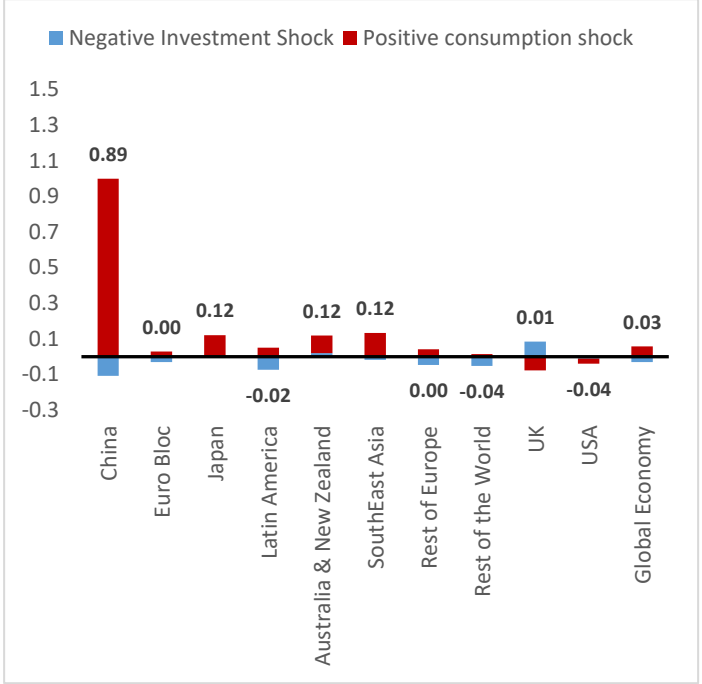
The rebalancing of China has been described as the decrease in investment, while consumption increases simultaneously for the economy to transition into a consumption-driven growth model. To proxy the rebalancing effect on the rest of the world, we aggregate the results of the effects of a decline in investment and the increase in consumption, on both regional investment and consumption after having normalized both shocks to 1 percent shocks. Figure 3.8 reports the net effect on investment and consumption following China's rebalancing. We can see again that Asia Pacific is mostly gaining from China's transition: Investment increases in Southeast Asia in total by 0.17 percent, while consumption increases by 0.12 percent. Japan, Australia, and New Zealand also register increases in both investment and consumption in total. Meanwhile, for commodity exporters in Latin America and the rest of the world, the positive consumption shock is not enough to offset both the decline in investment and consumption following the negative investment shock. And while the impact on the Euro area's consumption sums up to zero after consumption and investment shocks, investment will still decline given that many countries in the Euro Area export investment goods. On an aggregate level, results show that global investment will decline by 0.01 percent, while consumption increases by 0.03 percent, which means that increase in consumption could possibly offset the decline in investment in the long-run.

Figure 3.8. Net effects of China's Rebalancing on Regional Consumption and Investment

a. Implications on Regional Investment



b. Implications on Regional Consumption



Note: Graph shows impulse response combined results of a 1 percent negative China Investment structural shock, and a 1 percent positive China consumption structural shock. The results are cumulated over four quarters (one year) and the impact is in percentage.

3.4 Conclusion

This research sets up a GVAR model for 34 countries (8 of which are included in the Euro region) over the period 1979Q1-2015Q4 using country-specific consumption and investment data instead of GDP data to analyze the impact of the rebalancing of China on the world. The model estimates the rebalancing of China by calculating the effect of a 1 percent decline in China's investment, followed by a 1 percent increase in China's consumption. As a robustness check, we use different bilateral flows channels and note that the results are generally homogeneous.

Our results draw the following conclusions: A 1 percent decline of China's investment reduces global investment by 0.15-0.2, global consumption by 0.03 percent, and pushes down commodity prices by 2 to 3 percent. Results show that the rebalancing itself has a more limited impact on financial markets, and that shocks transmit through the trade channel and commodity prices. In addition, regional spillovers indicate that while the rest of the world is negatively affected by the decline in investment and commodity prices, Asia and the Pacific rather benefit from the rebalancing, through appreciation of safe haven currencies, relocation of labor-intensive investment to Southeast Asia, and an increase in demand for consumption goods.

Our calculations also show that a 1 percent increase its consumption will raise in the first year global investment by 0.1-0.2 percent, and global consumption by around 0.05 percent, thus offsetting a part of the negative impact of China's transition from investment towards consumption. However, the impact of the rebalancing is still borne on commodity exporters

and producers of investments goods, for whom the positive impact of the consumption increase does not offset the decline in investment. Declines may also have been driven by uncertainty, capital outflows, and an increase in volatility in financial markets.

In terms of policy implications, countries which are commodity exporters and exporters of investment goods could offset some of the negative impact of the rebalancing by diversifying their exports bases. They could further benefit from China's increased consumption demand by switching towards more production of consumption goods. Additionally, more countries in Southeast Asia should shift towards the labor-intensive production of goods to reduce negative spillovers, and to take advantage of production space left by China as it moves up the global value chain.

3.5 Appendix

Table A3.1: F-Statistics for Testing the Weak Exogeneity of the Country-Specific Foreign Variables, with **Investment**, Oil Prices, and the Price of Metal

Country	F test	Fcrit_0.05	Inv*	Dp*	Eq*	Ex*	R*	Poil*	Pmetal*
Argentina	F(1,122)	3.92	1.09	9.27*	0.05		14.77*	2.47	5.31*
Australia	F(2,131)	3.07	1.80	0.43	0.37		1.01	0.47	0.93
Brazil	F(2,121)	3.07	0.36	0.97	0.38		0.87	0.11	0.27
Canada	F(2,131)	3.07	0.78	1.50	2.01		0.31	1.43	0.83
Chile	F(2,131)	3.07	3.12	0.66	2.34		0.52	0.21	2.50
China	F(2,121)	3.07	0.23	0.15	1.12		0.80	1.13	
Ecuador	F(2,125)	3.07	1.06	2.67	0.48		1.04	0.28	1.03
Euro	F(3,130)	2.67	2.41	2.28	1.05		1.24	0.57	1.45
India	F(1,132)	3.91	0.07	0.76	3.51		0.51	1.31	0.63
Indonesia	F(2,132)	3.06	2.63	0.73	0.31		0.47	0.14	0.02
Japan	F(2,131)	3.07	2.58	1.04	0.18		0.96	0.07	0.65
Korea	F(3,130)	2.67	1.26	0.33	0.47		0.21	0.47	0.04
Malaysia	F(1,120)	3.92	1.37	0.26	0.29		1.09	0.00	0.39
Mexico	F(2,132)	3.06	0.93	0.08	0.37		0.17	0.16	0.90
New Zealand	F(2,131)	3.07	1.66	4.24*	0.63		6.59*	3.67*	0.21
Norway	F(2,132)	3.06	1.04	1.96	0.25		3.31*	3.90*	1.57
Peru	F(3,120)	2.68	3.51*	1.46	0.72		1.63	2.35	0.51
Philippines	F(3,130)	2.67	0.53	0.07	1.16		0.39	0.88	1.54
Singapore	F(3,123)	2.68	0.61	1.33	2.30		0.66	1.83	0.40
South Africa	F(3,123)	2.68	0.94	1.04	2.06		1.09	2.36	0.94
Sweden	F(3,130)	2.67	2.06	0.93	0.66		0.96	0.18	0.60
Switzerland	F(2,124)	3.07	0.23	1.07	0.40		0.10	0.26	0.15
Thailand	F(3,123)	2.68	0.35	1.08	1.03		0.85	1.78	0.13
Turkey	F(1,126)	3.92	0.01	0.29	0.03		0.22	1.36	0.02
United Kingdom	F(2,131)	3.07	1.02	0.26	4.18*		2.00	0.24	0.22
United States	F(2,134)	3.06	0.36			2.62			3.39*
Venezuela	F(1,122)	3.92	2.01	1.94	0.01		3.98	0.22	0.00

Note: * denotes statistical significance at the 5% level.

Table A3.1: F-Statistics for Testing the Weak Exogeneity of the Country-Specific Foreign Variables, with **Consumption**, Oil Prices, and the Price of Metal

Country	F test	Fcrit_0.05	Cons*	Dp*	Eq*	Ex*	R*	Poil*	Pmetal*
Argentina	F(1,122)	3.92	0.94	7.58*	0.00		12.34*	2.08	4.23
Australia	F(1,132)	3.91	1.59	0.03	0.16		0.40	0.32	0.11
Brazil	F(3,131)	2.67	0.42	9.17*	1.88		0.05	0.33	0.27
Canada	F(2,131)	3.07	0.88	0.13	0.33		0.82	0.20	1.27
Chile	F(3,130)	2.67	2.09	3.49*	0.93		1.00	1.32	0.70
China	F(2,121)	3.07	0.73	2.10	0.68		1.17	0.21	
Ecuador	F(1,126)	3.92	1.10	1.69	1.75		2.34	0.39	3.34
Euro	F(3,130)	2.67	0.52	0.79	0.31		0.57	0.59	1.17
India	F(1,132)	3.91	0.08	4.17*	2.19		2.16	0.01	0.52
Indonesia	F(3,131)	2.67	1.04	0.85	0.13		3.24	0.46	0.36
Japan	F(3,130)	2.67	1.18	0.42	0.13		0.36	0.02	0.91
Korea	F(3,130)	2.67	0.71	0.22	1.18		1.30	0.67	1.27
Malaysia	F(3,123)	2.68	0.15	0.70	2.91*		0.80	1.11	1.62
Mexico	F(2,132)	3.06	0.10	1.57	1.73		0.73	1.01	0.29
New Zealand	F(2,131)	3.07	1.37	2.00	1.23		3.81*	2.57	1.95
Norway	F(2,132)	3.06	3.66*	4.30*	0.05		0.97	2.52	0.26
Peru	F(3,122)	2.68	0.73	1.10	0.42		2.29	2.56	1.02
Philippines	F(3,130)	2.67	0.70	0.36	0.95		0.52	0.12	0.39
Singapore	F(3,123)	2.68	1.00	0.65	2.77		0.18	1.08	2.07
South Africa	F(3,123)	2.68	0.41	0.24	3.50*		0.64	2.65	3.15*
Sweden	F(2,131)	3.07	0.69	1.75	0.98		0.67	0.80	0.79
Switzerland	F(3,130)	2.67	0.21	0.22	1.46		0.54	1.11	0.04
Thailand	F(2,124)	3.07	0.71	0.99	1.22		0.91	0.02	0.44
Turkey	F(2,132)	3.06	0.08	0.28	0.82		0.15	1.46	0.69
United Kingdom	F(1,132)	3.91	0.49	0.03	4.20*		4.68*	1.00	0.00
United States	F(2,134)	3.06	0.73			1.31			1.15
Venezuela	F(3,120)	2.68	2.35	1.66	0.58		2.34	0.23	1.68

Note: * denotes statistical significance at the 5% level

CHAPTER 4. SPILLOVERS FROM CHINA TO THE MIDDLE EAST AND NORTH AFRICA[32]

4.1 Introduction

The literature related to the rebalancing of China has largely focused on its impact on advanced economies and selected emerging markets. Lower commodity prices and a decline in global growth are two of the various channels through which countries could be affected by the transition of China: the IMF's April 2016 Regional Economic Outlook reported that the G20's growth could be reduced by 0.25 percentage points, following a 1 percent decline in China's growth.

However, few studies have addressed the potential impact of China's transition on countries in the Middle East and North Africa (MENA) countries, and the Gulf Cooperation Council (GCC). One notable exception is Cashin, Mohaddes and Raissi (2012), who compute inward and outward spillovers on the MENA region from systemic countries. How are importers and exporters of oil in the region impacted by the change in China's business model? We deem this a relevant question, given the macroeconomic importance of the region to the rest of the world, and the role it plays in the production and supply of natural resources. We thus employ a Global VAR (GVAR) model to estimate the impact of China's slowdown on the MENA region and the rest of the world. Spillovers from macroeconomic shocks are captured for other

[32] The contents of this chapter are original to the author of this thesis, and results based on the analytical exercises were incorporated in the IMF's October 2016 Regional Economic Outlook (REO)'s Chapter 4, entitled "How Will China's Rebalancing Affect the Middle East and Central Asia?" (page 37-38).

countries through the inclusion of foreign variables, which are weighted averages of other countries' variables. We create different sets of foreign variables, each time according to different time periods, to investigate how the linkages between China, the MENA and GCC regions have evolved over time. In addition, we look at how those linkages have evolved with regards to other systemic countries as well. As such, we compare the impact of the magnitude of a China shock to the magnitude of shocks from the Euro Area and the United States.

We contribute to the existing literature in two ways: first, we extend the original dataset by Cashin *et al* (2012)[33] which assesses the GDP-to-GDP comparison of shocks, to 2014Q4, so that it encompasses the global financial crisis. Then, we also create a dataset for the countries in our model (notably the MENA and GCC regions), using country-specific consumption and investment data. We use that dataset to model the impact of transition of China from an investment-driven model to a consumption-driven economy. More specifically, we compute a negative investment shock to China's investment, followed by a positive shock to its consumption, and look at the cumulative impact of the shocks on the MENA region.

Our results show, when estimating our GVAR for the two fixed trade weight years 1996-1998 and 2012-2014, that China's linkages with the MENA have grown, which results in a larger magnitude for the propagation of shocks. The same exercise reveals that the linkages between the USA and the MENA, and the Euro Area and the MENA, have shrunk, allowing for the impact of the shocks to be of smaller magnitude. However, the results show that a negative output shock from the United States is still larger in magnitude than a China shock or a Euro

[33] The original dataset by Cashin *et al* (2012) ends at 2008Q1.

shock. We attribute this to the US' systemic role in the oil market. Finally, the results of the rebalancing exercise show that a decrease in investment in China also lowers investment in the MENA region through the oil channel, by pushing down oil prices. This could be because a decline in investment in China lowers the demand for natural resources, including oil and gas. However, an increase in consumption demand slightly offsets the adverse effects from the decline in oil prices, especially for oil importers, who benefit from the now-cheaper imports, and the increase in China's import demand for consumption goods.

The rest of this chapter is organized as follows. Section 4.2 presents the data used and the model specifications. Section 4.3 presents the empirical results of the GDP-to-GDP spillovers from China, the US, and the Euro Area to the MENA region. Section 4.4 presents the empirical results from China's rebalancing proxy. Section 4.5 concludes.

4.2 Empirical Estimation

4.2.1 Data

The original dataset used by Dees and al. (2007) includes 33 countries. This chapter extends the dataset to include 47 countries, 13 of which are countries in the Middle East and North Africa (MENA) region. The model thus spans from 1979Q1 to 2014Q4, and comprises of 18 oil exporting countries, 11 of which are OPEC member countries. Conflict areas like Libya, Syria and Iraq are left out of the analysis. Venezuela is also not included in the analysis.

Two region blocs are created in the estimation of this model. The first is the Euro Area bloc, which groups the 8 countries that joined the Euro area in 1999: Austria, Belgium, Finland,

France, Germany, Italy, the Netherlands, and Spain. The second area bloc is for the GCC region, and includes the following 6 countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. Grouping the Gulf countries does not go against economic reason: first, all said countries have their currencies pegged to the U.S. dollar. In addition, the GCC countries have fostered similar policies to further financial and trade integration in the region. The time series variables for these regions are constructed as weighted averages of the domestic variables, based on the Purchasing Power Parity GDP weights, for the averaged period between 2012-2014. Table 4.1 lists the countries included in our GVAR model.

Table 4.1. Countries included in the GVAR model

MENA oil exporters	**Systemic Countries**	**Other Oil Exporters**
Algeria	China	Canada
GCC countries:	Euro Area:	Ecuador
Bahrain	*Austria*	Indonesia
Kuwait	*Belgium*	Mexico
Oman	*Finland*	Nigeria
Qatar	*France*	Norway
Saudi Arabia	*Germany*	Pakistan
United Arab Emirates (UAE)	*Italy*	
Iran	*Netherlands*	
	Spain	**Latin America**
	Japan	Argentina
	United Kingdom	Brazil
MENA oil importers	United States	Chile
Egypt		Peru
Jordan	**Emerging Asia**	
Morocco	Korea	**Rest of the World**
Tunisia	Malaysia	Australia
Turkey	Philippines	India
	Singapore	New Zealand
	Thailand	South Africa
		Sweden
		Switzerland

Note: The countries in Italics are included in region blocs.

Meanwhile, we use the following country-specific macro-variables for our analysis[34]: Real GDP (GDP_{it}), equity prices (EQ_{it}), CPI inflation (CPI_{it}), the short-term interest rate (SR_{it}), the long-term interest rate (LR_{it}), and the nominal effective exchange rate ($NEER_{it}$)[35].

Real GDP series are taken from the IMF IFS, and missing values are filled from the IMF WEO estimations database. GDP values which are available only in annual frequency are interpolated into quarterly frequency using the Chow-Lin interpolation method, based on industrial production indices. Data for CPI inflation, interest rates and the exchange rate are also obtained from the IMF IFS. The exchange rate used is the nominal effective exchange rate, while equity prices are based on Bloomberg's MSCI country-specific index.

Moreover, two global variables are included in our model: The first is the price of oil per barrel in US dollars ($Poil$), obtained from the IMF IFS database, and the second is the total quantity of oil in barrels produced world-wide (Qoil), obtained from the OPEC database.

The domestic variable series used are then seasonally adjusted using EViews' Census X13, and constructed as such:

Real GDP: $y_{it} = \ln \frac{GDP_{it}}{CPI_{it}}$

Inflation: $dp_{it} = \ln(CPI_{it}) - \ln(CPI_{i,t-1})$

Equity prices: $eq_{it} = \ln(\frac{EQ_{it}}{CPI_{it}})$

The exchange rate: $ex_{it} = \ln(NEER_{it})$

The short − term interest rate: $r_{it} = 0.25 * ln(1 + SR_{it}^{s}/100)$

[34] The Data appendix offers more detailed information on the variables used.

[35] We opt to omit the long-term interest rates series as it is not publicly available for many countries, and it is recommended to include only six domestic variables for each country vector for the GVAR to remain stable.

The long − term interest rate: $lr_{it} = 0.25 * ln(1 + LR_{it}^{s}/100)$

As for the global variables, they are also used in log terms:

Price of oil: $poil = \ln(Poil)$

Quantity of oil: $Qoil = \ln(Qoil)$

4.2.2 VARX Specification

Excluding the United States and the GCC models, every other country-specific model is set up to include the following respective 6 domestic (endogenous) variables: Real GDP (Y_{it}) , CPI inflation (dp_{it}) , equity prices (eq_{it}), the exchange rate (ex_{it}), and short-term interest rates (r_{it}), and long-term interest rates (lr_{it}). The following 5 foreign (weakly exogenous) variables are then constructed and included in each country VARX*: y_{it}^{*} , eq_{it}^{*} , dp_{it}^{*}, r_{it}^{*} and lr_{it}^{*}. The foreign exchange rate variable ex_{it}^{*} is not included.

The US VARX* vector is set up to include all the domestic variables except for the exchange rate, but only the following foreign variables are added to the VARX: y_{it}^{*} , dp_{it}^{*} and ex_{it}^{*}. Finally, the price of oil global variable enters the US VARX* as an endogenous variable, given that the United States is the largest consumer of oil in the world, thus accounting for the largest share of oil demand and consequently controlling oil prices. This is standard in GVAR literature, which sets the US vector to reflect economic dominance.

Meanwhile, the GCC VARX* bloc is set up as the rest of the other countries, except that the domestic interest rate created for the region is not included. In addition, the world quantity of oil global variable is included as endogenous in its regional VARX bloc. This is because the GCC region controls for a very large portion of oil supply: by 2015, the GCC region accounted for 20 percent of world production of oil, and 50 percent of OPEC oil production.

The lag orders for the domestic and foreign variables are determined using the Akaike Information Criterion (AIC). Consistent with GVAR literature, we set the maximum lag orders to $p_{max} = 2$ and $q_{max} = 1$. The number of cointegrating relations is next determined for each country VARX*, and the rank orders obtained using Johansen's trace statistics. The estimated VARX* orders and their corresponding ranks are reported in Table 4.2.

Table 4.2. Lag Orders of the Country-Specific VARX*(p,q) Models Together with the Number of Cointegrating Relations (r)

Country	VARX* Order		Cointegrating Relations (r_i)	Country	VARX* Order		Cointegrating Relations (r_i)
	p_i	q_i			p_i	q_i	
Algeria	2	1	1	New Zealand	2	1	3
Argentina	2	1	1	Nigeria	2	1	2
Australia	1	1	5	Norway	2	1	1
Brazil	2	1	2	Pakistan	2	1	2
Canada	2	1	4	Peru	2	1	3
Chile	2	1	3	Philippines	2	1	3
China	1	1	2	Singapore	1	1	1
Ecuador	2	1	2	South Africa	2	1	4
Egypt	2	1	0	Sweden	2	1	3
Euro	1	1	3	Switzerland	1	1	3
GCC	2	1	3	Thailand	2	1	3
India	1	1	1	Tunisia	2	1	0
Indonesia	2	1	2	Turkey	2	1	2
Iran	1	1	1	United Kingdom	2	1	2
Jordan	2	1	2	United States	2	1	3
Japan	2	1	3	New Zealand	2	1	3
Korea	2	1	4	Nigeria	2	1	2
Malaysia	2	1	1	Norway	2	1	1
Mexico	1	1	2	Pakistan	2	1	2
Morocco	2	1	2				

Note: p_i and q_i refer to the lag order of the domestic and foreign variables respectively and are determined using the Akaike Information Criterion (AIC), with the maximum lag for order for the domestic variables set to 2, and the maximum lag order for foreign variables set to 1. The number of cointegrating relations (r_i) are determined using the trace statistic based on the 95% critical values from MacKinnon (1991) for all countries. Source: Author's estimations

4.2.3 Bilateral Flow Channels

We expect to see that China's trade linkages have evolved. This is because during the decade of 2000-2014, China's GDP grew at a pace of nearly 10 percent per year, making it a driver of world growth. China's growth boosted global trade and became the principal source of exports demand for 80 percent of world GDP[36]. The boom in infrastructure in China boosted demand for commodities, thus raising commodity prices and inducing positive spillovers to commodity exporters. To that extent, we can expect to see that trade linkages between China and the rest of the world evolved between 1979 and 2014. Tables 4.3.a and 4.3.b report the trade weights, computed by the GVAR model, between the MENA region and systemic countries for the periods 1996-1998 and 2012-2014.

The trade weights show us that the Euro Area was the main trading partner for most countries in the MENA region in 1996-1998, and specifically the countries of the Maghreb[37] (Algeria, Morocco, and Tunisia), and remains as such for 2012-2014. However, much of that trade weight has shifted towards China. For instance, China now accounts for 10 percent of Egypt's trade, versus a 3 percent trade weight for the period between 1996 to 1998. Furthermore, the trade weights show that most of the countries in the MENA region now trade more with China than with the United States. Again, Egypt's trade weight with the US for the period between 1996 to 1998 is 19 percent, versus a current weight of 9 percent. Only for Morocco and Jordan do we see a higher trade weight for the US than for China. However, this may not necessarily

[36] IMF World Economic Outlook, October 2016.

[37] Countries of the Mashreq include Egypt, Lebanon, and Jordan. Countries of the Maghreb include Algeria, Morocco and Tunisia.

mean that larger shocks would be transmitted from China, given the United States' role in the oil market.

Table 4.3.a MENA Trade weights, 1996-1998

a- Averages between 1996-1998

	Algeria	China	Egypt	Euro	GCC	Iran	Jordan	Japan	Libya	Morocco	Pakistan	Tunisia	Turkey	UK	USA
China	**0.01**	**0.00**	**0.03**	**0.04**	**0.02**	**0.03**	**0.03**	**0.10**	**0.01**	**0.02**	**0.03**	**0.01**	**0.01**	**0.02**	**0.05**
Euro	**0.60**	**0.15**	**0.38**	**0.00**	**0.16**	**0.31**	**0.27**	**0.12**	**0.33**	**0.37**	**0.15**	**0.53**	**0.45**	**0.36**	**0.12**
GCC	**0.00**	**0.02**	**0.05**	**0.03**	**0.00**	**0.06**	**0.14**	**0.06**	**0.07**	**0.08**	**0.26**	**0.02**	**0.04**	**0.05**	**0.15**
Iran	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.03	0.04	0.00	0.01	0.00	0.00
Japan	0.02	0.27	0.04	0.07	0.12	0.15	0.06	0.00	0.02	0.02	0.06	0.01	0.03	0.04	0.11
Pakistan	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.05	0.00	0.03	0.04	0.07	0.03	0.04	0.00	0.01	0.02	0.04	0.01	0.00	0.00	0.01
United Kingdom	0.03	0.03	0.04	0.18	0.04	0.14	0.05	0.03	0.04	0.02	0.03	0.04	0.05	0.00	0.03
USA	**0.14**	**0.22**	**0.19**	**0.17**	**0.08**	**0.00**	**0.10**	**0.31**	**0.01**	**0.07**	**0.07**	**0.03**	**0.07**	**0.11**	**0.00**
Maghreb	**0.01**	**0.00**	**0.02**	**0.04**	**0.02**	**0.00**	**0.02**	**0.00**	**0.06**	**0.02**	**0.03**	**0.03**	**0.06**	**0.10**	**0.09**
Mashreq	**0.00**	**0.00**	**0.00**	**0.02**	**0.02**	**0.00**	**0.02**	**0.00**	**0.01**	**0.12**	**0.03**	**0.00**	**0.01**	**0.00**	**0.00**
MENA	**0.02**	**0.02**	**0.07**	**0.10**	**0.04**	**0.06**	**0.18**	**0.06**	**0.14**	**0.22**	**0.32**	**0.06**	**0.11**	**0.16**	**0.24**
Other Oil Exporters	0.05	0.05	0.02	0.10	0.21	0.03	0.04	0.08	0.04	0.09	0.06	0.13	0.04	0.12	0.29
Latin America	0.04	0.02	0.05	0.04	0.02	0.05	0.03	0.02	0.02	0.03	0.02	0.02	0.05	0.02	0.03
Emerging Asia	0.02	0.18	0.06	0.07	0.10	0.11	0.08	0.20	0.03	0.07	0.10	0.04	0.07	0.07	0.08
Rest of the World	0.02	0.06	0.10	0.18	0.13	0.09	0.11	0.07	0.36	0.04	0.07	0.12	0.09	0.11	0.04

Table 4.3.b MENA Trade weights, 2012-2014

b- Averages between 2012-2014

	Algeria	China	Egypt	Euro	GCC	Iran	Jordan	Japan	Libya	Morocco	Pakistan	Tunisia	Turkey	UK	USA
China	**0.08**	**0.00**	**0.10**	**0.13**	**0.07**	**0.29**	**0.10**	**0.24**	**0.05**	**0.06**	**0.18**	**0.04**	**0.09**	**0.06**	**0.14**
Euro	**0.49**	**0.14**	**0.27**	**0.00**	**0.20**	**0.07**	**0.14**	**0.08**	**0.26**	**0.35**	**0.08**	**0.39**	**0.33**	**0.38**	**0.12**
GCC	**0.01**	**0.06**	**0.14**	**0.05**	**0.00**	**0.24**	**0.31**	**0.13**	**0.06**	**0.10**	**0.32**	**0.03**	**0.05**	**0.05**	**0.13**
Iran	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.03	0.00	0.04	0.00	0.00
Japan	0.02	0.11	0.03	0.03	0.10	0.05	0.02	0.00	0.00	0.01	0.02	0.01	0.02	0.02	0.06
Pakistan	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.04	0.01	0.06	0.05	0.05	0.11	0.04	0.00	0.08	0.04	0.02	0.03	0.00	0.01	0.01
United Kingdom	0.06	0.03	0.03	0.12	0.02	0.00	0.01	0.01	0.01	0.02	0.01	0.06	0.02	0.00	0.02
USA	**0.08**	**0.18**	**0.09**	**0.13**	**0.05**	**0.00**	**0.11**	**0.16**	**0.02**	**0.08**	**0.02**	**0.03**	**0.05**	**0.07**	**0.00**
Maghreb	**0.03**	**0.01**	**0.04**	**0.05**	**0.02**	**0.00**	**0.01**	**0.00**	**0.06**	**0.03**	**0.04**	**0.05**	**0.03**	**0.08**	**0.10**
Mashreq	**0.01**	**0.00**	**0.01**	**0.03**	**0.02**	**0.00**	**0.03**	**0.00**	**0.03**	**0.09**	**0.02**	**0.01**	**0.01**	**0.00**	**0.00**
MENA	**0.05**	**0.07**	**0.19**	**0.13**	**0.03**	**0.24**	**0.35**	**0.13**	**0.15**	**0.22**	**0.37**	**0.09**	**0.10**	**0.13**	**0.23**
Other Oil Exporters	0.04	0.08	0.03	0.11	0.18	0.02	0.03	0.07	0.08	0.06	0.09	0.14	0.05	0.11	0.26
Latin America	0.06	0.05	0.05	0.04	0.07	0.02	0.03	0.02	0.07	0.03	0.01	0.02	0.06	0.04	0.06
Emerging Asia	0.03	0.20	0.05	0.07	0.09	0.09	0.05	0.19	0.04	0.11	0.09	0.06	0.10	0.05	0.06
Rest of the World	0.04	0.11	0.10	0.17	0.13	0.11	0.11	0.09	0.24	0.03	0.07	0.12	0.13	0.12	0.05

Note: the trade weights are computed as shares of the sum of imports and exports by the GVAR model. The trade weights are read by column. Not including the MENA region (which accounts for the GCC, Mashreq, and Maghreb weights), the trade weights sum to 1.

4.3 GDP-to-GDP Spillovers

In this section, we investigate whether the growing trade linkages between China and the MENA have resulted in the weakening of the impact of the Euro Area and the United States on the region. We thus compare the magnitude of shocks to the MENA region by computing a negative shock to real GDP for the United States, the Euro Area, and China respectively. The shocks are carried out using different time weights (1996-1998), and (2012-2014), and through the bilateral trade channel.

4.3.1 Shock to China's GDP

Given China's systemic role in global trade and world growth, one can expect spillovers to other regions and commodity prices in case of a shock. A slowdown in China is likely to affect the MENA region through the oil channel: a reduction in oil demand will negatively impact oil exporters. Secondary effects may be incurred by oil importers, who rely on remittances from the MENA oil exporters. We proxy China's slowdown by a negative shock to China's output. To estimate orthogonal impulse responses, we identify a shock to real GDP by combining sign restrictions with the use of a recursive Cholesky scheme. Dees *et al.* (2007) employed structural impulse responses through a Cholesky factorization schemes for the specification of shocks.

4.3.1.1 Identification of Shocks

Following Dees *et al.* (2007), we adopt the following variable ordering as an identification scheme: short-term interest rate, the exchange rate, inflation, and real output. We experiment with a few variable orderings and our results are largely robust. We construct the impulse response functions following Eickmeyer and Ng (2015)'s approach, which combines the structural generalized impulse responses with imposing sign restrictions for the identification of shocks. The sign restrictions imposed are based on economically accepted empirical observations. As such, to observe the spillover of the shocks to the MENA region, we impose on China's cointegrating vector the following sign restrictions, to identify the negative impact of China's slowdown on oil prices.

In fact, there is a growing body of literature which explains that China has a direct impact on oil prices, and especially during the 2014-2016 oil price collapse episode. For instance, the IMF's 2016 October World Economic Outlook suggests that China's slowdown accounts for one third of the decline in oil prices. Beirne et al (2013) finds that China's GDP growth adds a premium to the price of oil which increases over time. The World Bank (2018) finds that the decline in China's demand for oil played a role in the decline of oil prices. As such, sign restrictions are imposed on China's cointegrating vector to highlight its impact on the price of oil, according to table 4.4.

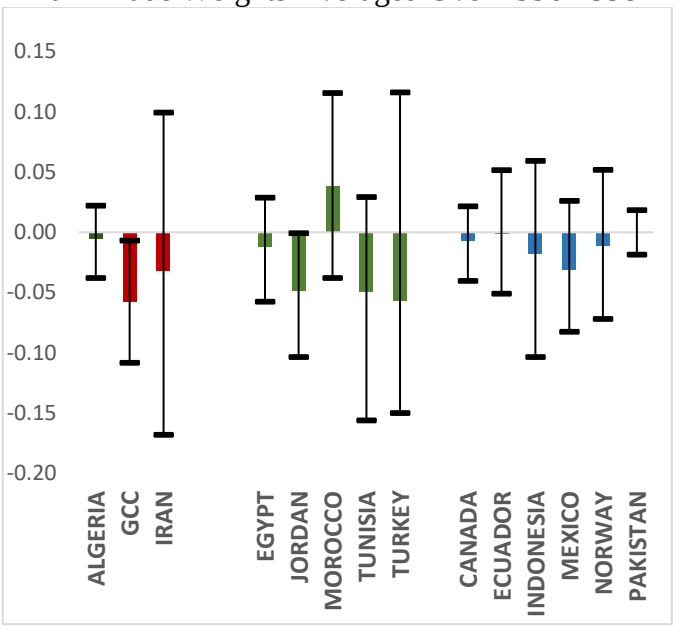
Table 4.4. Sign Restrictions on China's Cointegrating Vector

CV1	y_{it}	dp_{it}	e_{it}	r_{it}	y_{it}^{*}	dp_{it}^{*}	r_{it}^{*}	lr_{it}^{*}	Poil	Qoil
Sign restrictions	-	0	0	0	0	0	0	0	-	0

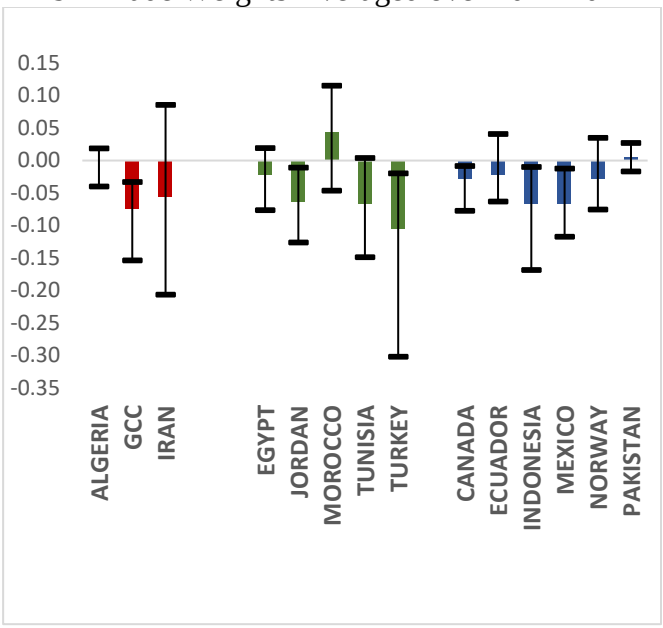
Figure 4.1 reports the results of the GVAR model, following a shock to China's output with trade weights computed for 1996-1998, and trade weights computed for 2012-2014.

Figure 4.1. Impulse responses of Output to a 1 Percent Negative Shock to China GDP, Four Quarters Cumulated, through the Trade Channel

a- Trade Weights Averaged Over 1996-1998



b- Trade Weights Averaged over 2012-2014



Note: The columns represent the annual (cumulated over four quarters) impulse response results of country-output following a one percent reduction in China's real GDP, with the bars corresponding to the 90th and 10th percent confidence bounds. The impact is in percentage.

The results reflect on China's increased integration with the MENA region. Using the trade weights averaged over 1996-1998, the 1% negative shock to China's output yields a decline in the GCC's output by 0.06% percent, versus a 0.03% decline in Iran's GDP, a 0.05% decline in Jordan and Tunisia's GDP respectively, and a 0.06% cut in Turkey's GDP. Figure 4.1.b shows that the shock becomes bigger (0.08 percent) and remains statistically significant on a yearly horizon for the GCC countries using the 2012-2014 trade weights. Meanwhile, the magnitude

of the shock also increases to -0.1 percent for Tunisia, Jordan and Turkey, and -0.06 percent to Iran. Moving on other oil exporters, we see that the impact of the shock also grows for them, and specially for Ecuador, Indonesia, and Mexico. While the growth in the magnitude of the shock can be explained by geographical proximity for Indonesia, it can be attributed to the increase in trade integration for the countries in Latin America, whose trade linkages especially developed with China after the subprime financial crisis (Cesa-Bianchi et Al, 2011).

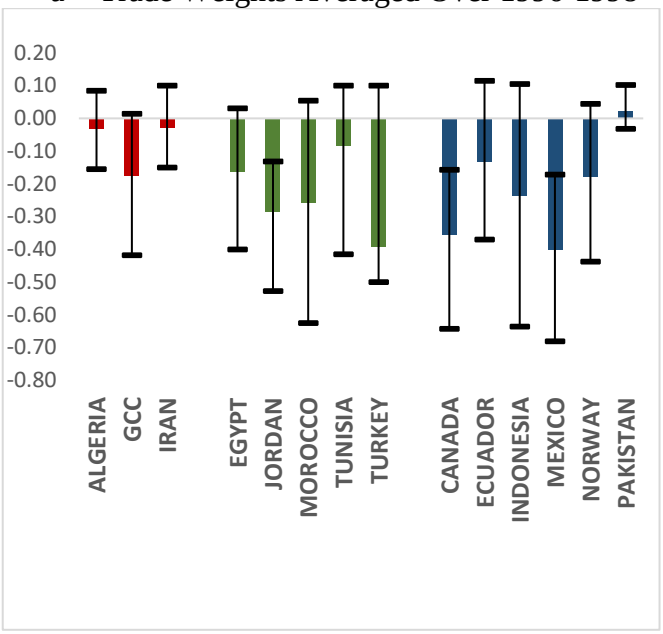
4.3.2 Shock to the USA's GDP

The United States has long established its systemic importance on the global economy. The extent of its systemic importance was brought to light during the subprime financial crisis, as spillovers from the financial system, the slowdown in US growth, and the consequences of monetary policies adopted propagated through different channels to the rest of the world. Trade linkages between the United States and the MENA region are strong, counting for 23 percent of total trade of the MENA region. Though these linkages have declined by 1 percent since 1996-1998, they remain the strongest linkages for the MENA region in total. In addition, the US' position in the commodity markets is crucial: as the single largest consumer of oil, it has an immediate impact on oil prices. Therefore, we can also assume spillovers to oil exporters through the oil channel as well.

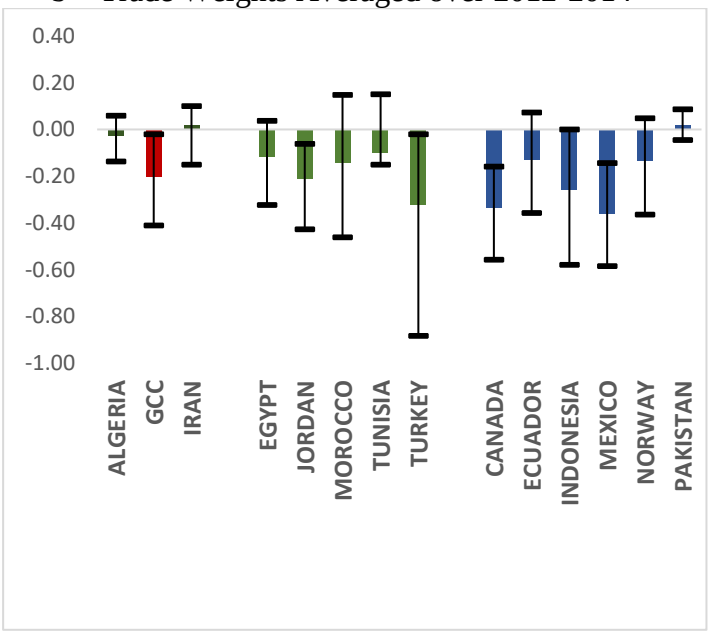
Figure 4.2 reports the result of our GVAR estimations for a one percent negative shock to US real GDP, using the trade weights averaged over the periods 1996-1998 and 2012-2014.

Figure 4.2. Impulse responses of Output to a 1 Percent Negative Shock to US GDP, Four Quarters Cumulated, through the Trade Channel

a- Trade Weights Averaged Over 1996-1998



b- Trade Weights Averaged over 2012-2014



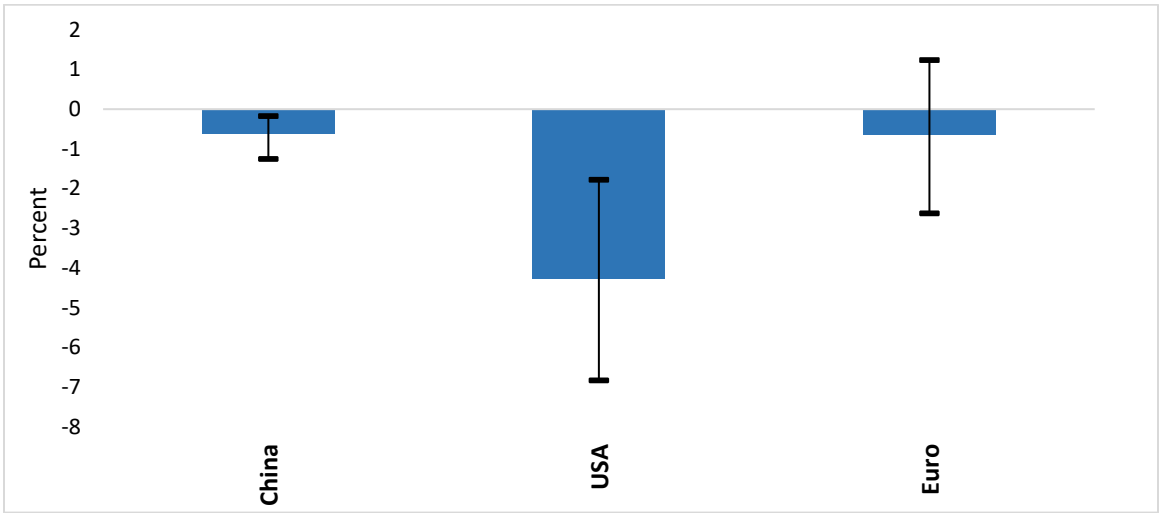
Note: The columns represent the annual (cumulated over four quarters) impulse response results of country-output following a one percent reduction in US real GDP, with the bars corresponding to the 90th and 10th percent confidence bounds. The impact is in percentage.

A shock to US GDP has considerably larger consequences on the MENA region and other oil exporters, due its heavy reliance on oil exports. Using trade weights averaged 1996-1998, a 1 percent decline in US GDP yields a decrease in the GCC's GDP by -0.17 percent, while output drops by 0.16 percent in Egypt, and by 0.29 percent in Jordan, 0.26 percent in Morocco, and 0.39 percent in Turkey. However, results using trade weights averaged over the years 2012-2014 suggest that, while the magnitude of a US shock remains much larger than that of a China shock, it is smaller than that using 1996-1998 trade weights. For instance, Egypt's GDP drops by 0.12 percent following a US shock using the 2012-2014 trade weights, while Morocco's drops by 0.14 percent. Furthermore, Jordan's GDP declines by 0.21 percent (versus a 0.29 percent using earlier weights), and Turkey's output drops by 0.32 percent.

Similarly, results indicate that the magnitude of the shock also becomes smaller for other oil exporters and systemic economies as you switch trade weights from 1996-1998 to 2012-2014. For instance, the magnitude of the shock on output drops from 0.36 percent to 0.34 percent for Canada, from -0.21 percent to -0.16 percent for the Euro area, and from -0.40 to -0.36 percent for Mexico.

The magnitude of spillovers from the US shock compared a shock to China (or the Euro Area) comes from the impact of the US on oil prices. Figure 4.3 presents the responses of oil prices to a shock from US, China, and Euro GDP respectively. We can see that while a Euro shock is not statistically significant on oil prices, a one percent negative shock to China's output will push down oil prices by 0.65 percent, while a one percent negative shock to US GDP will decrease oil prices by more than 4 percent.

Figure 4.3. Impulse responses of Oil Prices to a 1 Percent Negative Shock to US, China, and Euro GDP, Four Quarters Cumulated



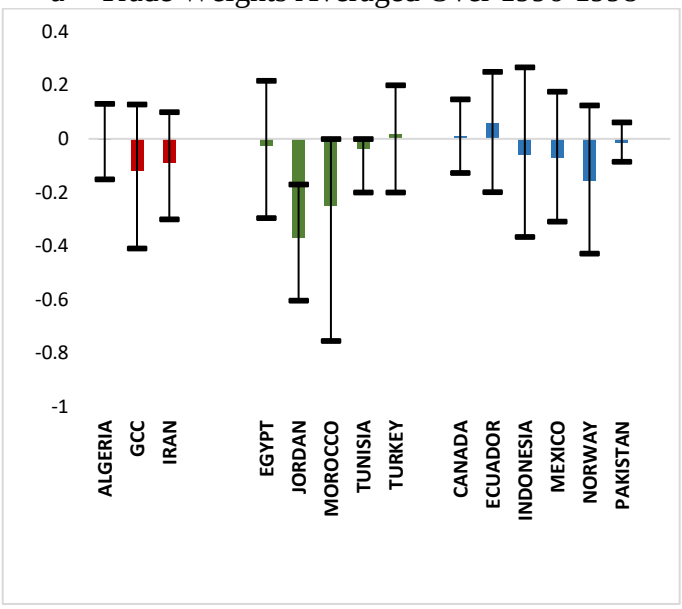
Note: The columns represent the annual (cumulated over four quarters) impulse response results of oil prices following a one percent reduction in US real GDP, China real GDP, and Euro Real GDP, with the bars corresponding to the 90th and 10th percent confidence bounds. The impact is in percentage.

4.3.3 Shock to the Euro Area's GDP

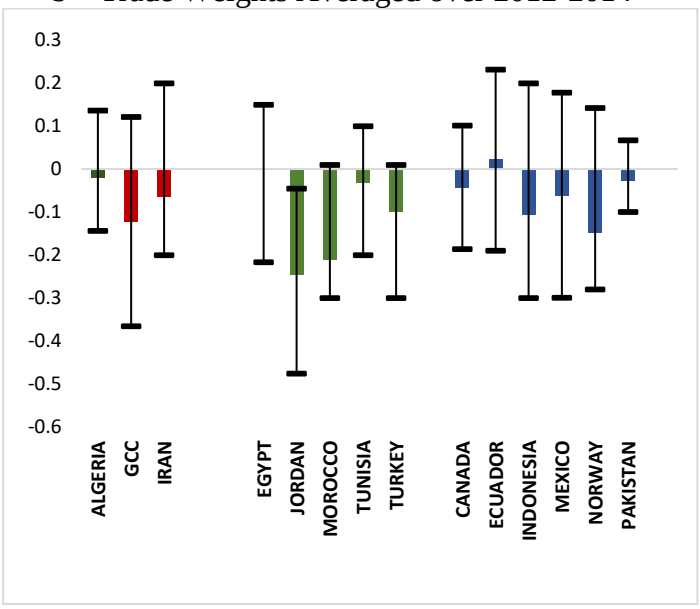
Trade linkages with Europe remain strong in the MENA region, though they have been declining. Indeed, the impact of shocks has also been gradually decreasing. Looking at figure 4.4.a, one negative percent structural shock to the Euro bloc's GDP reduced Jordan's GDP by about 0.4 percent during the period 1996-1998, whereas it reduces Jordan's GDP by 0.2 percent during the period 2012-2014. In addition, while a negative shock to the Euro Area has a statistically significant impact on North African countries like Tunisia and Morocco using 1996-1998 trade weights, results show that it does not affect them in a statistically significant manner anymore, as shown by the impulse response results for trade weights 2012-2014.

Figure 4.4 Impulse responses of Output to a 1 Percent Negative Shock to Euro GDP, Four Quarters Cumulated, through the Trade Channel

a- Trade Weights Averaged Over 1996-1998



b- Trade Weights Averaged over 2012-2014



Note: The columns represent the annual (cumulated over four quarters) impulse response results of country-output following a one percent reduction in Euro Area real GDP, with the bars corresponding to the 90th and 10th percent confidence bounds. The impact is in percentage.

4.4 Impact of China's Rebalancing on the MENA Region

In this section, we model a proxy for China's rebalancing from an investment-driven economy to a consumption-driven one to study its impact on the MENA region. We use country-specific consumption and investment data instead of real GDP data, to model the rebalancing effects of China.

4.4.1 Data and VARX Setup

For this exercise, we replace real GDP series with two sub-series: investment (Inv_{it})and consumption ($Cons_{it}$). Investment represents the gross capital formation for each country, while consumption is the sum of private and public consumption[38]. Data for consumption and investment are obtained from the IMF's World Economic Outlook (WEO) database, while high frequency indicators data are obtained from the IMF IFS, the CEIC, and Haver Analytics. Both variables are computed as such:

$$\text{Investment: } INV_{it} = \ln \frac{Inv_{it}}{CPI_{it}}$$

$$\text{Consumption: } CONS_{it} = \ln \frac{Cons_{it}}{CPI_{it}}$$

[38] For countries where the data is not available on a quarterly basis, we use the Chow-Lin method to interpolate data from an annual frequency to a quarterly frequency. The high-frequency indicator used to interpolate investment is the industrial production index of a country. If unavailable, we use the manufacturing production index. For the MENA region, the most consistent production index is the manufacturing production index for crude oil. Meanwhile, consumption data is interpolated using high-frequency sales data. In the case where sales data is also unavailable, we base our interpolations on the credit to the private sector series

The five other variables which were used for assessing GDP-to-GDP spillovers are again here included: inflation, equity prices, the nominal effective exchange rate, short-term and long-term interest rates, and the price and world quantity of oil. Since it is recommended to include up to 6 domestic variables in the GVAR for the model to remain stable, we split our dataset into two sub-datasets. The first one includes investment data (along with the 5 other original variables), while the second includes consumption data and the remaining variables. Our GVAR datasets our then estimated for the same 47 countries used in section III, for the period of 1979Q1 to 2015Q4[39].

The VARX specifications are as follow: for every country other than the US, each country-specific model will include the following 6 domestic variables: Investment (Inv_{it}) (or consumption ($Cons_{it}$)), CPI inflation (dp_{it}) , equity prices (eq_{it}), the exchange rate (ex_{it}), short-term interest rates (r_{it}), and the long-term interest rates (lr_{it}). The following 6 foreign (weakly exogenous) variables are constructed using the chosen bilateral flows channel, and included in each country VARX*: inv_{it}^{*} ($cons_{it}^{*}$), eq_{it}^{*} , dp_{it}^{*}, $r_{it}^{*}$and lr_{it}^{*}, while the foreign exchange rate variable ex_{it}^{*} is omitted.

The US VARX vector is again set-up to reflect its dominance on the world economy: except for the exchange rate, all the domestic variables are included. Meanwhile, we only include the following foreign variables: inv_{it}^{*} (or $cons_{it}^{*}$), and ex_{it}^{*}. The price of oil global variable is again included as endogenous to the US VARX. As for the GCC VARX vector, we again do not include domestic interest rates, and specify the quantity of oil produced as an endogenous variable to it.

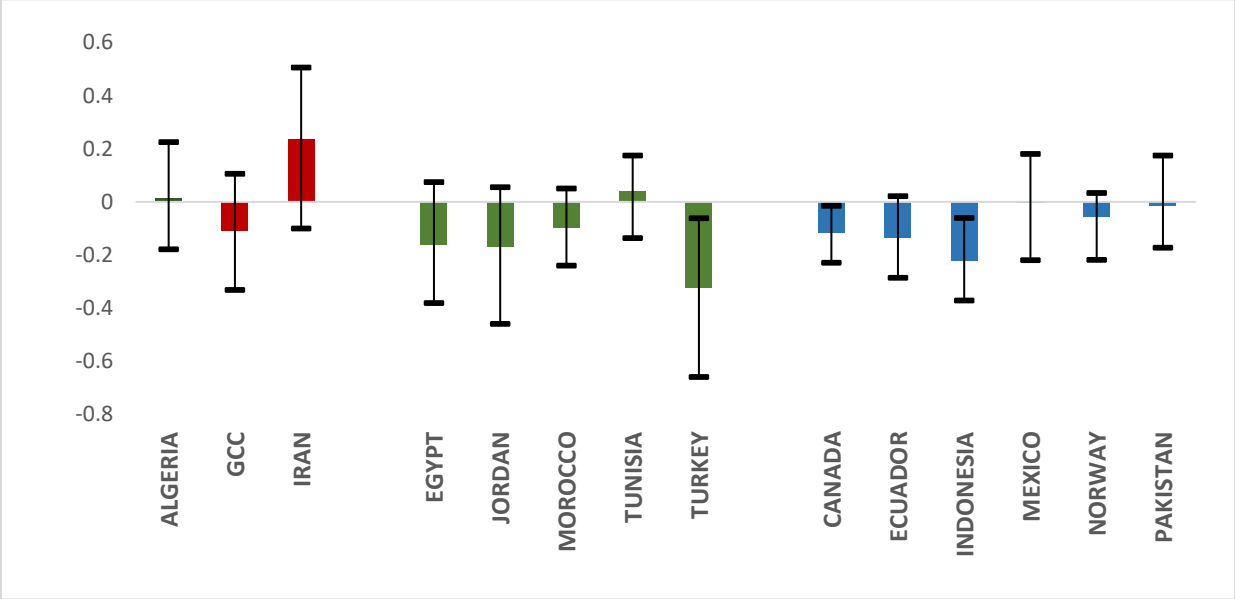
[39] Consumption data is not available for Libya and Peru, and so they are not included in the "Consumption" GVAR model estimations.

4.4.2 Dynamic Analysis

China's rebalancing is defined by its movement from an investment-driven economy to a consumption-driven one. We therefore proxy the rebalancing of China by a 1 percent reduction in its investment, followed by a 1 percent increase in its consumption. We measure the impact of those effects on China, the MENA region, and the rest of the world.

4.4.3 Negative Shock to China's Investment

Figure 4.5. Impulse responses of Investment to a 1 Percent Negative Shock to China's Investment, Four Quarters Cumulated, through the Trade Channel



Note: The columns represent the annual (cumulated over four quarters) impulse response results of country-investment following a one percent reduction of China's investment, with the bars corresponding to the 90th and 10th percent confidence bounds. The impact is in percentage.

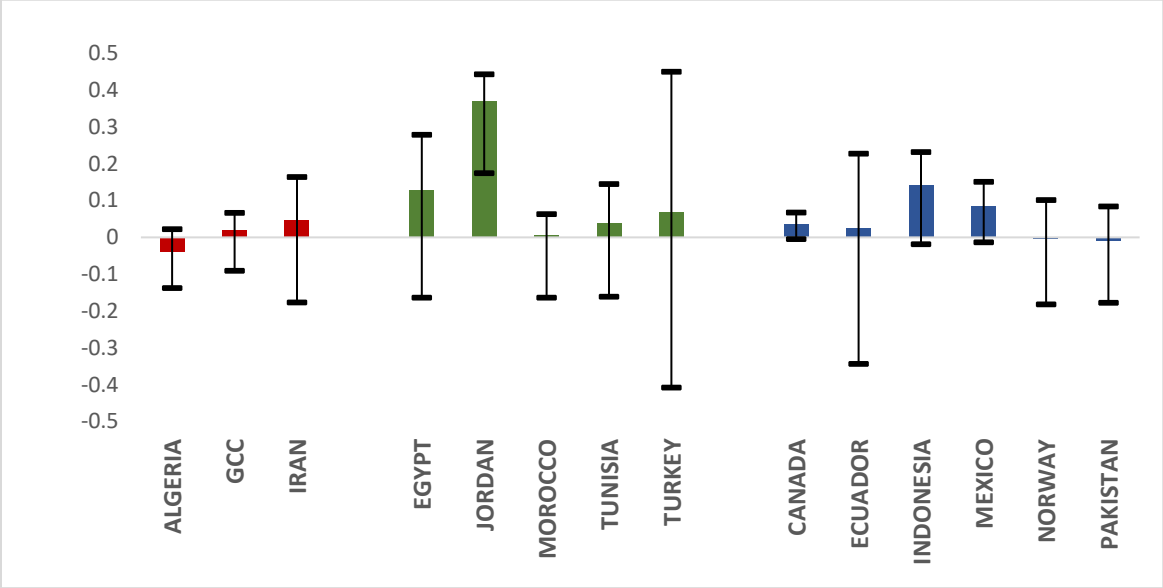
Figure 4.5 shows the results to a one percent impulse response shock to China's investment. Results show that, other than for Iran, the impact of a 1 percent decline in China's investment leads to reduction in investment in the MENA region, on oil exporters, and systemic economies. Investment declines for oil exporters, like the GCC and Libya, as well as oil importers. The

magnitude of the shock may be borne on oil importers twice: once from the reduction of country-specific investment in China due to its rebalancing, and then from second-round effects, due to the rebalancing's impact on the oil exporters.

4.4.4 Positive Shock to China's Consumption

Meanwhile, the second aspect of China's rebalancing is defined by the shift to a consumption-driven economy. We investigate the impact of this shift by computing a 1 percent positive impulse response shock to China's consumption. Figure 4.6 reports the results from a one percent impulse response shock to China's consumption. The results suggest positive spillovers to the MENA region, especially to oil importers. This could be due to the decline in oil prices, making imports cheaper. In addition, exporters of consumption goods would benefit from the increase of consumption demand from China, while countries who mainly import from China will additionally benefit from the depreciated Chinese Yuan. Consumption for oil exporters is not significantly affected, which suggests that they are more harmed by the decline in investment and oil prices, and must adjust accordingly.

Figure 4.6. Impulse responses of Consumption to a 1 Percent Positive Shock to China's Consumption, Four Quarters Cumulated, through the Trade Channel



Note: The columns represent the annual (cumulated over four quarters) impulse response results of country-consumption following a one percent increase in China's consumption, with the bars corresponding to the 90th and 10th percent confidence bounds. The impact is in percentage.

4.5 Conclusion

This research investigates the spillovers from China to the Middle East and North Africa by setting up two GVAR models for 47 countries (6 of which are included in the GCC bloc), using the bilateral trade flows channel. The first GVAR model runs from 1979Q1 to 2014Q4, and looks at GDP-to-GDP spillovers to the MENA region from China, the United States, and the Euro Area. The second GVAR model spans from 1979Q1 to 2015Q4, and uses country-specific consumption and investment data to estimate the direct impact of China's rebalancing on MENA and the rest of the world.

Our results draw the following conclusions from the first GVAR model: the linkages between China and the MENA region have deepened in the past decade, making for a propagation of shocks of larger magnitude from China to the MENA and GCC regions. Despite this finding, the results show that a negative shock to US GDP creates the largest spillover effects on the MENA and GCC regions. This is because, as results show, a decline in US GDP has the strongest impact on oil prices, compared to China and the Euro Area. In addition, while the propagation of shocks is stronger through the trade channel from China and the United States, spillovers from the Euro Area may be due to linkages of proximity and remittance flows to the MENA region.

Finally, turning on to spillovers from China's rebalancing, our results show that while the MENA region's investment is negatively affected from the decline in China's investment- as a decline in investment demand could push down demand for oil and gas and other infrastructure goods, and subsequently place downward pressures on oil prices- the results are not statistically significant for the main exporters of oil. This is in line with our initial results, which show that a negative shock from China is not as large or significant as from the USA. We also see that the MENA oil importers incur some positive spillovers on consumption, as imports become cheaper and China's import demand increases.

4.6 Appendix

Table A4: F-Statistics for Testing the Weak Exogeneity of the Country-Specific Foreign Variables.

Country	F test	Fcrit_0.05	Y*	Dp*	Eq*	Ex*	R*	Lr*	Poil	Qoil
Algeria	F(1,128)	3.92	0.50	3.35	1.77		10.79*	0.43	1.26	0.00
Argentina	F(1,116)	3.92	0.12	19.03*	0.00		32.30*	0.17	0.19	0.23
Australia	F(5,122)	2.29	1.12	2.24	0.75		0.49	2.08	0.55	1.29
Brazil	F(2,115)	3.08	1.64	0.68	0.04		1.19	0.73	0.12	1.09
Canada	F(4,123)	2.45	1.15	1.58	0.42		0.92	1.16	1.06	0.96
Chile	F(3,117)	2.68	1.01	1.60	1.25		0.25	0.97	0.85	0.84
China	F(2,127)	3.07	0.03	1.64	0.60		1.65	0.70	0.11	0.41
Ecuador	F(2,119)	3.07	0.66	0.48	0.51		2.28	1.42	1.09	0.42
Euro	F(3,116)	2.68	0.54	0.90	1.57		0.03	0.42	0.59	0.37
GCC	F(3,127)	2.68	1.05	1.49	0.77		0.70	0.40	1.44	
India	F(1,127)	3.92	3.71	1.64	3.44		3.21	0.18	0.14	0.53
Indonesia	F(2,127)	3.07	4.21	0.01	0.08		0.83	0.40	0.17	0.06
Iran	F(1,129)	3.91	2.71	0.03	0.71		0.23	0.21	2.54	0.00
Jordan	F(2,127)	3.07	4.12	2.52	3.28		0.49	0.78	1.10	2.89
Japan	F(3,124)	2.68	1.63	2.34	0.17		0.96	0.21	1.03	1.16
Korea	F(4,123)	2.45	0.22	1.32	0.67		0.84	2.16	1.32	1.14
Libya	F(1,128)	3.92	2.40	0.86	1.71		0.21	0.00	1.14	1.01
Malaysia	F(1,119)	3.92	4.62*	1.11	11.15		0.09	1.65	2.71	2.42
Mexico	F(2,127)	3.07	0.02	0.34	0.54		0.42	1.10	0.49	0.27
Morocco	F(2,127)	3.07	1.62	1.84	0.21		2.44	0.94	0.57	0.16
New Zealand	F(3,124)	2.68	0.34	2.40	1.58		3.42*	0.53	0.85	0.94
Nigeria	F(2,127)	3.07	0.11	2.28	0.16		1.76	1.50	0.99	1.84
Norway	F(1,127)	3.92	0.16	0.02	0.39		0.23	0.02	0.01	0.19
Pakistan	F(2,126)	3.07	1.77	1.47	2.30		4.78*	0.56	0.45	0.34
Peru	F(3,126)	2.68	3.65*	0.90	0.49		5.30*	1.79	4.85*	0.89
Philippines	F(3,112)	2.69	0.56	0.31	1.96		4.25*	0.75	1.65	0.45
Singapore	F(1,119)	3.92	0.52	2.37	2.00		1.36	0.78	0.20	0.01
South Africa	F(4,123)	2.45	1.17	0.94	1.57		1.14	1.37	0.40	1.03
Sweden	F(3,124)	2.68	2.85*	0.74	0.93		1.12	0.21	0.60	1.74
Switzerland	F(3,124)	2.68	0.84	5.34*	0.97		1.74	1.34	0.18	0.71
Thailand	F(3,116)	2.68	0.39	0.98	1.62		0.21	0.76	0.63	1.72
Turkey	F(2,127)	3.07	0.57	0.12	0.08		0.98	0.72	3.04	1.47
United Kingdom	F(2,125)	3.07	1.78	0.36	2.37		1.53	1.42	0.84	8.25*
United States	F(3,127)	2.68	0.26	1.79		1.63				2.84*
Venezuela	F(1,128)	3.92	1.00	3.19	0.00		10.82*	0.10	0.15	0.51

Note: * denotes statistical significance at the 5% level.

CHAPTER 5. SPILLOVERS FROM THE MINIMUM WAGE INCREASE ON THE WAGE DISTRIBUTION[40]

5.1 Introduction

In 2012, policy makers in Japan launched an ambitious policy framework (commonly referred to as Abenomics) based on monetary easing, flexible fiscal policy, and structural reforms to revive the economy and make a definitive escape from deflation. The assessment of the Japanese economy for the 2016 Article IV program by the IMF stressed that, while Abenomics met with initial success, its ambitious targets, including the two percent inflation target, will not be met under current policy. This was attributed to a large extent due to a lack of nominal wage growth, a key factor preventing the positive wage-price dynamics that Japan needs to revive domestic demand and reach escape velocity from deflation. Despite the fact that Japan has maintained relatively strong productivity growth through the last two decades, wage growth has lagged behind, reflecting both entrenched deflationary expectations and structural characteristics of the labor market.

The case for a rise in nominal wages to break the deflationary cycle in Japan is not new. Everaert and Ganelli (2016) note that full time wages have increased a mere 0.3 percent since

[40] The work presented in this chapter has been published in the Japanese Political Economy Journal in May 2018, accepted as "Minimum Wage as a Wage Policy Tool in Japan", by Chie Aoyagi (caoyagi@imf.org), Giovanni Ganelli (gganelli@imf.org). Ms. Aoyagi and the author of this thesis equally undertook the data collection for this research, while the author of this thesis conducted the analytical work and wrote the manuscript. Mr. Ganelli designed and supervised the research. All authors edited the manuscript.

Prior to that, this research was published as an IMF working paper WP/16/232 in November 2016, entitled "Minimum Wage as a Policy Tool in Japan", by Chie Aoyagi (caoyagi@imf.org), Giovanni Ganelli (gganelli@imf.org), and Nour Tawk.

1995, and call for substantial wage increases to be the "fourth arrow" of Abenomics. Aoyagi and Ganelli (2013) also stressed that policies aimed at raising wages would facilitate acceptance of reform of employment protection, which in turn would help reducing duality in the labor market, thus boosting productivity. But why is wage growth so weak? Aoyagi and Ganelli (2013) argue that there is a "coordination problem", where companies and wage-setters seem to look backward in deciding on wage increases, i.e. they are reluctant to raise wages as they perceive deflation to be long-lasting.

Against this background, and in a renewed effort to revive the economy, the Japanese government announced various initiatives aimed at promoting higher wages, including moral suasion under the tripartite commission and the public-private dialogue, and the announcement of substantial increases in the minimum wage. These initiatives were consistent with advice given during the 2016 Article IV consultations, which recommended that Abenomics should be "reloaded" through a policy upgrade package, including income policies to stimulate wage growth.

This analytical exercise empirically assesses the effectiveness of one of the policy tools included in the income policies toolkit, under which the minimum wage is expected to be raised by 3 percent per year over the next few years, until it reaches 1,000 JPY per hour. Our main finding is that, while the increase in the minimum wage planned by the government can help stimulate average wage growth, the quantitative impact might fall short of the vigorous wage dynamics that Japan needs to escape deflation. This implies that the minimum wage increase should be complemented by other more "unorthodox" income policies, as we elaborate below.

To study the pass-through between the minimum wage and average wages, we employ a prefectural panel dataset of almost two decades (1997-2014) for men and women. This allows us to exploit the variability in Japan's prefectural data, and has the advantage of capturing and contrasting gender-specific characteristics of the Japanese labor market. We make use of an Instrumental Variables regression to control for endogeneity in the data which may overestimate the pass-through effect. Our dependent variables are respectively the hourly average total wage, the hourly average male wage, and the hourly average female wage. We find that while an increase in the minimum wage will overall increase all wages, the increase is more pronounced on male wages. We also find that a one percent increase in the minimum wage could lead to about a 0.5 percent increase in total wages.

Accordingly, based on our estimates, the plan to step up minimum wage growth from 2 to the planned 3 percent per year could raise wage growth by an additional 0.5 percent annually. This would be a significant boost to wage growth, but it would still fall short of what is needed to engender the kind of wage-price dynamics that Japan needs to reach escape velocity from deflation. Given the Bank of Japan's inflation target of 2 percent, and assuming productivity growth of 1 percent, nominal wage growth of 3 percent would seem desirable for Japan. The policy implication of our analysis is therefore that, while the minimum wage increase policy announced by the authorities is helpful in stimulating wage growth, it should be complemented by other, more "unorthodox" income policies—e.g. a "soft target" through a "comply or explain mechanism" for wage growth; increases in public wages; stronger tax incentives or penalties as a last resort and possibly an additional wage bargaining round (see IMF 2016 for more details). As we discuss in more detail in the conclusions of this research, such income policies would need to be complemented by tax reform to make sure that higher wages do not

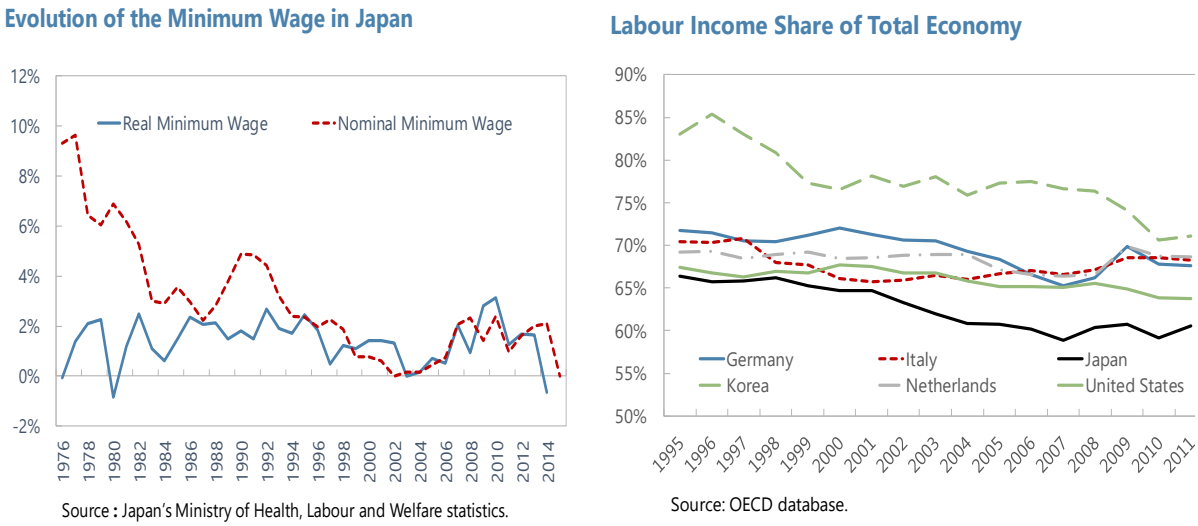
increase Japan's already excessive labor market duality by pushing more workers into non-regular jobs.

The rest of the chapter is organized as follows. Section 5.2 presents stylized facts of the labor market in Japan. Section 5.3 discusses the relevant literature reviewed. Section 5.4 discusses the empirical model used for the pass-through and the data used for the analysis. Section 5.5 presents the results. Section 5.6 concludes.

5.2 Stylized Facts

In September 2015, against a background of timid inflation and disappointing growth figures and in a new attempt to revive the economy, the Japanese government announced his aim to increase Japan's nominal GDP by 20 percent to reach 600 trillion JPY by 2020. He later announced his policy to raise the national weighted average minimum wage by 3 percent on a yearly basis, which would result in a hike from 798 JPY to over 1,000 JPY per hour by fiscal year 2023. This seems an ambitious target in a historical perspective, as the minimum wage has not grown past 3 percent since 1994 and the nominal wage has also been below 3 percent since 1993 (Figure 5.1.A). This weakness in real wage growth reflects in part an unwinding of previous real wage strength, as shown in the decline in Japan's labor share since the 1990s. However, in comparison with other advanced economies, Japan's labor share started from a relatively lower level in the mid-1990s and its decline over last two decades has been more pronounced (figure 5.1.B). The sharper declining trend in labor share in Japan is to a large extent driven by the comparative evolution of average wages and productivity.

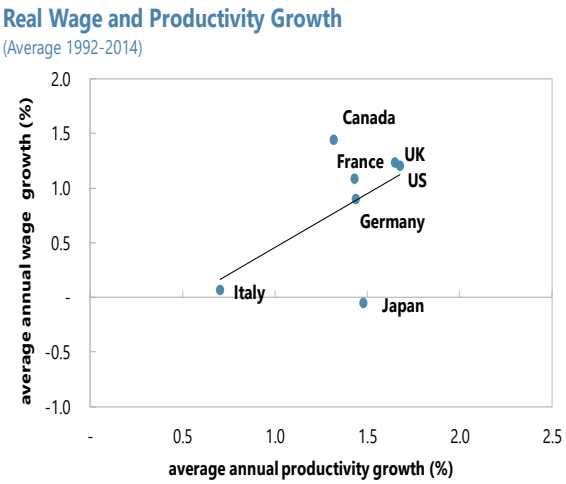
Figure 5.1. A. Evolution of the minimum wage in Japan. B. Labor income share of the total economy.



Japan experienced reasonably strong productivity growth in the early 90s and through the "lost decades", but this growth was accompanied by a zero (and sometimes negative) real wage growth (figure 5.2.A). Of the other G7 countries, only Italy experienced a comparable degree of wage stagnation, but it was combined with weak productivity growth (figure 5.2.B).

Figure 5.2. A. Wages and productivity growth. B. Real wage and productivity growth in OECD countries (average 1992–2014).

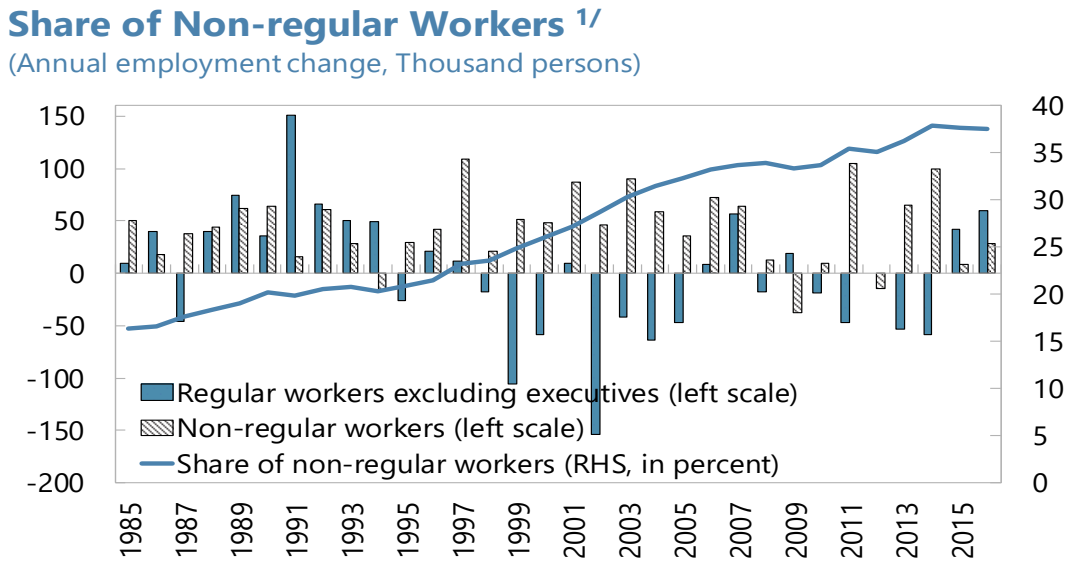
Sources : Haver Analytics, and Japan's Ministry of Health, Labour and Welfare statistics.



Source:OECD, and IMF staff calculations.

In theory, the low unemployment rate in Japan should place upward pressures on wages because of labor shortages. However, characteristics in the labor market negate this effect. Mainly, Japan's excessive labor market duality is likely to have contributed in a significant way to its stagnant wage growth, as the share of non-regular workers rose gradually to reach almost 40 percent of total employees, and the share of part-time positions in new job openings reached 60 percent, putting downward pressure on average wage growth (figure 5.3). The presence of nonregular workers in the labor force pushes down average wages, given that their wages are typically lower. In addition, the low horizontal mobility in the labor market, in which workers opt for lower wages in return for long-term employment, creates a low incentive environment for raising salaries. Finally, the entrenched deflationary mentality in Japan, in which both firms and company workers have backward expectations, prevents a nominal wage growth.

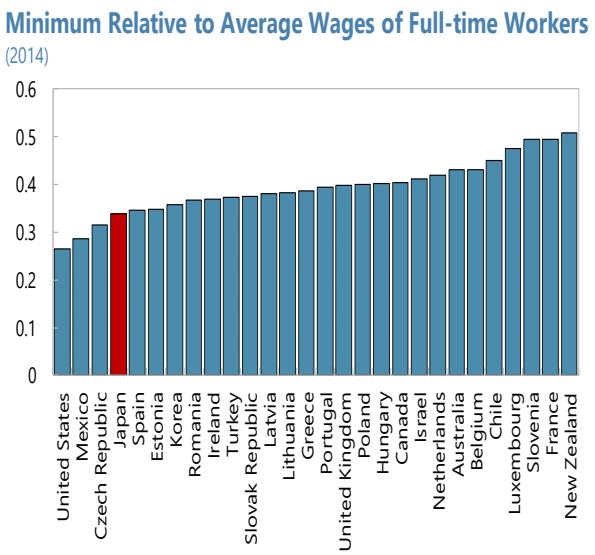
Figure 5.3. Share of nonregular workers (annual employment change, thousand persons).



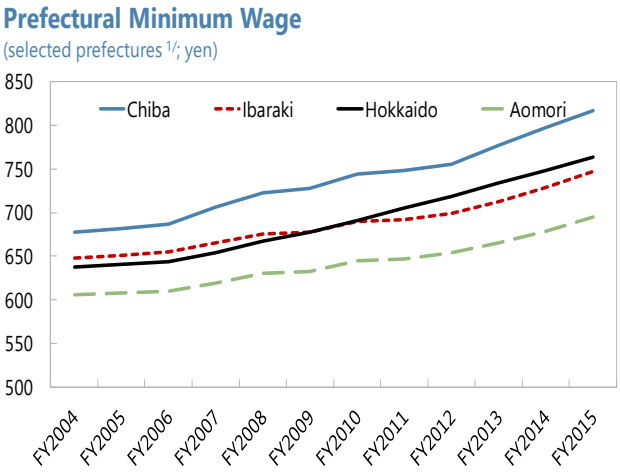
Sources: Labor Force Survey (Ministry of Internal Affairs and Communications), and IMF staff calculations
1/ Feb.1985-2001, 2002-2015 Jan.-Mar. average.

On the other hand, Japan's minimum wage is relatively low. The minimum wage relative to average wages of full time workers ranks fourth lowest in the OECD (with only the U.S., Mexico and Czech Republic having lower minimum wages), suggesting that there is room to further raise it (figure 5.4.A). Japan has a minimum wage system which, although set at the prefectural level, can be significantly influenced by the central government. The country's 47 prefectures are divided into four ranks depending on their relative economic position—from A being highest to D being lowest— and The Central Minimum Wage Council, an advisory body for the Ministry of Health, Labor and Welfare, sets guideline on prefectural minimum wage increases for each rank (figure 5.4.B). Based on the panel's recommendations and taking local conditions into consideration, local councils decide on the actual minimum wage level for each prefecture.

Figure 5.4. A. minimum wage relative to average wages of full-time workers, compared with OECD countries. B. Prefectural minimum wages (selected prefectures*, JPY).



Source: OECD Employment database.



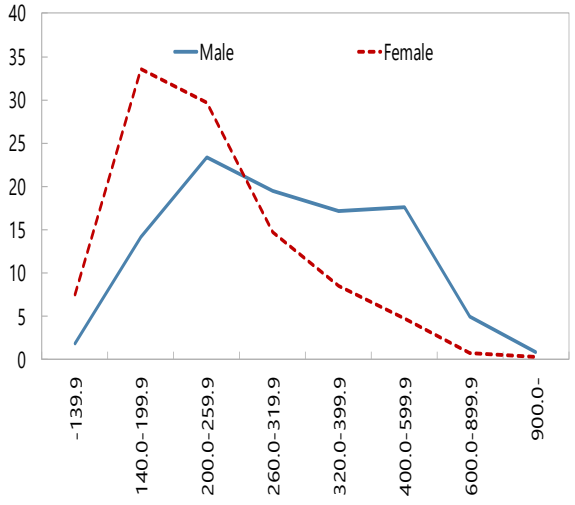
1/ Prefectures are selected from each rank as of 2015; Chiba (Rank A), Ibaraki (B), Hokkaido (C), Aomori(D)
Source: Ministry of Health, Labour and Welfare.

Although the recommendation by the central council is not legally binding, in practice it provides a lower bound. Implementation of the planned increases could be further ensured by strengthening the central government's role in setting the minimum wage. For the fiscal year 2016, the government advisory panel agreed to recommend raising the country's average minimum hourly wage by 24 yen, or 3 percent, which was later incorporated into the decisions made by prefectures, so that the actual outcome was an increase slightly higher than the one recommended by the central government (25 yen to 823 yen per hour on average).

In 2014, the Japan Institute for Labor Policy (JILPT) estimated that 13.4 percent of total workers (4.7 percent of full-time workers and 39.2 percent of part-time workers) in Japan are earning a wage lower than "1.15 x prefectural minimum wage" (figure 5.5.A). Additionally, the Cabinet Office estimated that in 2014 the number of workers paid the minimum wage plus 20 yen was 3.4 million (about 6.5 percent of the working population), while the number of

workers paid the minimum wage plus 40 yen was 5.1 million (almost 10 percent of the working population). An estimate of the share of workers currently earning less than 1,000 JPY can also be made by looking at the distribution of wages for men and women. If we assume that full-time workers work 168.4 hours per month[41], we find that the workers who earn less than 179,900 yen per month (179,900/168.4 hours=1,068yen) are about 10 percent of total male full-time workers and about 29 percent of total female full-time workers. For part-time workers, the share of workers below the minimum wage (calculated as below 999 yen per hour) is about 54 percent for men and 66 percent for women (figure 5.5.B). The above estimates suggest that a large portion of the Japanese working population will be directly affected by the increase in the minimum wage.

Figure 5.5. A. Monthly wage distribution for full-time workers (monthly wage in thousand JPY, percentage of total number of workers). B. Hourly wage distribution for part-time workers (hourly wage in JPY, percentage of total numbers of workers).



Sources: Ministry of Health Labor and Welfare; and IMF staff calculations.

Sources: Ministry of Health Labor and Welfare; and IMF Staff Calculations.

[41] 168.4 is the estimated average number of hours worked per month by full-time workers in 2014 by the Ministry of Health, Labor and Welfare monthly survey.

Furthermore, the existing literature (see session 5.3 below) suggests that the effect of an increase in the minimum wage would go beyond the direct impact on workers whose earnings are around the minimum wage level, and that an increase in the minimum wage has spillover effects on the wage distribution. As the wages of the minimum-wage earners (who belong to a lower wage percentile) increase, this changes the total wage distribution, and may lead to changes in wages of the workers in other wage percentiles. Given this background, we believe that estimating the pass-through from the minimum wage to average wages is a relevant exercise.

5.3 Literature Review

The existing literature concerning minimum wages generally focuses on the impact of the former either on the wage distribution (in terms of spillovers or wage inequality) or employment. The literature attributes the increase in overall wages due to a minimum wage increase to three potential effects. The first is a "truncation" effect: in a competitive market where workers are compensated for their marginal product of labor, an increase in the minimum wage will lead to loss of employment for all the workers who are paid less than the minimum wage, thus causing a truncation of the wage distribution below the new minimum wage. The second effect is referred to as a "spike" effect, by which if firms choose to retain the workers whose wages are below the minimum wage, their wages will be increased according to the minimum wage hike, causing the wage distribution density to spike around the minimum wage. The last effect is a spillover one: given that the minimum wage will raise the cost of minimum-wage earners, firms may choose to substitute them for more skilled

workers. The increase in the demand for higher-skilled labor will subsequently raise their wages (Autor, Manning and Smith, 2010).

Wage distribution studies look at the "ripple "effects of a change in the minimum wage on earners at different levels of the wage distribution: if minimum wage earners are at the 10^{th} percentile wage earning percentile, studies show that workers in other percentiles (typically the 5^{th} or 20^{th} percentile) may be affected, depending on which factors come into play. Some of the most influential studies on the impact of the minimum wage on the wage distribution are the papers by DiNardo, Fortin and Lemieux (1996), Lee (1999), and Autor, Manning and Smith (2010). DiNardo, Fortin and Lemieux (1996) rely on the U.S. Current population survey's (CPS) data for a semi-parametric analysis of how the minimum wage changes affect the wage distribution and inequality. They find that, in the U.S., the decline of the real value of the minimum wage caused a substantial increase in wage inequality for women. Lee (1999) uses Ordinary Least Squares (OLS) on cross-state variation data to explore the effect of the fall of the federal minimum wage on inequality and earnings in the U.S. He finds that more than the total increase of wage differentials at the lower tail of the income distribution (50/10 ratio) was due to the decrease in the minimum wage.

Autor, Manning and Smith (2010) also investigate the impact of the minimum wage on earnings inequality in the U.S. They argue that Lee (1999)'s results are over-estimated due to bias in the data and propose to use Instrumental Variables (IV) instead of OLS to correct the sources of bias. They find that increasing the minimum wage reduces inequality in the lower tail of the wage distribution (by increasing the wages of the lower tail earners), but that usually the impact is very small for males. They also find that for the U.S., the effect of the minimum

wage extends to the wage percentiles where the minimum wage is not binding, implying spillovers to other percentiles.

Studies concerning the impact of the minimum wage on the Japanese labor market are scarce. A notable study is the paper by Kambayashi, Kawaguchi, and Yamada (2013) who use women's wage percentile data to assess the impact of a minimum wage increase in a deflationary period (between 1994 and 2003). They find that the minimum wage increase resulted in the reduction of inequality for women by the subsequent increase of their wages, and caused negligible employment losses.

Some studies also investigate the effects of a minimum wage increase on employment, given that a substitution effect may come into play as the minimum wage rises, where employers may choose to hire (now seemingly less costly) higher skilled workers instead of minimum wage earners. Neumark, Schweitzer and Wascher (2004) use the CPS hourly and weekly wage data on rotation groups of people that show variations in the wage data. They argue that an increase of the minimum wage has negative employment effects on minimum wage earners, and has little positive effect on higher-wage earners. Gramlich (1976) suggests that a substitution effect may come into play as minimum-wage workers' wage increase, thus increasing the employment of higher-wage earners. Schmitt (2013) and Betcherman (2012) review recent research which suggest that there are little to no employment effects following a minimum wage increase.

Other researchers look into the impact of a minimum wage increase on part-time and full-time employment. Cunningham (1981) and Katz and Krueger (1992) find evidence suggesting that the minimum-wage hike may discourage part-time work and boost full-time employment,

while Gramlich (1976) and Hungerford (2000) report that in some cases part-time work seems to increase, reducing full-time employment. These authors also find that high wage workers could be affected directly or indirectly by supply or demand shifts. Average wages might increase if the demand for higher-wage earners increases, as firms opt for employing full time (or more experienced) workers given that minimum wage earners have become more expensive. On the other hand, the labor supply of high-wage workers might increase as low-wage workers become unemployed or face less hours of work because of the minimum wage increases, leading to a decline in wages for high-skilled workers.[42]

Our main contribution to the literature is the following. We look at the pass-through of the real minimum wage on total wages, men's wages, and women's wages in Japan using an updated panel dataset from 1997 to 2014. We find that a 1 percent increase in the minimum wage would increase average wages by 0.42 percent for women and by 0.66 percent for men, while total (for both men and women) average wages would increase by 0.48 percent.

5.4 Empirical Strategy: Estimation of the Pass-Through of Minimum Wages to Average Wages in Japan

5.4.1 Data

The dataset employed in this research includes prefectural level data from Japan's Ministry of Health, Labour and Welfare statistics, and covers seventeen years, from 1997 to 2014.

[42] Neumark, Schweitzerand Wascher also suggest that results concerning the impact of the minimum wage vary regarding the period lag: research indicates that a significant portion of the minimum wage effect on employment occurs after a one-year lag. They also note that while immediate effects are usually positive, adverse effects can be seen in one year.

We run three separate regressions, in which the dependent variables are respectively average wage for men, women, and the total weighted average of men and women's wages.[43] For each regression, a vector Z of variables is included. In addition to the minimum wage (adjusted for inflation), we use the following variables: the unemployment rate, the consumer price index (CPI), prefectural real GDP, the share of part-time work applicants (which is our proxy of duality in the labor market),[44] the share of employment in manufacturing, and the average age of workers.[45]

Data on the wage percentiles on a prefectural level is not publicly available, which explains our choice of dependent variables. Wages for males, females and in total are monthly wages, reported on a yearly basis. They do not include bonuses, and they cover full-time workers only. In order to transform real wages from a monthly to an hourly measure, we divide them by the number of hours worked each month including overtime. Finally, we also adjust them for inflation. The minimum wage variable is the prefectural-level minimum wage, on an hourly rate. The minimum wage variable is also adjusted using the CPI index. Finally, while real GDP is the GDP of each prefecture, due to data availability the CPI index is the index for each major city in each prefecture, rather than the prefecture itself.

[43] For any given year t, the weighted average total wage is computed by summing together men's wages multiplied by the number of male workers and female wages multiplied by the number of female workers, and then dividing the sum by the total number of workers that year.

[44] We use the share of part-time new job applications to total new job applications as our proxy of duality because the share of part time workers to total workers is not available at the prefectural level.

5.4.2 Empirical Estimation

Autor, Manning and Smith (2010) argue against using OLS. They identify two sources of bias in their data: first, they point out that fluctuations between the state wage median and other wage percentiles may be correlated. Secondly, they note that there may be a correlation between the trends in wages and the minimum wage, as they would fluctuate together and follow trends in the economy. They note (as well as Lee (1999)) that using fixed effects may worsen the bias: if there is an upward trend in wages, using fixed effects may strengthen this trend, and vice-versa if a downward trend exists. Despite the fact that we use real average wages instead of wage percentiles, we believe that endogeneity between minimum wages and average wages could very possibly exist, as minimum wages and average wages fluctuate together depending on trends in the economy. In addition to that, a key factor for policy-makers in setting the prefectural minimum wage is average wages in each prefecture, which may be another source of endogeneity in the data.

We regress log of hourly average real wage in each prefecture on the prefectural hourly real minimum wage and the control variables. We present our results using Ordinary Least Squares (OLS) and then Instrumental Variables, and find that OLS present a much higher coefficient for the pass-through between the minimum wage and average wages. Using a Durbin-Wu-Hausman test (augmented regression test), we confirm the existence of endogeneity between minimum wages and average wages**.** Therefore, we employ a two-stage least squares regression using the number of male and female applicants to social welfare as instruments.

We therefore follow the same strategy used by Autor, Manning and Smith (2010) and make use of an instrumental variables regression. When using instrumental variables in a regression,

the instrument must satisfy the condition that it would lead to a change in the minimum wage variable without affecting the dependent variable (real wages), aside from indirectly via the minimum wage.

In Japan, minimum wages are established at a prefectural level, and take into consideration three factors: a) workers' cost of living, b) workers' wages, and c) the capacity of normal industries to pay wages (Japan's Labor Administration and Legislation). The first factor is measured by the access and demand for public assistance. In other words, in prefectures where the minimum standards of living are not met, there must be a higher amount of public assistance. As a response to that, minimum wages are adjusted accordingly, to help meet the standards of living of such prefecture. In that context, public welfare would have a direct impact on minimum wages but not on average earnings, which therefore makes a proxy for it a valid instrument for an instrumental variables regression. [46]

Given that there is no publicly available data for the amount of public welfare offered by each prefecture, we choose to use as instruments the number of male and female applicants to social welfare in each prefecture, divided by the total amount of social welfare applicants in Japan, to approximate which prefectures have the highest demand for public welfare. [47]

We now set up the model that examines the pass-through between average wages and the minimum wage. Let w_{it} denote the average wage in prefecture i in year t, mw_{it} the minimum

[46] The results of the standard tests for weak instruments (Stock, Wright and Yogo, 2002) as well as the over-identifications test (the Sargan, Basmann and Wooldridge tests) are shown in the appendix.

[47] Our data shows that the prefecture with the highest number of applicants for public welfare to population is Tokyo.

wage, and x_{it} the vector of control variables that expectedly affect wages. We therefore describe the relationship between the minimum-wage and total wages as follows:

$$\ln w_{it} = \beta_1 \ln mw_{it} + x_{it} + u_{it}$$

As mentioned above, the controls vector x_{it} includes the CPI index, GDP, the average age of workers, the unemployment rate, the duality proxy and the share of employment in manufacturing, and u_{it} represents the error term. Having established the presence of endogeneity in the data, we use 2SLS to determine the pass-through between real wages and the minimum wage.

5.5 Results

The results of our Instrumental Variables estimation are reported in Table 5.1, and are supportive of the hypothesis that an increase in the minimum wage would help increase average wages in Japan. The regression suggests that a 1 percent increase in the hourly minimum wage could increase the hourly average wage by about 0.48 percent. Our results show that wages for men would increase by 0.66 percent as well, while women's wages would increase by 0.42 percent. This increase is statistically significant for both men and women. Table 5.2 reports the results from an OLS estimation, with the coefficients predictably overestimated.

Our results are also indicative of labor trends for the Japanese work-force, as our estimation reveals that women's average age is negatively correlated to their wages, while for men, their age has a positive impact on their wages. This reflects the traditional seniority wage system that in Japan, where workers' wages grow in accordance to the length of their period of work

in a company instead of their productivity. In contrast, we see that women are left out from the seniority based pay increase, mainly because many women drop out of the work force after bearing children and later restart working only as supplemental income earners in the household. Some of the factors behind this phenomenon include the tax deduction for spouses, which places an income cap on the second earner in a Japanese household (typically the woman). Other discouraging factors could be the lack of support with regards to childcare facilities to women when they are working.

The spousal tax deduction could also explain how minimum wage and duality measurement have different effects on male and female average wages. Female workers who choose to work full-time would not receive the spousal tax deduction, which is why most women choose to work part-time in Japan. While the spousal tax deduction system is not by itself gender discriminatory, in practice it is mostly women who adjust working hours to be eligible for the deduction. This reduces the supply of women for full-time labor, which explains why the labor duality is higher for female workers. In that context, men and women seem to transact in separate labor markets and thus average wages for men and women respond differently to some factors. With the minimum wage increasing, women may choose to lower their working hours in order not to pass the spousal tax deduction threshold, thus causing a smaller change in the monthly wage distribution. This can explain why the pass-through of the minimum wage to men is higher than that to women, despite the fact that women make the majority of minimum wage workers.

In addition, the duality proxy, which is a measure of relative supply of part-time workers to full-time workers, is positive and significant for women. Intuitively, as this indicator increases, the full-time labor supply becomes relatively scarce, and thus pushes up the average wage of

full-time workers in the female labor market. This explains why the duality proxy is positive for women, while the coefficient is negatively correlated to men's wages and wages in total (although these effects are not statistically significant).

Table 5.1: Wage Determinants in Japan (Prefectural Panel), Regression Results Using Instrumental Variables (hourly), in logs

Period: 1997-2014	Dep. Variable: **Real wages (total)**	Dep. Variable: **Real wages (Women)**	Dep. Variable: **Real wages (Men)**
Minimum Wage	0.48** (1.92)	0.42** (2.28)	0.66** (2.42)
CPI Inflation	-0.008** (-2.36)	-0.001 (-0.31)	0.01** (02.31)
Prefectural GDP	0.0003 *** (4.33)	0.0004*** (6.20)	0.0004*** (5.09)
Share of part-time workers	-0.09 (-0.99)	0.12** (1.65)	-0.1 (-0.85)
Unemployment Rate	-0.009* (-1.75)	0.002 (0.52)	0.01* (1.69)
Share of employment in manufacturing	0.002*** (3.52)	0.001* (1.78)	0.003*** (3.21)
Average female age	-0.03*** (-6.22)	-0.02*** (-5.00)	---
Average male age	0.04*** (5.28)	---	0.03*** (4.27)
Constant	-2.41 (-1.30)	-1.93 (-1.36)	-6.23** (-3.14)
R-Squared	0.63	0.70	0.53

Source: IMF Staff Calculations
Z-statistics are reported in parenthesis. * denotes significance at 10% level, ** significance at 5% level, and *** significance at 1 percent level

Table 5.2. Wage Determinants in Japan (Prefectural Panel), Regression Results Using Ordinary Least Squares (hourly), in logs

Period: 1997-2014	Dep. Variable: **Real wages (total)**	Dep. Variable: **Real wages (Women)**	Dep. Variable: **Real wages (Men)**
Log Minimum Wage	1.05 ***	1.22***	1.06***
	(9.63)	(15.37)	(8.05)
CPI Inflation	-0.002	0.007***	0.01***
	(-0.87)	(3.96)	(4.27)
Prefectural GDP	0.0002 ***	0.0001***	0.0002***
	(3.73)	(4.23)	(6.24)
Share of Part-time Job Applications	-0.21***	-0.09**	-0.20**
	(-2.92)	(-1.77)	(-2.09)
Unemployment Rate	-0.008**	0.003	0.007
	(-1.71)	(0.77)	(1.44)
Share of Employment in Manufacturing	0.001**	-0.002	0.002**
	(2.56)	(-0.72)	(2.73)
Average female age	-0.02***	-0.01*	---
	(-5.80)	(-4.10)	
Average male age	0.03***	---	0.03***
	(4.78)		(5.64)
Constant	-6.61***	-8.03***	-9.12***
	(-7.61)	(-12.52)	(-8.87)
R-Squared	0.65	0.75	0.53

Source: IMF Staff Calculations
T-statistics are reported in parenthesis. * denotes significance at 10% level, ** significance at 5% level, and *** significance at 1 percent level

5.6 Conclusion

In this chapter, we evaluate the potential impact of Japan's planned minimum wage increase on average wages. Our econometric results indicate that the pass-through of a one percent increase in the minimum wage would translate into about a 0.5 percent increase on wage in total. Gender specific regressions suggest an increase of 0.42 percent in the average wages of women, versus a 0.66 percent increase in the average wages of men.

The planned minimum wage increase in Japan has already been put in motion. In July 2016, a government advisory panel agreed to a 3 percent increase for the next year, a step up from the 2 percent it advised in previous years. Accordingly, our estimations suggest that this policy would expected to result in an additional 0.5 percent increase in average wages. This increase in average wages resulting from the minimum wage policy would be a significant boost to wage growth, but it would still fall short of what is needed to engender the kind of wage-price dynamics that Japan needs to reach escape velocity form deflation. Given the Bank of Japan's inflation target of 2 percent, and assuming productivity growth of 1 percent, wage growth of 3 percent would seem desirable for Japan. The policy implication of our analysis is therefore that, while the minimum wage increase policy announced by the authorities is helpful in stimulating an increase in wages , it should be complemented by other income policies—e.g. a "soft target" for wage growth and increases in public wages. Furthermore, implementation of the planned increases could be further ensured by strengthening the central government's role in setting the minimum wage.

Another important issue to consider when evaluating the impact of the minimum wage policy, and of income policies more in general, is related to complementarity with other reforms, such

as tax policy. In Japan, part-timers account for the majority of non-regular workers, and they are mostly women. One of the factors behind the high female share of part-time workers is the tax deduction for spouses, which is a tax advantage that goes to married couples when one of them (usually the wife) earns less than 1.03 million yen. Also, from October 2016, previously exempt workers will be required to pay into the national health insurance and pension programs if they meet certain conditions, such as working at least 20 hours a week at a company with 501 or more employees and earning at least 1.06 million yen a year. The tax and social security system is therefore encouraging many married women to limit paid work, and the government is currently examining how to eliminate this tax advantage to mobilize more female labor force in regular jobs.

Despite efforts in this direction, such as subsidies to employers which split social insurance contributions with employees (conditional on increasing work hours and wages for their part-time employees) anecdotal evidence suggests that many part-time workers chose to reduce working hours to avoid hitting the new threshold. There is therefore a risk that, even if income policies are successful, in the absences of tax and social security reform, the attendant increase in wages might end up encouraging non-regular work. This underscores the importance of eliminating tax and social security distortions at the same time as income policies are implemented.

5.7 Appendix

Tests for Instruments Validity and Significance

1. Average Total Wages Regression:

Table A5.1. First-Stage Regression Results

Variable	R-squared	Adjusted R-sq	Partial R-Sq	F (2,365)	Prob > F
Real Minimum Wage (in log)	0.7478	0.7409	0.2027	30.9384	0.0000

Critical Values H_o: Instruments are weak	Number of Endogenous regressors: 1 Number of Excluded instruments: 3			
2SLS relative bias	5%	10%	20%	30%
	13.91	9.08	9.54	5.39
2SLS Size of nominal 5% Wald Test	10%	15%	20%	25%
	22.30	12.83	9.54	7.80

The F-statistic is 30.94, which exceeds Stock, Wright and Yogo's (2002) recommended F-statistic value for inference (F=10) for a 2SLS estimator to be reliable.

Furthermore, our test statistic exceeds the critical values for the "2SLS relative bias test" at 5%, 10%, 20% and 30% (30.94 > 13.9), as well as the "2SLS Size of nominal 5% Wald Test" at the 10%, 15%, 20% and 25% levels (30.93>22.30). We can therefore conclude that our instruments satisfy Stock and Yogo (2005)'s two conditions for an instrument to not be weak.

Table A5.2. Test of Over-Identifying restrictions

Test of Over-Identifying Restrictions	Value	Significance (p-value)
Sargan (score) chi2(1)	= 7.3	p= 0.0069
Basmann chi2(1)	= 7.24	p= 0.0071
Wooldridge (score) chi2(2)	=8.25	p = 0.0161

Based on the Wooldridge score test, we do not reject the null hypothesis that our instruments are valid at the 1% significance level, though we reject the null hypothesis that our instruments are valid at the 5% significance level.

2. Average Male Wages Regression:

Table A5.3. First-Stage Regression Results

Variable	R-squared	Adjusted R-sq	Partial R-Sq	F (2,365)	Prob > F
Real Minimum Wage (in log)	0.7445	0.7382	0.2375	37.9969	0.0000

Critical Values H_o: Instruments are weak	Number of Endogenous regressors: 1 Number of Excluded instruments: 3			
2SLS relative bias	5%	10%	20%	30%
	13.91	9.08	6.46	5.39
2SLS Size of nominal 5% Wald Test	10%	15%	20%	25%

	22.30	12.83	9.54	7.80

The F-statistic is equal to 37.99, and thus passes Stock Wright and Yogo's (2002) recommended F-statistic value for inference (F=10) for a 2SLS estimator to be reliable, as well as the tests for 2SLS relative bias, and the 2SLS Size of nominal 5% Wald Test

Table A5.4. Test of Over-Identifying Restrictions

Test of Over-Identifying Restrictions	Value	Significance (p-value)
Sargan (score) chi2(2)	= 4.36	p= 0.1131
Basmann chi2(1)	= 4.293	p= 00.1169
Wooldridge (score) chi2(2)	=5.00398	p = 0.0819

Based on the Sargan and Basmann score tests, we do not reject the null hypothesis that our instruments are valid at the 1%, 5% and 10% significance level, though with the Wooldridge test score we reject the null hypothesis that our instruments are valid at the 10% significance level.

3. Average Female Wages Regression:

Table A5.5. First-Stage Regression Results

Variable	R-squared	Adjusted R-sq	Partial R-Sq	F (2,366)	Prob > F
Real Minimum Wage (in log)	0.7477	0.7415	0.2320	36.8583	0.0000

Critical Values H_o: Instruments are weak	Number of Endogenous regressors: 1 Number of Excluded instruments: 3			
2SLS relative bias	5%	10%	20%	30%
	13.91	9.08	6.46	5.39
2SLS Size of nominal 5% Wald Test	10%	15%	20%	25%
	22.30	12.83	9.54	7.80

The F-statistic is equal to 36.85, and thus passes Stock Wright and Yogo's (2002) recommended F-statistic value for inference (F=10) for a 2SLS estimator to be reliable, as well as the tests for 2SLS relative bias, and the 2SLS Size of nominal 5% Wald Test

Table A5.6. Test of Over-Identifying Restrictions

Test of Over-Identifying Restrictions	Value	Significance (p-value)
Sargan (score) chi2(2)	= 0.85916	p= 0.6508
Basmann chi2(1)	= 0.83225	p= 0.6576
Wooldridge (score) chi2(2)	=0.897377	p = 0.6385

Based on the Sargan, Basmann, and Wooldridge score tests, we do not reject the null hypothesis that our instruments are valid at the 1%, 5% and 10% significance level.

Conclusion

The main results of this thesis have already been presented in detail in the introduction and their respective chapters, and therefore will only be restated briefly here. Rather, in this conclusion, we will focus on the main contribution of each analytical exercise to the existing literature, and the policy recommendations which can be derived from the results obtained. Finally, we will explain the limitations of each analysis, and discuss possible avenues for future research.

In Chapter Two, we employ a Global VAR (GVAR) model to study the possible spillover effects from the Bank of Japan's Quantitative and Qualitative Easing (QQE) program on emerging Asia. This research contributes to the literature by being the first to look at the impact of QQE on other countries in emerging Asia, through the fluctuations in equity prices, aka the stock market channel. More importantly, the main contribution of this chapter is in its identification of unconventional monetary shocks. Specifically, we apply sign restrictions to an equity price shock to disentangle it from a standard financial shock, so that we can identify the impact of QQE on stock prices. Additionally, we test the propagation of shocks using the shadow short-term rate as an unconventional monetary policy tool. Our results highlight the importance of looking at the effects of unconventional monetary policy through unorthodox proxies, when interest rates are at (or below) zero. Specifically, by highlighting the transmission of shocks not only through the interest rate channel but also the stock price channel, we observe that spillovers were not indiscernible in Southeast Asia. Rather, despite currency appreciation in Southeast Asia, spillovers were positive in the short-term, due to

increased investor confidence in the region, illustrated by a temporary increase in equity prices, and capital inflows.

Having observed that countries with deeper financial linkages to Japan experienced temporary spillover shocks, we focus our policy recommendations to that group. First, we suggest that countries counter the losses from currency appreciation by taking advantage of the lower import costs from Japan, especially for intermediate production goods. A flexible exchange rate can help better absorb temporary trade shocks, as well as any appreciation caused by the increase in capital inflows. In addition, a financial deepening for such countries can reduce the impact of global risk factors, and mitigate the risks brought forward by a higher foreign participation. Meanwhile, central banks can make use of that increase in investment by creating incentives for foreign direct investment (FDI) and by placing caps that limit temporary portfolio flows, so to stabilize the exchange rate. inflows. Finally, we recommend continued clear forward guidance from the Bank of Japan, so that central banks in emerging Asia can prepare for exchange rate shocks by increasing their respective reserves.

In the future, we wish to extend this research by overcoming some of the challenges which arose from this analytical exercise. Specifically, we would like to investigate in more depth how to apply sign restrictions to identify an unconventional monetary policy shock from a financial shock. This is because the literature for this exercise remains limited, whereas there is abundant evidence in the literature of applying sign restrictions to identify a monetary shock from a financial shock. In addition, we hope in the future to explore different transmission channels to a monetary or financial shock. For instance, we hope to obtain at some point large and high frequency data for bilateral portfolio flows, so that we can include this channel of transmission in the GVAR. Finally, we aim to obtain more high-frequency data for other

countries in emerging Asia, especially other ASEAN countries, so to include them in this analysis.

Chapter Three looks at the spillovers of the rebalancing of China on the rest of the world. Specifically, it builds a GVAR model using country-specific consumption and investment data, then calculates the net effects on the rest of the world of a negative shock to China's investment followed by a positive shock to China's consumption. By doing so, this chapter can look at the effects of China's switch from an investment-driven economy to a consumption driven one on investment and consumption patterns in other countries. To that aspect, the main contribution of the research is by its identification of the rebalancing shocks, as opposed to the current literature, which studies the rebalancing by focusing on GDP-to-GDP spillovers from China to the rest of the world. Using a proxy which looks at both the effects of the decline in investment demand in China and the increase in the consumption demand offers a novel way to view how the impact of the rebalancing might be borne on other countries. To this extent, our research is the first to investigate potential spillovers from the change in GDP components for China and other countries. Through this exercise, we could note that spillovers are not necessarily only negative. In fact, through the increase in consumption demand for China, many countries seem to mitigate the adverse effects of the decline in investment, by benefiting from the increased export demand for consumption goods and the decline in export prices. However, the proxy analysis shows that the impact of this switch in China's growth model is twice borne on commodity exporters, where the decline in investment is as adverse on commodity prices as the increase in consumption.

Considering these results, we focus our policy suggestions on this group of countries, and recommend the diversification of their exports base, so that the losses from the decline in commodity prices are mitigated. Additionally, increasingly strong fiscal and monetary fundamentals can help a country substantially weather financial shocks and capital outflows, especially in the cases of a global "risk-off" sentiment, which generally highly impacts emerging markets. Finally, a flexible exchange rate regime is recommended for the commodity exporting countries with pegged exchange rates, as it absorbs terms of trade shocks, does not deplete the central bank's reserves, and causes a milder contraction in output. However, we suggest that this switch takes place when the economy is relatively stable, and the central bank has accumulated enough reserves to stabilize the depreciation of the currency.

In this chapter, the main challenge in the research came from the time frame of the dataset itself, which ends in 2015. We hope to extend our dataset in the future up to 2017, and explore ways to disentangle the rebalancing shocks of China from any other shocks that may be picked up by the dataset.

In Chapter Four, we compare the magnitude of shocks from systemic economies, namely the United States, the Euro Area, and China, on the Middle East and North Africa (MENA) region. In addition, by using time-varying weights in the GVAR model, we look at the evolution of trade linkages in the last two decades between the region and these three systemic economies. Our research contributes to the literature by adding to the small body of research which studies the impact of systemic shocks on the MENA region. It builds a large extended dataset of 47 countries, which extends to 2014Q4. Finally, it applies the rebalancing proxy of China, innovated in Chapter Three, to the MENA region, and is the first research to do so, to the best of our knowledge. Chapter Four offers similar insights as chapter Three but for the MENA

region. However, through the comparison of shocks between the MENA and the other economies, we mainly highlight that the region is much more vulnerable to shocks from the United States than from China and the Euro area, specifically through the oil price channel.

To that extent, we also suggest that a transition to a flexible exchange rate system would be helpful in alleviating the adverse effects of present or future shocks from these systemic economies, especially for the commodity exporters who do not have enough reserves to withstand the near-term exchange rate fluctuations. Again, we recommend shifting towards a more diverse exports base, to lessen the impact of future commodity price shocks. As for the commodity importers in the MENA, they can take advantage of the lower oil prices and cheaper imports to boost their local production, so that they can decrease their reliance on the GCC and Euro Area.

The limitations of the research were mainly related to data availability. Despite the systemic importance of the MENA region, and the efforts towards collecting its macro related data, a sizable portion of data for various countries is not easily attainable. But it is our hope, once more data is obtained, to build an extended GVAR model which covers more countries from the MENA region, to capture the effects of systemic shocks on the region. Additionally, concerning the GVAR literature, we would like to expand the model to more countries which are currently not included in most datasets, such as Russia and countries in the Caucus and Central Asia. Finally, we hope to explore, if data permits, the impact of systemic shocks on the remittance flows for the MENA, given the importance of this transmission channel to commodity importers in the region.

Finally, in Chapter Five, we estimate the pass-through of the minimum wage to average wages of full-time workers in Japan. This exercise employs a dataset which extends until 2014, for both male and female workers, for the 47 prefectures of Japan. This study is the first, to the best of our knowledge, to look at the spillovers from an increase in the minimum wage on the wage distribution for both men and women in Japan, thus offering a comparative analysis of how and why the pass-through differs for each gender. By carrying out this research, we also contribute by extending the small body of literature concerning the impact of the minimum wage on wages in Japan. The main findings are that, while the spillover effect on the wage distribution is positive, it may not be large enough to engender the wage-price dynamics needed for Japan to escape deflation. We also observe that while women are the majority of part-time workers in Japan, they may not fully benefit from the increase in the minimum wage, due to tax laws that may indirectly discourage their participation in the labor market. In accordance to the obtained results, we stress the importance of eliminating tax distortions so that the increase in wages is more efficient and more pronounced. We also encourage complementarity of the labor reforms with other reforms, such as in tax policy, to mobilize more female workers into the labor force.

Future extensions of this work concern using wage percentile data for Japan, as we believe that the contribution of such research would be of more importance for policymaking. For instance, most minimum wage literature uses the wage percentile data (which is not publicly available on a prefectural level for Japan) to assess the impact of the minimum wage on the wage distribution. With this data, one can look at the spillover effects from a minimum wage increase on the certain percentiles of the wage distribution, specifically those immediately above or below the minimum wage-earning percentile. The results from such an analysis would yield

more insight on the impact of the minimum wage on wage inequality and unemployment. We hope to obtain this data in the near future, to shed more light on the dynamics of the Japanese labor market.

In conclusion, the chapters in this dissertation contribute to the literature on the study of the propagation of shocks and spillovers from policies, by highlighting the various channels through which policies can have an impact, on a domestic and international level. We hope that our work, by offering new proxies for the identification of shocks, as well as by extending the data coverage of the GVAR to less-studied regions, can contribute to the study of spillovers for researchers and policy-makers.

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Data Appendix

Variable	Description	Source	Notes
Real GDP (y)	$y = \ln \frac{GDP_{it}}{CPI_{it}}$	IMF IFS, IMF WEO	The monthly time series are obtained using the Chow-Lin interpolation method, with the Industrial production index as a reference. (seasonally adjusted using Eviews X13)
CPI inflation (dp)	$dp = \ln(CPI_{it}) - \ln(CPI_{i,t-1})$	IMF IFS, IMF WEO	
Equity prices (eq)	$eq = \ln \frac{EQ_{it}}{CPI_{it}}$	Bloomberg	The MSCI index for each country is used.
Exchange rate (ex)	$ex = \ln \frac{E_{it}}{CPI_{it}}$	Bloomberg and the BIS for Japan	The bilateral exchange rate is used for chapter 2. The nominal effective exchange rate is used for chapters 3 and 4
Monetary base (mb)	Monetary base, percent.	IMF IFS	
Short-term interest rate (r)	r= 0.25*ln(1+ R_{it}^{s}/100)	IMF IFS	- For China, the deposit rate is used. - For Malaysia, the Philippines, the treasury bill rate is used. - For Japan, Indonesia, Thailand, the money markets rate is used.
Shadow short-term rate	r= 0.25*ln(1+ R_{it}^{s}/100)	Federal Bank of New Zealand/ Leo Krippner Research	The shadow rate is used for Japan, for Chapter 2.
Bank credit (bc)	$bc = \ln \frac{BC_{it}}{CPI_{it}}$	IMF IFS	Claims on the private sector (seasonally adjusted using Eviews X13)

Price of Oil	US dollars per barrel, in natural logarithm	IMF IFS	
Price of Metal	Index price for metals	IMF IFS	
Imports and Exports	In millions of U.S. Dollars	IMF CDIS	Direction of Trade statistics
Portfolio flows	In millions of U.S. Dollars	IMF CPIS	Coordinated Portfolio Investment Survey
FDI flows	In millions of U.S. Dollars	IMF	Coordinated Direct Investment Survey
Capital inflows	In millions of U.S. Dollars $cf = \ln \frac{CF_{it}}{CPI_{it}}$	Haver Analytics (EPFR Asia)	
Private Investment		Haver Analytics	Gross capital formation is used for the investment series.
Consumption		Haver Analytics	The sum of public and private consumption is used for the consumption series.
Average Wages, Japan		MHLW	Ministry of Health, Labour and Welfare (MHLW) statistics
Average Age of Workers, Japan		MHLW	
Share of Part-Time Work Applicants, Japan		MHLW	
Unemployment Rate, Japan		LFS	Labor Force Survey (LFS)/ Statistics Bureau
Prefectural GDP, Japan		MHLW	
Prefectural CPI, Japan		LFS	
Share of Employment in Manufacturing, Japan		LFS	