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Quantifying the spillovers from China rebalancing using a multi-sector Ricardian trade model

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Abstract

This paper assesses the spillovers from different facets of China rebalancing using a calibrated Ricardian trade model that includes 41 economies, each consisting of 34 sectors. We find that China's move up the value chain in particular has the potential for significant spillovers – on the one hand, adversely affecting industrialized economies heavily involved in the Asia value chain, while at the same time generating positive spillovers to lower and middle income countries. The model's strength lies in endogenously capturing production value chains and international trade of goods across sectors.

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I. CHINA'S REBALANCING: WHAT IT IS, PAPER'S APPROACH AND MAIN FINDINGS, AND WHAT OTHERS HAVE DONE

China's Rebalancing

China's economy is undergoing structural changes or so called rebalancing. China's remarkable growth in the last four decades has been rooted in a strong export and investment-led manufacturing sector, as millions of workers left the relatively unproductive agricultural sector. Growth has begun to shift away from external demand and investment into a more sustainable path led by domestic consumption.

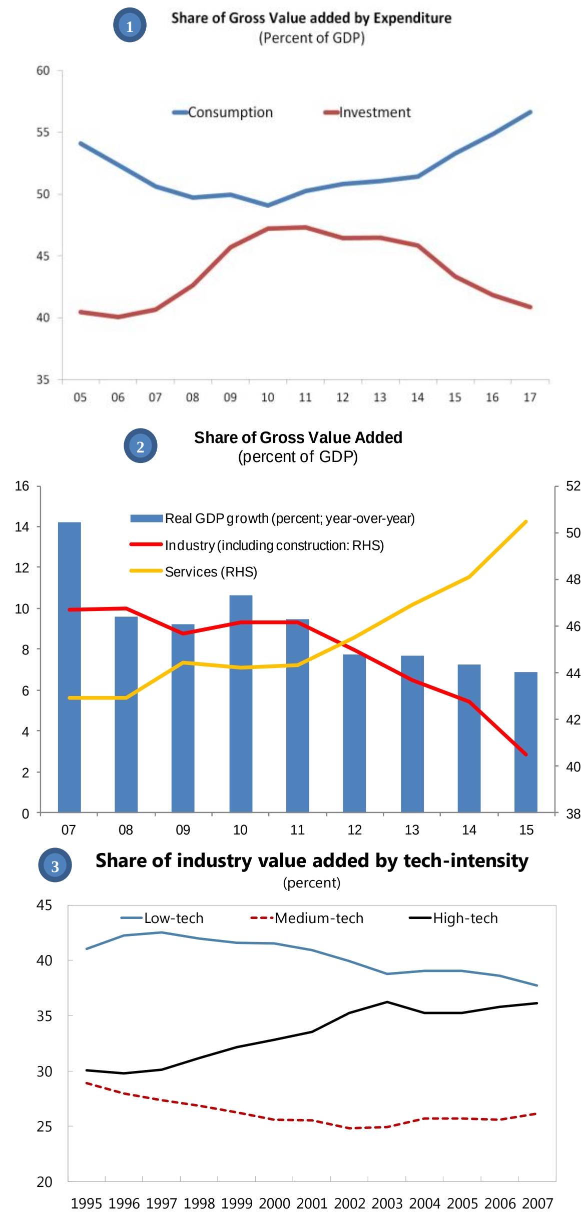
Three developments are usually mentioned interchangeably when discussing the ongoing rebalancing of the Chinese economy (Figure 1):

1. Domestic demand is shifting away from investment and towards consumption as Chinese households become wealthier and their disposable income rises.

2. On the production side, services are outgrowing manufacturing.

3. Within industry, lower tech sectors are growing less than high tech. China is moving up the value chain.

Figure 1: China's rebalancing: three developments



Bottom panel uses industry classification according to tech-intensity from appendix table A4. Source: IMF's World Economic Outlook April 2016, WIOD, author's calculation.

China's rise as a trade power-house means that such a rebalancing may have important spillovers to other economies. As the largest exporter in the world and second largest importer, China is now at the center of the world trade network and is among the top trading partners of virtually any country. At the same time, production value chains are also becoming more complex. Given the size of the Chinese economy and the complexity of its interlinkages, events in China are likely to reverberate across the World, beyond first round effects. Importantly, such an impact could be felt even if China's overall growth does not slow down considerably.

This paper's approach to measuring spillovers and main findings

This paper quantifies the spillovers from each of the three facets (see above) of China's rebalancing separately by using the multi-country, multi-sector Ricardian trade model introduced in Caliendo and Parro (2015). That model is extended here to allow the study of additional counterfactuals.

The calibrated model includes 41 economies, each consisting of 34 sectors and thus can capture rich spillover predictions[2]. It allows the study of impacts on income and trade across the various economies, as well as differences in sectoral performance within each economy, something that has not been as explored in the literature. Aggregate exposures may be misleading when quantifying spillovers if rebalancing affects specific sectors of the economy and exposures vary significantly across sectors.

We find that China's move up the value chain is quantitatively the most relevant development, having the potential to generate the largest adverse spillovers among all the shocks both in absolute terms as well as in relation to the original shock in China. This shock is particularly adverse for economies heavily involved in the Asia value chain like Taiwan, Province of China, Korea and to a lesser extent Japan and Germany, with the size of spillovers depending crucially on the degree to which China is assumed to move into higher tech-sectors. Spillovers from this shock to Taiwan, Province of China and Korea's welfare can be as large as -¾ of the impact of the shock on China itself.

China's shift towards greater final consumption also entails large adverse effects to major economies[3], although some lower-to-middle-income economies seem to benefit. On the other hand, productivity rebalancing towards services has limited spillovers, particularly when compared to the large adverse impact in the Chinese economy itself.

Importantly, China's rebalancing has very heterogeneous impacts depending on: (1) the shock that is behind rebalancing; (2) the economy in question; (3) the sector. These three insights lend support to the choice of methodology followed in this paper.

Literature on spillovers from China

The analysis done here should be complemented with a growing literature, both at the IMF and elsewhere, on measuring spillovers from rebalancing in China and/or a slowdown in the Chinese economy.

Empirical studies have used a diverse set of frameworks: GVAR (IMF (2014a) and Cashin and others (2016)), VAR (Hong and others (2016) and World Bank (2016)), factor augmented VAR (Ahuja and Myroda (2012)), Panel regressions (Ahuja and Nabar (2012)), network analysis (IMF (2011) and Kireyev and Leonidov (2016)). These studies have studied reduced form relations between aggregate variables, where rebalancing is often equated to a

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[2] For a list of the economies and sectors considered see appendix tables A1 and A3, respectively.

[3] Throughout the text "major economies" refers to those with the largest trade exposure to China measured as half the sum of exports and imports to/from China.

drop in either total GDP or some of its components. Hong and others (2016) come closest to the goal of the present paper by analyzing a rebalancing from aggregate investment to final consumption. Their ranking of economies according to the degree of spillovers is similar to the one found here when assuming a shift towards consumption in China, although comparing the magnitude of the shock is not straightforward.

Another commonly used approach is studying impulse responses in dynamic stochastic general equilibrium models, like the G40 model used in IMF (2014a), GIMF used in IMF (2010) and FSGM as in Dizioli and others (2016) or Anderson and others (2015). All these focus on the behavior of aggregate variables where countries are bilaterally linked through fixed export weights that don't depend on the shock studied. Additionally, IMF (2014a), (2016a) and (2016b) focus on financial spillovers using a variety of approaches.

The model presented here is better compared to another recent literature that uses trade models to quantify shocks in China, such as Hsieh and Ossa (2011) and Di Giovanni and others (2014) following seminal work of Melitz (2003) and Eaton and Kortum (2002).

A trade model of this type is well suited to capture rich input-output interlinkages and to model the extensive international production value chains that nowadays dominate world trade. Caliendo and Parro (2015) argue that accounting for this input-output structure is crucial for their counterfactual exercise. Presumably the logic applies to the shocks studied here as well.

The model's simplifying assumptions tend to lean on the side of understating the magnitude of spillovers. The model presented here focuses on the trade channel alone, which has been identified as a main channel but is not unique[4]. The financial channel could serve as an additional amplifier of the shocks studied here. The model also abstracts from dynamics, thus ignoring transition costs which may be sizable and further exacerbate the magnitude of implied spillovers. Note in particular that the model assumes full employment before and after the shocks because wages are fully flexible. Dynamic productivity changes are also not considered which would serve as an additional amplifier[5].

On the other hand, the model does not include trade in services, which could potentially be an important mitigating factor, although a full offset is unlikely at least in the medium-term. Trade in services is not considered, not so much because trade data is unavailable, but rather because the associated level of trade costs are hard to measure, unlike the case of goods trade where tariffs are readily available. Ignoring services trade could mean the model spillovers are overstated as the distribution of adverse spillovers in goods trade could coincide with the distribution of positive spillovers from China's increased demand for services. Such a possibility while important is unlikely to fully offset the spillovers found here at least in the medium-term, since services trade is still an order of magnitude smaller than trade in goods

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[4] IMF 2016a argues that the trade channel is still crucial to understand spillovers, although the financial channel is becoming increasingly important particularly after the global financial crisis.

[5] See Sampson (2016) for a recent discussion and treatment.

(see Appendix figure A1). Finally, a full offset is also unlikely given the strong complementarity between goods and services trade as documented in Egger and others (2015).

This paper adds to the understanding of the impact of observed and prospective structural changes to the Chinese economy. Its strenghts lie in studying the nature of changes in comparative advantage and recomposition of value chains as China rebalances. But given some of the simplifying assumptions, the paper should be used in conjunction with some of the studies discussed above.

Section II. presents the Ricardian model in detail, as well as some derivations used later. Section III. briefly presents the data and how the model is calibrated and Section IV. discusses simulations of a set of shocks originating in China and how they affect selected economies. Section V. presents concluding remarks.

II. A QUANTITATIVE TRADE MODEL TO ASSESS SPILLOVERS

The model presented in this section is a version of Caliendo and Parro (2015), with a wider set of counterfactual experiments, in particular shocks to preferences and shocks to fundamental productivity. Notation is kept close to that in Caliendo and Parro (2015) and assumes that fundamental productivity scales value added as in Caliendo and others (2015).

General Environment Consider a world with N countries and J sectors, denoted by i, n and j, k, h respectively. In each country and sector there are both producers of a continuum of intermediate goods and producers of final goods[6]. Final goods can be either used as inputs into the production of intermediate goods or in final consumption by households.

Households Each country has L_n workers/individuals whose representative utility is:

$$u(C_n) = \prod_{j=1}^{J} \left(C_n^j\right)^{\alpha_n^j}, \text{ where } \sum_{j=1}^{J} \alpha_n^j \tag{1}$$

α_n^j are shares in final demand for goods. National income is composed of wages ($w_n L_n$), lump-sum tariff rebates (R_n) and trade deficit with the rest of the world (D_n):

$$I_n = w_n L_n + R_n + D_n \tag{2}$$

Intermediate Goods Producers The production technology for a given intermediate good ω^j is Cobb-Douglas of the form:

$$q_n^j\left(\omega^j\right) = z_n^j\left(\omega^j\right)\left[l_n^j\left(\omega^j\right)\right]^{\gamma_n^j} \prod_{j=1}^{J}\left[m_n^{k,j}\left(\omega^j\right)\right]^{\gamma_n^{k,j}} \tag{3}$$

where $l_n^j\left(\omega^j\right)$ is labor and $m_n^{k,j}\left(\omega^j\right)$ are the final goods from sector k used in the production of intermediate good ω^j. There is a continuum of ω^j goods in the unit interval for each sector j. $\gamma_n^{k,j}$ is the share of materials from k used in producing ω^j and γ_n^j is the share of value added such that $\sum_{k=1}^{J} \gamma_n^{k,j} = 1 - \gamma_n^j$. $z_n^j(.)$ is idiosyncratic productivity.

Markets are competitive and labor is fully mobile within the borders of each country.[7] Firms price at unit cost $c_n^j / z_n^j\left(\omega^j\right)$ because of Cobb-Douglas production function. Let c_n^j be the cost of an input bundle:

$$c_n^j = \Gamma_n^j w_n^{\gamma_n^j} \prod_{k=1}^{J} \left(P_n^k\right)^{\gamma_n^{k,j}} \tag{4}$$

note costs include wages (labor) and prices for intermediate inputs.

[6] Caliendo and Parro (2015) refer to these as “composite goods producers”.

[7] These are strong assumptions. In the calibration, sectors are defined at the 2-digit ISIC code. It is unlikely that markets are competitive within each of these broad sectors. Branding and price discrimination are likely to play a role in particular sectors. Moreover, labor does not migrate seamlessly across sectors in the short- and even medium-term. The model is thus not appropriate for thinking of transitions between two steady-states.

Final Goods The production function of final goods is Dixit-Stiglitz of the form:

$$Q_n^j = \left[\int r_n^j \left(\omega^j\right)^{1-1/\sigma^j} d\omega^j \right]^{\sigma^j/\left(\sigma^j-1\right)}$$

σ^j is the elasticity of substitution across intermediate goods and r_n^j is the demand for good ω^j. Cost minimization leads to a unit price of final goods in each country/sector of:

$$P_n^j = \left[\int p_n^j \left(\omega^j\right)^{1-\sigma^j} d\omega^j \right]^{1/\left(\sigma^j-1\right)} \tag{5}$$

with $p_n^j\left(\omega^j\right)$ being the lowest price of intermediate ω^j across countries available in country n.

Trade costs There are two components to trade costs: an iceberg trade cost and an ad-valorem flat-rate tariff:

$$\kappa_{ni}^j = \left(1+\tau_{ni}^j\right) d_{ni}^j \tag{6}$$

Thus, a unit of intermediate traded good ω^j produced in country i is available in country n at unit cost $c_i^j \kappa_{ni}^j / z_i^j\left(\omega^j\right)$.

Comparative advantage The price for traded intermediate good ω^j in country n is:

$$p_n^j\left(\omega^j\right) = \underset{i}{Min}\left\{ \frac{c_i^j \kappa_{ni}^j}{z_i^j\left(\omega^j\right)} \right\}$$

In case the intermediate good is nontraded, its price is only a function of local input bundle cost and technology.

Following Eaton and Kortum (2002), assume $z_n^j\left(\omega^j\right)$ is independently Fréchet distributed with parameters λ_n^j and θ^j that govern the level of productivity in each country/sector and dispersion of productivities across sectors, respectively. In that case, it can be shown that the price of the final good is:

$$P_n^j = \mathrm{T}_j \left[\sum_{h=1}^{N} \lambda_h^j \left[c_h^j \kappa_{nh}^j \right]^{-\theta_j} \right]^{-\frac{1}{\theta_j}} \tag{7}$$

where T_j is a constant.

Let the expenditure on final goods of sector j in country n be $X_n^j = P_n^j Q_n^j$. Then, the share of expenditure in country n in goods from country i is:

$$\pi_{ni}^j = \frac{\lambda_i^j \left[c_i^j \kappa_{ni}^j\right]^{-\theta_j}}{\sum_{h=1}^N \lambda_h^j \left[c_h^j \kappa_{nh}^j\right]^{-\theta_j}} \quad (8)$$

using the properties of the Fréchet distribution.

Total expenditure on good j is hence:

$$X_n^j = \sum_{k=1}^J \gamma_n^{j,k} \sum_{i=1}^N X_i^k \frac{\pi_{in}^k}{1+\tau_{in}^k} + \alpha_n^j I_n \quad (9)$$

And a country's trade deficit D_n is by definition:

$$\sum_{k=1}^J \sum_{i=1}^N X_n^k \frac{\pi_{ni}^k}{1+\tau_{ni}^k} - D_n = \sum_{k=1}^J \sum_{i=1}^N X_i^k \frac{\pi_{in}^k}{1+\tau_{in}^k} \quad (10)$$

Equilibrium is a set of national wages and final goods prices such that (10), (9), (8), (7) and (4) hold given trade costs, sectoral productivity, aggregate trade deficits and size of labor force in each country.

As in Deckle and others (2012), we express the equilibrium conditions in changes relative to a base year for counterfactual analysis, which avoids the need to estimate the level of some of the parameters.

Equilibrium in changes for all shocks Equilibrium is a set of changes in wages and prices such that the following equations[8] hold when taking each shock at a time:

$$c_n^j = \left(w_n\right)^{\gamma_n^j} \prod_{k=1}^J \left(P_n^k\right)^{\gamma_n^{k,j}} \quad (11)$$

$$\pi_{ni}^j = \lambda_i^j \left[\frac{c_i^j}{P_n^j}\right]^{-\theta_j} \quad (12)$$

$$P_n^j = \left[\sum_{h=1}^N \lambda_h^j \left(c_h^j\right)^{-\theta_j} \pi_{nh}^j\right]^{-\frac{1}{\theta_j}} \quad (13)$$

$$X'^j_n = \sum_{k=1}^J \gamma_n^{j,k} \sum_{i=1}^N X'^k_i \frac{\pi'^k_{in}}{1+\tau_{in}^k} + \alpha'^j_n I'_n \quad (14)$$

$$\sum_{k=1}^J \sum_{i=1}^N X'^k_n \frac{\pi'^k_{ni}}{1+\tau_{ni}^k} - D'_n = \sum_{k=1}^J \sum_{i=1}^N X'^k_i \frac{\pi'^k_{in}}{1+\tau_{in}^k} \quad (15)$$

[8] These are just equations (10), (9), (8), (7) and (4) in changes where "hats" denote changes from a base year and "primes" denote the new level of each variable.

where $I'_n = w_n w_n L_n + \sum_{k=1}^{J}\sum_{i=1}^{N} X'^k_n \frac{\pi'^k_{ni}}{1+\tau^k_{ni}}\tau^k_{ni} + D'_n$

These equations differ from equations (10)-(15) in Caliendo and Parro (2015) because they accommodate additional shocks, and instead abstract from changes in trade costs, $\tau^k_{in} = 0$.

The shocks included in equations (11)-(15) above are:

- Preference shocks, α'^j_n
- Supply shocks, λ^j_n
- Income shocks, D'_n

Impact on Welfare The impact of each shock on welfare or real income is measured using:

$$d\ln W_n = \underbrace{\frac{1}{I_n}\sum_{j=1}^{J}\sum_{i=1}^{N}\left(E^j_{ni} d\ln c^j_n - M^j_{ni} d\ln c^j_i\right)}_{Terms-of-Trade} + \underbrace{\frac{1}{I_n}\sum_{j=1}^{J}\sum_{i=1}^{N}\tau^j_{ni} M^j_{ni}\left(d\ln M^j_{ni} - d\ln c^j_i\right)}_{TradeVolume}$$
$$+ \underbrace{\frac{1}{I_n}\sum_{j=1}^{J}\sum_{i=1}^{N} M^j_{ni}\frac{1+\tau^j_{ni}}{\theta_j} d\ln\lambda^j_i}_{SupplyShock} + \underbrace{\frac{1}{I_n} dD_n}_{IncomeShock} \tag{16}$$

The first term reflects improvements in terms-of-trade following any given shock. As the pattern of trade specialization changes, production costs and prices adjust. A sector contributes positively to income growth if export prices rise more than import prices and the sector is net exporting to the world. Changes in input prices in country n in sector j are weighted with the country's exports, $E^j_{ni} d\ln c^j_n$, whereas changes in input costs for the same sector in other countries are weighted by n's imports, $M^j_{ni} d\ln c^j_i$.

The second term is the contribution of larger trade to income, since tariffs on imports constitute additional income accruing to households in n. This contribution depends on changes in real imports at the sector level, $d\ln M^j_{ni} - d\ln c^j_i$, and the actual volume of tariffs in that sector. A country that has no tariffs on any of its imports would have this second term set to zero.

The third term isolates the direct contribution that supply shocks make. This term could be subsumed in the two previous terms. Note that a positive supply shock in another country in a nontraded sector will not have any direct impact in country n since imports from that sector are assumed to be zero.

The fourth and last term is the direct impact of changes in trade balance and reflects a pure change in income since a higher aggregate deficit translates into higher expenditure.

Mapping supply shocks in the model with measured TFP shocks Using the same approach as Caliendo and others (2015)[9], one can relate measured TFP in country n and sector j, A_n^j, to fundamental sector-level productivity, λ_n^j. First note that the change in measured productivity equals the change in the real cost of input bundle:

$$\hat{A}_n^j = \hat{c}_n^j / \hat{P}_n^j \tag{17}$$

Manipulating equation (12), we express the change in the real cost of input bundle as:

$$\frac{\hat{c}_n^j}{\hat{P}_n^j} = \left(\frac{\hat{\lambda}_n^j}{\hat{\pi}_{nn}^j} \right)^{\frac{1}{\theta_j}} \tag{18}$$

Combining equations (18) and (17) and solving for fundamental productivity:

$$\hat{\lambda}_n^j = \hat{\pi}_{nn}^j \left(\hat{A}_n^j \right)^{\theta_j} \tag{19}$$

If TFP is measured in constant prices, i.e. without changing base year weights, then the equation above simplifies to[10]:

$$\hat{\lambda}_n^j = \left(\hat{A}_n^j \right)^{\theta_j} \tag{20}$$

Therefore, supply shocks in the model can be mapped directly to constant price TFP.

The next Section discusses data and calibration of this model. The reader interested in model simulations in response to China rebalancing shocks should jump to Section IV.

III. DATA AND CALIBRATION

The model in the previous section is first calibrated to match the observed bilateral trade between economies/sectors in a base year using equations (4), (7)-(10), and then it is solved in deviations from that base year for each desired counterfactual using equations (11)-(15).

To bring the model to the data, the most important source used is World Input-Output Dataset (WIOD), as detailed in Timmer and others (2015). We use in particular the World Input-Output tables, November 2013 update. WIOD is harmonized in terms of industry-classifications both across time and economies, with a breakdown of 35 industries that are classified according to International Standard Industrial Classification (ISIC), Revision 3.

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[9] See equation (17) in that paper. The model there assumes that the locational parameter in the Fréchet distribution of idiosyncratic productivity is one, while what is defined there as fundamental productivity, T_n^j, raised to the power of γ_n^j enters directly in an equation that corresponds to equation (3) in this paper. That representation can be shown to be equivalent to defining $\lambda_n^j = \left(T_n^j \right)^{\gamma_n^j \theta_j}$ here.

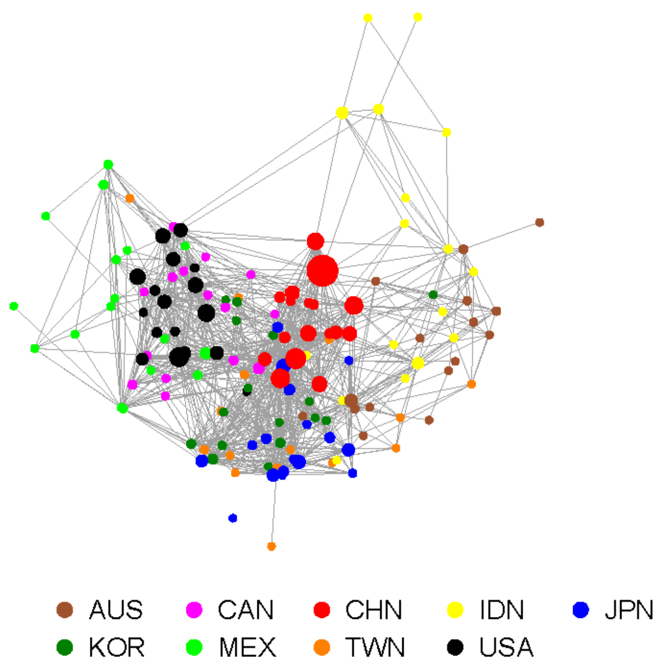
[10] See footnote 15 in Caliendo and others (2015) for a detailed discussion.

(continued…)

The model is calibrated to 2011, the latest year available in WIOD, and features 40 economies and a "Rest of the World" block each composed of 34 sectors.[11] Because tariff data is not available for services, we impose zero exports from those sectors, resulting in 17 traded sectors.

Figure 2 is a network representation of the rich inter-linkages between sectors and across economies captured by the calibrated model. Each node represents a sector, with its color depending on the economy it is in and its size being proportional to value added in U.S. dollars.[12] The network places each sector relative to others depending on the strength of its connections. Bilateral connections are measured as the average of inputs and outputs between sectors. The picture is only a partial depiction of the full network imbedded in the model since it focuses on a sub-set of economies (only East Asia and North America) and a sub-set of sectors (only traded sectors). We have also ignored small sectors/connections.

Figure 2. Global network between traded sectors in 2011:
East Asia and North America



Source: WIOD, author's calculations.

Figure 2 shows that China is at the center of Asia's supply chain. Japan and Korea also have ties with the United States, while other Asia/Pacific economies like Australia or Indonesia

[11] WIOD covers 27 European Union (EU) countries and 13 other major economies. We exclude one sector from WIOD's original 35 sectors, which has a considerable number of missing values. See Appendix tables 1 and 3 for a complete list of economies and sectors used in the calibration. All data adjustments are detailed in Appendix: Detailed Data Sources.

[12] Note that China's traded sectors are somewhat larger than the size of corresponding sectors in the United States, with the reverse being true regarding nontraded sectors (not shown).

are mostly connected to China. On the other side of the Pacific, Mexico is mostly tied to the U.S. with limited direct ties to Asia, unlike Canada.

The model presented in the previous section takes the rich inter-linkages exemplified in Figure 2 and simulates the impact of a shock originating in one part of this vast network on any given economy/sector. In particular, the model is able to distinguish differential effects on economies/sectors depending on the source shock.

Importantly, the network of trade patterns changes endogenously when solving the model for any given shock. Other approaches to modeling spillovers may assume fixed exposures across economies/sectors, which could be unreasonable depending on the size and origin of the shock.

In the next Section we discuss a set of counterfactuals or shocks that are intended to capture one of the three dimensions that have been linked to so called "China rebalancing" discussed in Section I.

IV. THE IMPACT OF REBALANCING IN THE CHINESE ECONOMY: COUNTERFACTUAL EXPERIMENTS

In the introduction, we presented three different dimensions that are often associated to Chinese rebalancing:

1) Domestic demand is moving from investment to consumption;
2) On the production side, services are growing at a faster pace than manufacturing;
3) Within manufacturing, tech-intensive sectors are growing at a faster pace than less tech-intensive sectors;

In this section, we map these three dimensions into shocks in the model presented in Section II. and compute the resulting spillovers for other economies. Spillovers are calculated in the case of no other concurrent event beyond the original shock. One thing to keep in mind is that, while the intensity of the shocks fed into the model is often just indicative, and thus spillovers should be interpreted as giving relative elasticities to each set of shocks, spillovers may not be extrapolated easily to a different sized shock since the model is non-linear. We discuss this point further in sub-section C. below, where we look at how spillovers depend on the size of a particular shock.

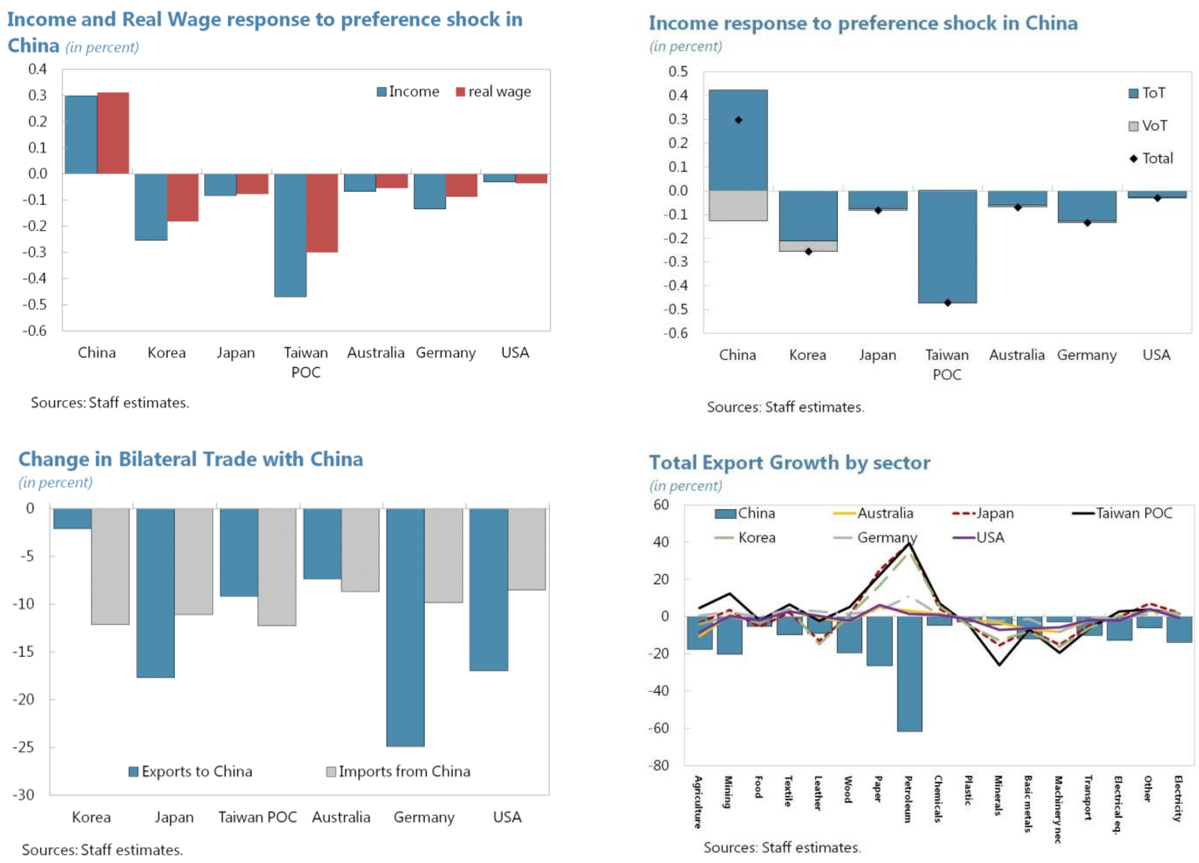
We present counterfactuals for each of the three dimensions in detail in the next three sub-sections.

A. Development 1: Move into consumption away from investment

In this subsection, changes in the relative importance of consumption and investment in Chinese final demand are proxied by changes in preferences over different types of goods or sectors in China, defined as α'^{j}_{CHN} in the model. Absent a clear quantitative prior on how preferences should move, the "preference shock scenario" assumes that Chinese consumer preferences change to match the preferences of the U.S. consumer in the base year ($\alpha'^{j}_{CHN} = \alpha^{j}_{USA}$).[13]

The shock implies that the average Chinese consumes more nontraded goods, with the notable exception of construction, and less traded goods, particularly machinery, transport and electrical equipment. Figure 3 contains four panels that summarize key responses to the shock for China and a select group of economies with the largest trade exposure to China. Appendix table 5 has the full set of results for all economies.

Figure 3: Preference shock towards consumption in China



A preference shock towards consumption in China leads to an improvement of Chinese real income of 0.30 percent, while leading to lower real income for all other major economies (Figure 1, top left). Taiwan, Province of China and Korea seem to be those most affected with a drop of real income of 0.47 and 0.25 respectively. Real wages show a similar pattern.[14]

[13] Appendix figure A2 shows the assumed shock in preferences.

[14] Hong and others (2016) find a similar ordering for the impact of a 1 percentage point rise in China's consumption share of GDP with a similar sized concomitant drop in China's investment share, although it is

(continued…)

Using equation (16), the effects on income can be mostly attributed to changes in the terms-of-trade, with China seeing an improvement and others a deterioration (Figure 1, top right). Volume of trade on the other hand contributes negatively also to China, since under this scenario there is a net decrease in Chinese imports which leads to a fall in tariff income.

China cuts back on its imports from all major economies since the shock involves a shift from Chinese consumption of traded to nontraded goods, and the latter are much less import intensive than the former (Figure 1, bottom left). Exports of China to those same economies are also smaller, since in the exercise trade balances are kept constant.

China's exports contract across all traded sectors (Figure 1, bottom right). On the other hand, exports of major economies increase in some sectors and decrease in others. Korea, Japan and Taiwan, Province of China exports of petroleum, paper and wood products fare comparably well, while those of machinery nec and minerals do not. This can be traced back to the original shock; whereby Chinese consumers' preferences change in the same direction. Appendix table 6 has more details on sectoral export patterns before and after the preference shock.

The effects across other non-major economies depend on their relative level of income (Appendix Table 5). Low-to-middle-income economies seem to benefit on average, particularly those in southern and southeastern Europe but not those in other regions (see Brazil or Indonesia). Exports to China contract significantly in general, but total exports are less affected which points to export substitution away from China. China's own total exports contract 9.46 percent.

Finally, note that the assumed move towards consumption in China will undoubtedly happen over a long period of time and thus the "preference shock scenario" should be viewed as a shock that is somewhat large in size. Although final consumption is taking up a growing share of China's GDP and was around 50 percent in 2011, it is still far below the same number for the US which was about 85 percent.

B. Development 2: Productivity of service sectors increases while it decreases in industry

Services have accounted for an increasing share of Chinese GDP as discussed in the introduction. This however, seems to be primarily driven by increases in inputs rather than higher total factor productivity (TFP), although we lack data to compute TFP for the most recent years. WIOD data available up to 2009 shows that TFP of services outperformed that of industry (manufacturing and mining and quarrying) from 2004 (Figure 4). However, that conclusion does not hold when using labor productivity data available up to 2014, with services having lower labor productivity growth since 2008.

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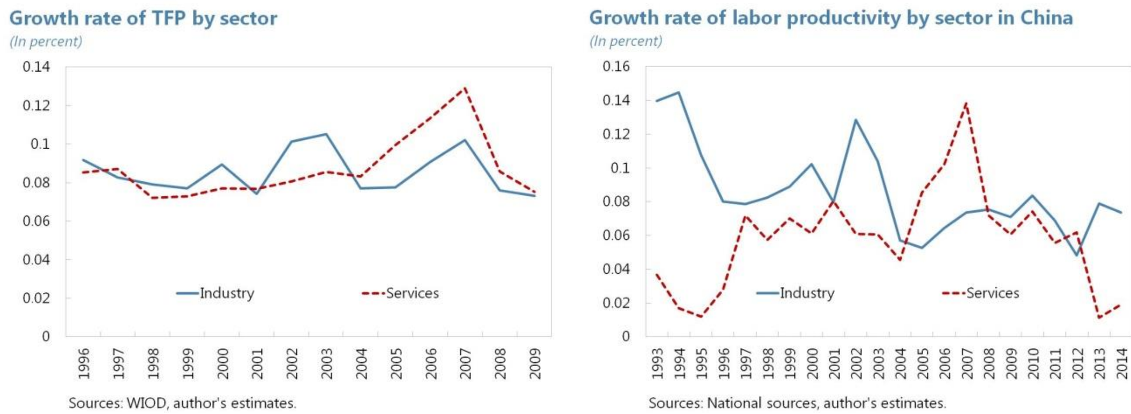
hard to directly compare results given the different nature of the experiment. There, spillover impacts are measured on domestic value-added exports to China in percent of GDP, and thus may be more usefully compared to the impact on real income in this paper, rather than to the impact on gross exports to China.

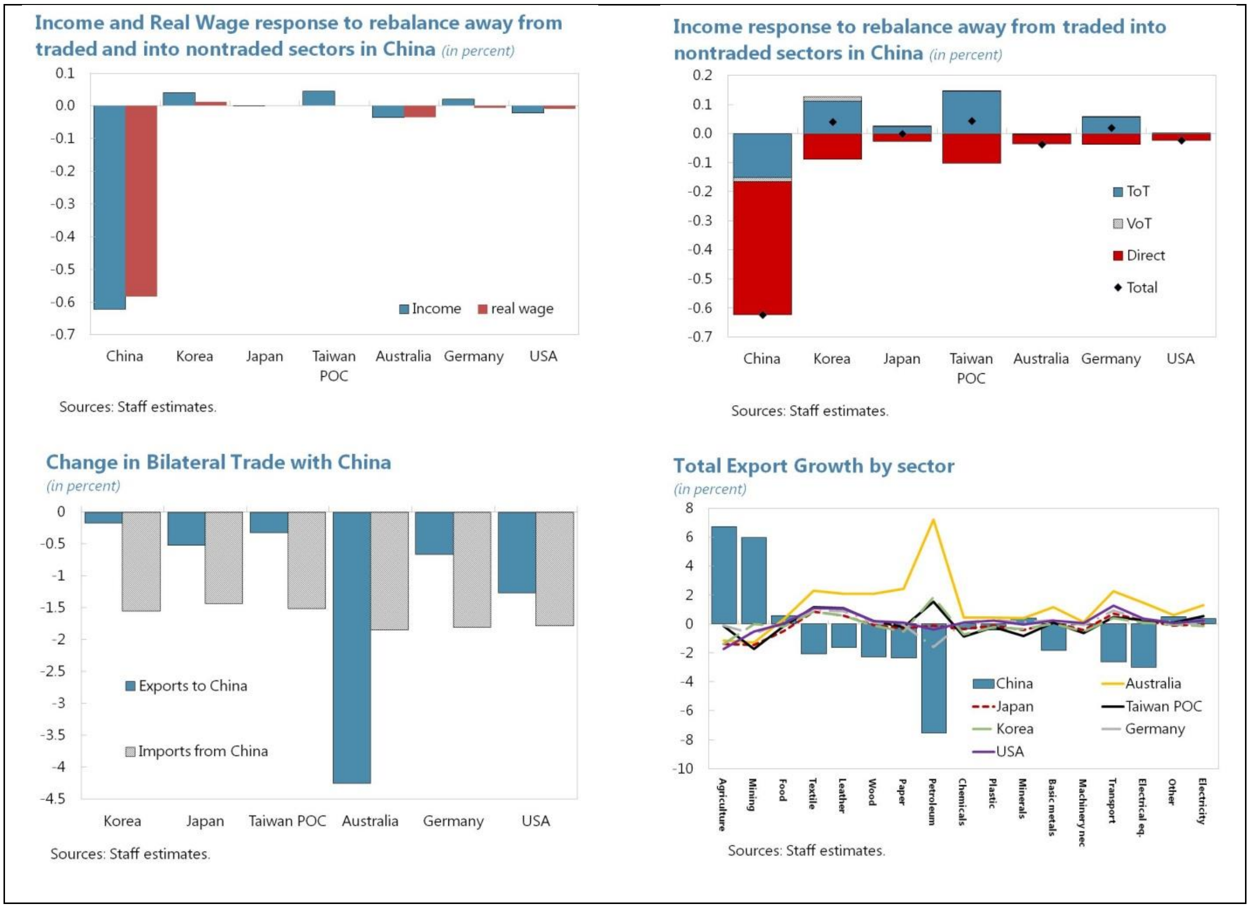
Figure 4. Growth rate of TFP and labor productivity by sector in China



The only way to expand the services sector from the production side in the model is to increase its TFP, since labor is the only input in the model and it is assumed to be fully mobile across sectors. We hence shock positively the services sector (which we equate to nontraded sectors) while shocking negatively the productivity of industry. All results assume a shock of 1% to TFP, mapped to shocks in λ_{CHN}^{j} using equation (20). Simply shocking nontraded sectors would not produce large spillovers as much of the gains would inherently be circumscribed to China, although nontraded sectors use imported inputs and are themselves used as inputs by Chinese traded sectors. Figure 5 contains four panels that summarize key responses to this shock.[15]

Figure 5: Increased productivity in Chinese nontraded sectors and decreased in traded sectors

[15] Appendix table 7 has the full set of results for each economy.



Given China's larger reliance on traded sectors, a positive shock to nontraded sectors' productivity that is offset by a negative shock to the productivity of traded sectors has a net negative impact on Chinese real income or welfare of 0.6 percent and has limited spillovers to other economies (Figure 5, top left). On one hand, Taiwan, Province of China and Korea's income increase marginally by 0.04 percent, while on the other, Australia is negatively affected with its income declining by 0.04 percent.

The limited spillovers from this shock stem from two offsetting effects.[16] China becoming less productive in traded sectors affects negatively all economies, with the magnitude depending on the degree of import dependence from China. This effect can be seen in the red bars of Figure 5, top right. At the same time, China vacates some markets where it is no longer as competitive which tends to benefit all economies through improvements in their terms-of-trade as represented by the blue bars in the same figure. For Korea and Taiwan, Province of China the second effect dominates while for Australia it is the first effect that is quantitatively more important.

[16] Note that spillovers from this shock are different from those discussed in the previous sub-section because the nature of the shocks is very different as well. The previous sub-section features a sector specific demand shock while in the present sub-section a supply shock is applied to all sectors depending only on whether they are traded or non-traded.

All economies see a reduction in their bilateral trade with China, particularly imports from China, given the loss of competitiveness of the traded sectors in China (Figure 5, bottom left). Exports to China, although declining, seem to be less affected for all major economies except Australia. Here again there are two opposite effects: the declining productivity in Chinese traded sectors leads to reduced imported input-use which is offset by increased imported inputs for nontraded sectors. The first effect is strongest since traded sectors use imported inputs more intensively.

Although Australia is the major economy whose exports to China seem most affected, its overall exports are not as affected and in fact its traded sectors expand except for Mining and Agriculture (Figure 5, bottom right). China's export growth pattern is almost reversed. Mining and Agriculture are upstream sectors that are heavily used as inputs by other traded sectors. Since China's traded sectors contract, some of the Chinese production in Mining and Agriculture which was previously used domestically is now shipped abroad (these changes can be observed clearly in Appendix table 8).

Although spillovers are small across all economies, major manufacturing economies seem to benefit relatively more than others. Korea and Taiwan, Province of China come out with the largest gains in real income and smallest decreases of exports to China, despite the large direct impact of more expensive imports from China. As was the case for the preference shock, China sees its exports diminish (-1.67%), which is accompanied by a boost to total exports of most other economies.

Alternatively, instead of scaling back all traded sectors in China, we could consider a productivity decline in particular sectors that have oversupply, like construction and base metals. Such a shock does not lead to qualitatively different spillovers from those discussed above but the sectoral distribution of impacts is more heterogeneous (See Appendix Figure A3 for the summary of results).

C. Development 3: China moves up the value chain

As mentioned in the introduction, another side to China's rebalancing lies in changes in its production structure within manufacturing towards the production of higher-value goods. As China has become more technologically developed, it has both increased the quality of the output of existing industries as well as forayed into new industries. While China is firmly positioned downstream within the Asian value chain, early signs have emerged of import substitution of parts and other components that have been traditionally produced by more sophisticated upstream economies like Taiwan, Province of China, Korea and even Japan.

The model presented in Section II is particularly well suited to study China's move up the value chain since it has embedded an input-output structure that tracks changes in the composition of value chains. Presumably, if China becomes more competitive in a given upstream sector, more of the inputs of other Chinese industries will be sourced domestically while at the same time it is possible that China itself starts competing in export markets in goods from that same upstream sector. All of these possibilities can be well captured by the model.

One drawback of the analysis done here resides in the calibration, which should be more granular if more detailed data were available. The data aggregation from WIOD used to calibrate the model is 2-digit ISIC level as discussed in Section III. Ideally, we would want to use greater detail of the input-output structure of these economies to more accurately capture shifts in production patterns. Having said this, the approach followed in this paper is better suited to study China's move up the value chain relative to focusing on aggregate trade patterns as other studies do.

Even at the level of aggregation considered, there are several ways to define the degree of production sophistication in an industry. We considered 4 potential alternatives: a sector's 1) tech-intensity; 2) factor intensity; 3) labor intensity; 4) complexity in production. See Appendix table 4 to view industry sectors classified in terms of their sophistication according to all four criteria. There is considerable overlap in different classifications of industry sophistication, and thus results tend to be qualitatively similar across these different classifications.

In the main text that follows, the exercise focuses on technology intensity by measuring the impact of a positive TFP shock of 1 percent in high-tech industry sectors and a simultaneous negative shock in low-tech industry sectors of the same magnitude in China. We chose to also shock low-tech industries to capture the idea that as China moves up the value chain it will vacate certain markets where it is no longer no longer competitive. This can be justified by also noting that labor intensive sectors in China may in the future be at a disadvantage given the challenging demographics and competition from lower-income economies which are included in the "Rest Of the World" block, and are thus not singled-out in the model's calibration.

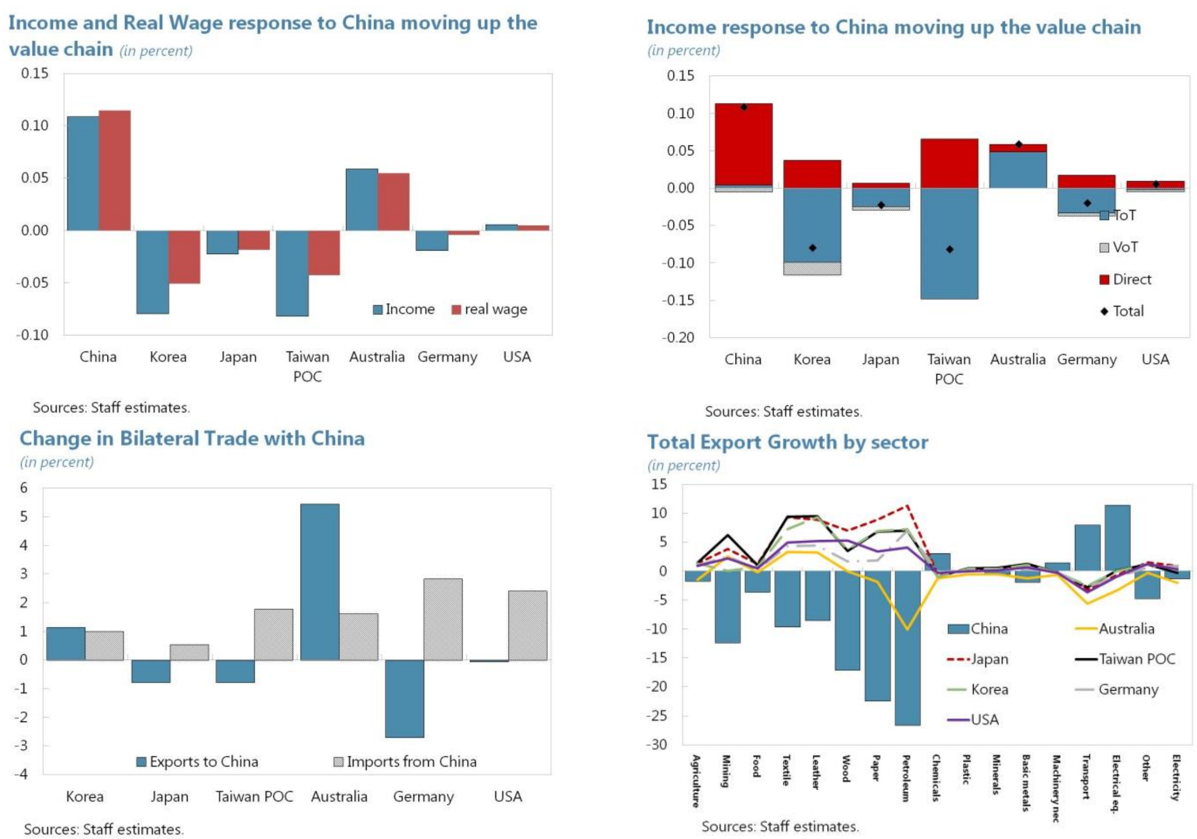
Under this scenario, China's income increases by 0.11 percent while Korea's and Taiwan, Province of China's decreases by 0.08 percent (Figure 6, top left). Real income of Japan, Germany and USA is relatively unchanged, while Australia actually benefits seeing its income rise by 0.06 percent. Effects across all economies are shown in Appendix table A9.

Spillovers are driven by changes in terms of trade. The direct impact of China moving up the value chain is positive for all major economies as shown in the red bars of Figure 6, top right panel, since imports of inputs from China to these economies are on net cheaper. Interestingly, Taiwan, Province of China and Korea have the most positive direct impact. However, China becomes competitive in industries that Korea and Taiwan, Province of China used to occupy. This displacement justifies the sharper decline in terms of trade as those exports of high value goods are only partially compensated by newly competitive exports of low-value goods. Australia does not suffer this competitive effect and essentially benefits from lower prices on its imports while exploring a large degree of complementarily with China's new production pattern as seen by a surge in its exports to China (Figure 6, bottom left).

In terms of sectoral performance, lower tech sectors across major economies increase their exports, like food and beverages or textiles, while the reverse is true for higher-tech sectors like machinery and electronics (Figure 6, bottom right). In particular, China's export share of tech-intensive industries like transport, electric equipment and chemicals goes up while it goes down in lower tech sectors (see Appendix Table A10).

Looking across all economies, Korea and Taiwan, Province of China still standout as suffering the sharpest fall in their real incomes while Australia and the Rest Of the World benefit most. In fact, lower and middle income economies seem to benefit on average, such as the Rest Of the World, which includes mostly middle-and-lower income economies as well as oil exporters, Indonesia, Brazil and some economies in Southern and Southeastern Europe. This is expected as their comparative advantage in lower-tech manufacturing is reinforced while at the same time they can benefit from cheaper imports of higher-tech goods from China.[17] Exports change unevenly across economies, depending on whether their pattern of production is more or less concentrated in higher-tech industries.

Figure 6: China moves up the value chain into higher-tech industries



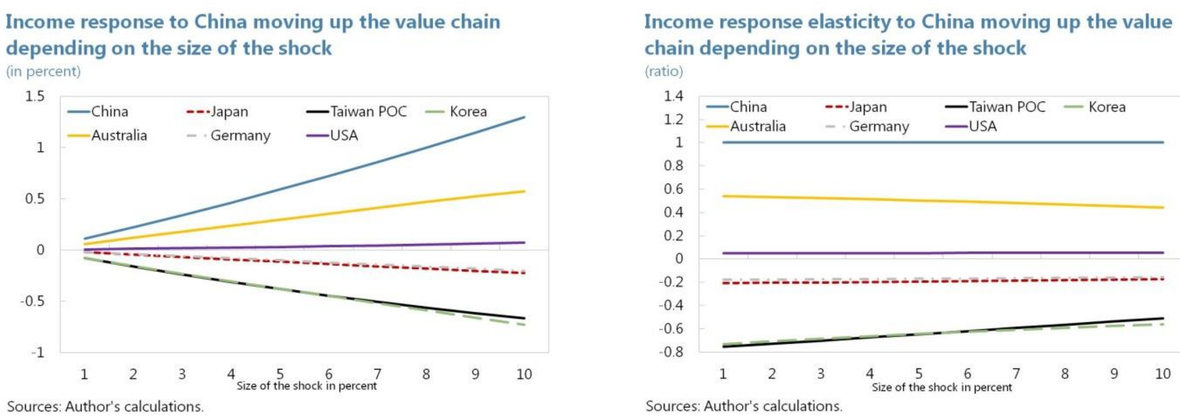
The absolute effects of this shock seem more moderate than previous shocks in particular the preference shock discussed in subsection A. There, while the relative elasticity of the shock (measured as the income spillovers to others relative to effect on China's income) is comparable to the present shock, the overall absolute effects were three times larger.

[17] See IMF 2016c for a study with similar findings for lower-to-middle income economies in Southeast Asia.

However, it is not appropriate to compare the two shocks directly. The preference shock features a quite significant shift in preferences that would likely take place over an extended period of time while the productivity shocks considered here are relatively small in comparison at only 1 percent in either direction.

If we simulate shocks of larger magnitude, the effects on income of both China and others are much larger (Figure 7, left). In fact, a shock of China moving up the value chain generated by 3 percent change in TFP generates equivalent effects as the shock to preferences discussed in subsection A. If the shock is larger, effects will be comparatively more positive for China and more negative for Korea or Taiwan, Province of China, for example.

Figure 7: Effects on income depending on size of the moving up the value chain shock



The right panel in Figure 7 shows that spillovers from this model are nonlinear. This figure divides spillovers on income from major economies by the effect on China itself to compute an elasticity of the shock. China is by definition always at unit elasticity, while the others vary from around 0.5 for Australia and -0.75 for Taiwan, Province of China. Interestingly, as we vary the size of the shock the elasticity of spillovers goes down, particularly for the most affected economies of Korea and Taiwan. This example shows that inferring the effects of large shocks in China based on the elasticity to a small shock is likely to overestimate spillovers.

V. Concluding Remarks

This paper used a multi-country, multi-sector trade model to assess the magnitude of spillovers stemming from shocks related to particular aspects of rebalancing in the Chinese economy. The model is geared towards capturing shifts in production value chains and patterns of goods trade across sectors since comparative advantage is endogenously determined.

The analysis here should be used as a complement to other approaches. Others have focused, for example, on measuring financial spillovers or dynamic impacts in aggregate investment, consumption and net exports. These are all relevant and not captured by the present model. Recent attempts to expand the same type of framework presented here to include dynamics like Eaton and others (2016) or Allen and others (2014) are promising avenues to conduct a more general exercise. Considering other channels and dynamics would likely amplify the magnitude of spillovers found here.

One area not captured that could mitigate, but likely not fully offset, the magnitude of spillovers is trade in services. In the model presented here, services are assumed to be nontradable because data on the level of trade costs in services are unavailable. China's rising income and shift towards services consumption presents an opportunity for economies whose services are competitive in the global market, some of which may be exactly those found to be most adversely affected in the goods trade channel. We note, however, that while outgrowing trade in goods in recent years, trade in services is still considerably smaller. Thus, a full offsetting of the effects found here would require a significant re-composition of trade, something not likely to occur even in the medium term.

Finally, it is important to remember that the effects presented here are in a counterfactual world where nothing else happens except for certain events in China. This is done to evaluate the effects of such events on their own as is often done in the literature. The final spillovers would depend on the actual set of policy responses followed. Policy responses to shocks in China, particularly those that generate large spillovers, should be expected.

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Appendix: Detailed Derivation of Results

Derivation of equilibrium equation (13)

Combine (7) and (8) to get:

$$\pi_{nh}^{j} = \lambda_{h}^{j} \left(\mathrm{T}_{j} \right)^{-\theta_j} \left[\frac{c_h^j \kappa_{nh}^j}{P_n^j} \right]^{-\theta_j}$$

And then define:

$$\lambda_{h}^{j} = \pi_{nh}^{j} \left[\frac{c_h^j \kappa_{nh}^j}{P_n^j} \right]^{\theta_j} \frac{1}{\left(\mathrm{T}_{j} \right)^{-\theta_j}} \tag{21}$$

Then compute the changes in equation (7):

$$\frac{P_n'^j}{P_n^j} = \hat{P}_n^j = \mathrm{T}_j \left(\left[\sum_{h=1}^{N} \lambda_h'^j \left[c_h'^j \kappa_{nh}^j \right]^{-\theta_j} \right]^{-\frac{1}{\theta_j}} \right) / P_n^j$$

$$\hat{P}_n^j = \mathrm{T}_j \left(\left[\sum_{h=1}^{N} \frac{\lambda_h'^j}{\lambda_h^j} \lambda_h^j \left[\frac{c_h'^j}{c_h^j} c_h^j \kappa_{nh}^j \right]^{-\theta_j} \right]^{-\frac{1}{\theta_j}} \right) / P_n^j$$

$$\hat{P}_n^j = \mathrm{T}_j \left(\left[\sum_{h=1}^{N} \frac{\lambda_h'^j}{\lambda_h^j} \left(\frac{c_h'^j}{c_h^j} \right)^{-\theta_j} \lambda_h^j \left[c_h^j \kappa_{nh}^j \right]^{-\theta_j} \right]^{-\frac{1}{\theta_j}} \right) / P_n^j$$

Using equation (21):

$$\hat{P}_n^j = \mathrm{T}_j \left(\left[\sum_{h=1}^{N} \frac{\lambda_h'^j}{\lambda_h^j} \left(\frac{c_h'^j}{c_h^j} \right)^{-\theta_j} \pi_{nh}^j \left[\frac{c_h^j \kappa_{nh}^j}{P_n^j} \right]^{\theta_j} \left(\mathrm{T}_j \right)^{\theta_j} \left[c_h^j \kappa_{nh}^j \right]^{-\theta_j} \right]^{-\frac{1}{\theta_j}} \right) / P_n^j$$

And simplifying:

$$\hat{P}_n^j = \mathrm{T}_j \left(\left(\left(P_n^j \right)^{-\theta_j} \left(\mathrm{T}_j \right)^{\theta_j} \right)^{-\frac{1}{\theta_j}} \left[\sum_{h=1}^{N} \frac{\lambda_h'^j}{\lambda_h^j} \left(\frac{c_h'^j}{c_h^j} \right)^{-\theta_j} \pi_{nh}^j \right]^{-\frac{1}{\theta_j}} \right) / P_n^j$$

$$\hat{P}_n^j = P_n^j \left(\left[\sum_{h=1}^{N} \frac{\lambda_h'^j}{\lambda_h^j} \left(\frac{c_h'^j}{c_h^j} \right)^{-\theta_j} \pi_{nh}^j \right]^{-\frac{1}{\theta_j}} \right) / P_n^j$$

Leading to equation (13).

Derivation of Changes in Income, equation (16)*:*

Welfare or real income is given by dividing equation (2) by the overall price level:

$$W_n = \frac{I_n}{P_n} = \frac{w_n L_n}{P_n} + \frac{R_n}{P_n} + \frac{D_n}{P_n} \tag{22}$$

Totally differentiating equation (22)

$$d\ln W_n = \frac{w_n L_n}{I_n} d\ln w_n + \frac{R_n}{I_n} d\ln R_n - d\ln P_n + \frac{1}{I_n} dD_n \tag{23}$$

Totally differentiating tariff revenue, $R_n = \sum_{j=1}^{J}\sum_{i=1}^{N} \frac{\tau_{ni}^j M_{ni}^j}{P_n}$,

$$dR_n = \sum_{j=1}^{J}\sum_{i=1}^{N} \tau_{ni}^j M_{ni}^j d\ln M_{ni}^j + \sum_{j=1}^{J}\sum_{i=1}^{N} M_{ni}^j d\tau_{ni}^j$$

Using the fact that we are not changing tariffs:

$$dR_n = \sum_{j=1}^{J}\sum_{i=1}^{N} \tau_{ni}^j M_{ni}^j d\ln M_{ni}^j \tag{24}$$

Totally differentiating the overall price level:

$$d\ln P_n = \sum_{j=1}^{J} \alpha_n^j d\ln P_n^j \tag{25}$$

We can now substitute (25) and (24) into (23) to get:

$$d\ln W_n = \frac{w_n L_n}{I_n} d\ln w_n + \frac{1}{I_n}\left(\sum_{j=1}^{J}\sum_{i=1}^{N} \tau_{ni}^j M_{ni}^j d\ln M_{ni}^j\right) - \sum_{j=1}^{J} \alpha_n^j d\ln P_n^j + \frac{1}{I_n} dD_n \tag{26}$$

To get the sectoral price level we differentiate equation (7):

$$d\ln P_n^j = \sum_{h=1}^{N} \pi_{nh}^j \left(-\frac{1}{\theta_j} d\ln \lambda_h^j + d\ln c_h^j + d\ln \tilde{\tau}_{nh}^j\right) \tag{27}$$

Using (27) into (26) and ignoring changes in tariffs, we get:

$$\begin{aligned} d\ln W_n = {} & \frac{w_n L_n}{I_n} d\ln w_n + \frac{1}{I_n}\left(\sum_{j=1}^{J}\sum_{i=1}^{N} \tau_{ni}^j M_{ni}^j d\ln M_{ni}^j\right) \\ & - \sum_{j=1}^{J} \alpha_n^j \sum_{h=1}^{N} \pi_{nh}^j \left(-\frac{1}{\theta_j} d\ln \lambda_h^j + d\ln c_h^j\right) + \frac{1}{I_n} dD_n \end{aligned} \tag{28}$$

Market clearing in the labor market is such that:

$$w_n L_n = \sum_{j=1}^{J} \gamma_n^j \sum_{i=1}^{N} E_{ni}^j \tag{29}$$

Using (9) to solve for α_n^j, market clearing condition in the labor market above and adding and subtracting $\frac{1}{I_n}\sum_{j=1}^{J}\sum_{i=1}^{N} E_{ni}^j d\ln c_n^j$ leads to:

$$
\begin{aligned}
d\ln W_n &= \frac{w_n L_n}{I_n} d\ln w_n + \frac{1}{I_n}\sum_{j=1}^{J}\sum_{i=1}^{N}\tau_{ni}^{j} M_{ni}^{j}\left(d\ln M_{ni}^{j} - d\ln c_i^{j}\right) \\
&-\frac{1}{I_n}\sum\nolimits_{j=1}^{J}\sum\nolimits_{i=1}^{N} E_{ni}^{j}\left(d\ln c_n^{j} - \sum_{k=1}^{J}\gamma_n^{k,j} d\ln P_n^{k}\right) \\
&-\frac{1}{I_n}\sum_{j=1}^{J}\left(-\frac{1}{\theta_j}\right)\sum\nolimits_{h=1}^{N} M_{nh}^{j}\left(1+\tau_{nh}^{j}\right) d\ln \lambda_h^{j} \\
&+\frac{1}{I_n}\sum\nolimits_{j=1}^{J}\sum\nolimits_{i=1}^{N}\left(E_{ni}^{j} d\ln c_n^{j} - M_{ni}^{j} d\ln c_i^{j}\right) + \frac{1}{I_n} dD_n
\end{aligned}
\tag{30}
$$

Taking the definition of input bundle (4):

$$
d\ln w_n = \frac{1}{\gamma_n^{j}} d\ln c_n^{j} - \sum_{k=1}^{J}\frac{\gamma_n^{k,j}}{\gamma_n^{j}} d\ln P_n^{k} \tag{31}
$$

Note that

$$
w_n L_n d\ln w_n = \frac{w_n L_n}{\gamma_n^{j}} d\ln c_n^{j} - \sum_{k=1}^{J}\frac{\gamma_n^{k,j} w_n L_n}{\gamma_n^{j}} d\ln P_n^{k} = \sum\nolimits_{j=1}^{J}\sum\nolimits_{i=1}^{N} E_{ni}^{j}\left(d\ln c_n^{j} - \sum_{k=1}^{J}\gamma_n^{k,j} d\ln P_n^{k}\right)
$$

Where in the second equality labor market clearing (29) was used. Thus, cancelling out terms in (30) and re-ordering leads to equation (16):

$$
\begin{aligned}
d\ln W_n &= \frac{1}{I_n}\sum\nolimits_{j=1}^{J}\sum\nolimits_{i=1}^{N}\left(E_{ni}^{j} d\ln c_n^{j} - M_{ni}^{j} d\ln c_i^{j}\right) + \frac{1}{I_n}\sum_{j=1}^{J}\sum_{i=1}^{N}\tau_{ni}^{j} M_{ni}^{j}\left(d\ln M_{ni}^{j} - d\ln c_i^{j}\right) \\
&+\frac{1}{I_n}\sum_{j=1}^{J}\left(\frac{1}{\theta_j}\right)\sum\nolimits_{h=1}^{N} M_{nh}^{j}\left(1+\tau_{nh}^{j}\right) d\ln \lambda_h^{j} + \frac{1}{I_n} dD_n
\end{aligned}
\tag{32}
$$

Appendix: Detailed Data Sources

<u>Data from WIOD in 2011</u>

- Gross output,
- value added coefficients (γ_n^{j}),
- Input-output coefficients ($\gamma_n^{k,j}$)
- Final consumption shares in China for counterfactual scenario (α'^{j}_{CHN})
- Bilateral exports (E_{ni}^{j})

Adjustments to data

1) missing gross output data

- Excluded P sector due to missing data, sector has limited linkages
- LUX sectors 19 and 23, used STAN which reports zero gross output
- Cyprus and Latvia sector 23, missing replaced with zero
- Sweden sectors 19, missing after 2008, replace with value in 2008
- China and Indonesia sector 50 is missing, assume zero following entry in IO tables

2) Missing value added shares for sectors listed above: replaced by mean share for that sector in that year across all economies
3) Since we could only get tariff data (see Data from UNCTAD) for the first 17 sectors (up to sector E), we ignore export data for all other sectors and assume they produce nontradable goods.

Table A1. List of economies used in the calibration

Australia	Spain	Italy	Portugal
Austria	Estionia	Japan	Romania
Belgium	Finland	Korea	Russia
Bulgaria	France	Lithuania	Slovak Republic
Brazil	United Kingdom	Luxembourg	Slovenia
Canada	Greece	Latvia	Sweden
China	Hungary	Mexico	Turkey
Cyprus	Indonesia	Malta	Taiwan P.O.C.
Czech Republic	India	Netherlands	United States
Germany	Ireland	Poland	Rest of the World
Denmark			

Source: WIOD.

<u>Data from UNCTAD</u>

- Bilateral tariffs at 2-digit ISIC level

Data format is in ISIC rev. 3, which coincides with WIOD but is more detailed (See table A2). Transformations needed:

1) Aggregate into WIOD sectors weighting sub-sectors by import value
2) For a few missing observations assume:
- If exporting from Europe, faces the average tariff a EU export faces in the same sector
3) No data for services sectors, some have sizeable exports to value added in WIOD
- Assume missing sectors are nontraded, that leaves 17 traded and 17 nontraded sectors.

Table A2. Matching UN ISIC rev. 3 codes and WIOD codes for Traded sectors

ISIC rev. 3	ISIC rev. 3 sector name per UN database	WIOD code	sector #
1	AGRICULTURE, HUNTING AND RELATED SERVICE ACTIVITIES	AtB	1
2	FORESTRY, LOGGING AND RELATED SERVICE ACTIVITIES	AtB	1
5	FISHING, OPERATION OF FISH HATCHERIES AND FISH FARMS…	AtB	1
10	MINING OF COAL AND LIGNITE; EXTRACTION OF PEAT	C	2
11	EXTRACTION OF CRUDE PETROLEUM AND NATURAL GAS; …	C	2
12	MINING OF URANIUM AND THORIUM ORES	C	2
13	MINING OF METAL ORES	C	2
14	OTHER MINING AND QUARRYING	C	2
15	MANUFACTURE OF FOOD PRODUCTS AND BEVERAGES	15t16	3
16	MANUFACTURE OF TOBACCO PRODUCTS	15t16	3
17	MANUFACTURE OF TEXTILES	17t18	4
18	MANUFACTURE OF WEARING APPAREL; DRESSING AND DYEING OF FUR	17t18	4
19	TANNING AND DRESSING OF LEATHER; MANUFACTURE OF LUGGAGE…	19	5
20	MANUFACTURE OF WOOD AND OF PRODUCTS OF WOOD AND …	20	6
21	MANUFACTURE OF PAPER AND PAPER PRODUCTS	21t22	7
22	PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED	21t22	7
23	MANUFACTURE OF COKE, REFINED PETROLEUM PRODUCTS …	23	8
24	MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS	24	9
25	MANUFACTURE OF RUBBER AND PLASTICS PRODUCTS	25	10
26	MANUFACTURE OF OTHER NON-METALLIC MINERAL PRODUCTS	26	11
27	MANUFACTURE OF BASIC METALS	27t28	12
28	MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT …	27t28	12
29	MANUFACTURE OF MACHINERY AND EQUIPMENT N.E.C.	29	13
30	MANUFACTURE OF OFFICE, ACCOUNTING AND COMPUTING …	30t33	14
31	MANUFACTURE OF ELECTRICAL MACHINERY AND APPARATUS	30t33	14
32	MANUFACTURE OF RADIO, TELEVISION AND COMMUNICATION	30t33	14
33	MANUFACTURE OF MEDICAL, PRECISION AND OPTICAL INST…	30t33	14
34	MANUFACTURE OF MOTOR VEHICLES, TRAILERS AND SEMI-T…	34t35	15
35	MANUFACTURE OF OTHER TRANSPORT EQUIPMENT	34t35	15
36	MANUFACTURE OF FURNITURE; MANUFACTURING N.E.C.	36t37	16
40	ELECTRICITY, GAS, STEAM AND HOT WATER SUPPLY	E	17

Source: UN stats, author.

<u>Data from Caliendo and Parro (2015)</u>

- Trade elasticities at the sector level (θ_j)

Caliendo and Parro (2015) estimate trade elasticity parameters in Section 4 of their paper. We map the sectors they used to those in WIOD and use their estimates in Table 1 pertaining to “99% sample”. In case a sector is missing, we use the mean estimate for a manufacturing sector which is 8.22. See table A3.

Table A3. Trade elasticity used to calibrate model

WIOD code	sector #	ISIC rev. 3 sector name per WIOD database	Trade elasticity
AtB	1	Agriculture, Hunting, Forestry and Fishing	9.11
C	2	Mining and Quarrying	13.53
15t16	3	Food, Beverages and Tobacco	2.62
17t18	4	Textiles and Textile Products	8.1
19	5	Leather, Leather and Footwear	8.1
20	6	Wood and Products of Wood and Cork	11.5
21t22	7	Pulp, Paper, Paper , Printing and Publishing	16.52
23	8	Coke, Refined Petroleum and Nuclear Fuel	64.85
24	9	Chemicals and Chemical Products	3.13
25	10	Rubber and Plastics	1.67
26	11	Other Non-Metallic Mineral	2.41
27t28	12	Basic Metals and Fabricated Metal	6.99
29	13	Machinery, Nec	1.45
30t33	14	Electrical and Optical Equipment	8.22
34t35	15	Transport Equipment	8.22
36t37	16	Manufacturing, Nec; Recycling	3.98
E	17	Electricity, Gas and Water Supply	8.22
F	18	Construction	8.22
50	19	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	8.22
51	20	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	8.22
52	21	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	8.22
H	22	Hotels and Restaurants	8.22
60	23	Inland Transport	8.22
61	24	Water Transport	8.22
62	25	Air Transport	8.22
63	26	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	8.22
64	27	Post and Telecommunications	8.22
J	28	Financial Intermediation	8.22
70	29	Real Estate Activities	8.22
71t74	30	Renting of M&Eq and Other Business Activities	8.22
L	31	Public Admin and Defence; Compulsory Social Security	8.22
M	32	Education	8.22
N	33	Health and Social Work	8.22
O	34	Other Community, Social and Personal Services	8.22

Source: Caliendo and Parro (2015), author.

<u>Data from UN COMTRADE</u>

- Industry production complexity, tech- and factor- intensity

China's move into more sophisticated industries is one of the counterfactuals considered. In order to rank sectors according to their sophistication we used several measures that are summarized in table A4.

The results presented in the main body of the paper use the tech-intensity classification (the first classification in table A4). Results are qualitatively similar when considering the other three alternative classifications, which is expected given the large degree of overlap between all four classifications considered.

Table A4. Classification of sectors in terms of sophistication according to different measures

WIOD code	sector #	Intensity indices				classification			
		tech-	factor-	complexity	labor-	tech-	factor-	complexity	labor-
C	2			0.0	35.2	Low	Low	Low	
15t16	3	L	C	-0.2	30.4	Low		Low	
17t18	4	L	L	-0.6	41.7	Low	Low	Low	Low
19	5	L	L	-0.6	42.3	Low	Low	Low	Low
20	6	L	C	-0.3	36.1	Low		Low	
21t22	7	L	C	0.4	33.8	Low		High	
23	8	ML	C	-0.2	29.2			Low	High
24	9	MH	K	0.2	28.9	High	High		High
25	10	ML	K	0.2	33.5		High		
26	11	ML	K	0.2	35.0		High		
27t28	12	ML	C	0.3	28.0				High
29	13	MH	K	1.0	36.8	High	High	High	
30t33	14	H	K	0.7	33.0	High	High	High	
34t35	15	MH	K	0.9	39.4	High	High	High	Low
36t37	16	L	L	0.1	21.8	Low	Low		High

Note: Intensity indices for tech-, factor- and complexity are sourced from COMTRADE. China's share of labor compensation in value added from WIOD in 2009 is shown under "labor-". Under "classification", we split sectors into "High" and "Low" sophistication. Tech- classifies sector as "High" if tech-intensity index is either high or medium tech ("H" or "MH") and as "Low" if low tech. Under factor-, a sector is classified as "High" if it is knowledge intensive ("K") and "low" if labor intensive ("L"). Under complexity, sectors are considered sophisticated if their complexity index is above 0.4, and classified as "low" if below 0. Labor- separates sectors into "High" if their labor intensity is below 30 and "Low" if labor-intensity in the sector is above 38.
Source: COMTRADE, WIOD, author.

Appendix: Additional Tables and Figures

Table A5. Change in key outcomes for all economies in "China preference shock"

	Income				Real	Total	Exports
	Total	ToT	VoT	Direct	wage	Exports	to China
Australia	-0.07	-0.06	-0.01	0.00	-0.05	-1.00	-7.33
Austria	-0.04	-0.04	0.00	0.00	-0.04	-0.46	-23.63
Belgium	-0.03	-0.03	0.00	0.00	-0.03	-0.14	-6.86
Bulgaria	0.01	0.01	0.00	0.00	-0.01	-0.42	-17.44
Brazil	-0.06	-0.04	-0.02	0.00	-0.04	-1.46	-13.61
Canada	-0.05	-0.04	-0.01	0.00	-0.04	-0.46	-3.36
China	0.30	0.42	-0.13	0.00	0.31	-9.46	n.a.
Cyprus	0.01	0.02	0.00	0.00	-0.01	-0.49	-12.11
Czech Rep.	-0.12	-0.11	-0.01	0.00	-0.08	-0.61	-26.67
Germany	-0.13	-0.13	-0.01	0.00	-0.09	-1.09	-24.87
Denmark	-0.05	-0.04	0.00	0.00	-0.03	-0.62	-27.09
Spain	-0.02	-0.02	0.00	0.00	-0.02	-0.30	-10.20
Estonia	-0.04	-0.03	-0.01	0.00	-0.03	-0.24	-8.28
Finland	-0.07	-0.06	0.00	0.00	-0.04	-0.75	-16.36
France	-0.03	-0.03	0.00	0.00	-0.03	-0.54	-17.03
UK	-0.03	-0.02	0.00	0.00	-0.03	-0.61	-19.80
Greece	0.01	0.01	0.00	0.00	-0.01	-0.66	-23.08
Hungary	-0.06	-0.05	0.00	0.00	-0.04	-0.39	-22.24
Indonesia	-0.04	-0.04	0.00	0.00	-0.03	-0.58	-4.00
India	-0.06	-0.04	-0.02	0.00	-0.05	-0.39	-0.53
Ireland	-0.07	-0.07	0.00	0.00	0.00	-0.14	-2.93
Italy	-0.04	-0.03	-0.01	0.00	-0.03	-0.72	-27.77
Japan	-0.08	-0.07	-0.01	0.00	-0.08	-2.95	-17.69
Korea	-0.25	-0.21	-0.04	0.00	-0.18	0.46	-2.09
Lithuania	0.01	0.01	0.00	0.00	-0.01	-0.23	-12.29
Luxembour	0.01	0.01	0.00	0.00	-0.01	-0.44	-19.23
Latvia	0.04	0.04	0.00	0.00	0.04	0.40	34.36
Mexico	-0.03	-0.03	0.00	0.00	-0.03	-0.24	-2.25
Malta	-0.01	-0.01	0.00	0.00	-0.12	-2.79	-17.77
Netherland	-0.09	-0.09	0.00	0.00	-0.05	-0.36	-11.86
Poland	-0.05	-0.04	-0.01	0.00	-0.04	-0.31	-18.13
Portugal	0.02	0.02	0.00	0.00	0.01	-0.14	-7.71
Romania	0.01	0.01	0.00	0.00	0.00	-0.07	-25.02
Russia	-0.06	-0.05	-0.01	0.00	-0.05	-0.49	-0.16
ROW	-0.06	-0.05	-0.01	0.00	-0.04	-0.73	-6.76
Slovak	-0.07	-0.07	-0.01	0.00	-0.06	-0.55	-21.66
Slovenia	-0.03	-0.02	-0.01	0.00	-0.02	-0.28	-24.85
Sweden	-0.05	-0.04	0.00	0.00	-0.02	-0.35	-15.51
Turkey	-0.05	-0.04	-0.01	0.00	-0.04	-0.51	-10.60
Taiwan PO(	-0.47	-0.47	0.00	0.00	-0.30	-0.95	-9.16
USA	-0.03	-0.03	0.00	0.00	-0.04	-1.70	-16.97

Values in percentage points. Source: author's calculations.

Table A6. Change in export share for major economies for "China preference shock"

	China		Korea		Japan		Taiwan POC		Australia		Germany		USA	
sector	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Agriculture	0.99	0.90	0.14	0.13	0.12	0.12	1.41	1.49	5.13	4.63	1.05	1.07	4.58	4.27
Mining	0.60	0.53	0.00	0.00	0.46	0.49	0.05	0.05	64.00	65.28	0.53	0.55	2.81	2.87
Food	2.82	2.95	1.23	1.18	0.58	0.56	0.61	0.60	6.96	6.87	5.38	5.43	5.60	5.58
Textile	13.53	13.45	2.24	2.32	0.93	0.98	3.15	3.39	0.53	0.55	2.03	2.13	1.34	1.40
Leather	2.88	2.90	0.20	0.17	0.03	0.03	0.37	0.37	0.14	0.14	0.30	0.31	0.07	0.07
Wood	0.61	0.54	0.01	0.01	0.17	0.18	0.06	0.06	0.31	0.31	0.66	0.68	0.48	0.48
Paper	0.51	0.41	0.61	0.71	0.53	0.68	1.34	1.65	0.57	0.61	3.50	3.66	3.76	4.07
Petroleum	0.80	0.34	10.59	14.21	2.90	4.16	7.03	9.89	1.38	1.44	1.88	2.11	9.28	9.58
Chemicals	6.55	6.88	10.64	11.18	8.78	9.41	12.00	12.98	2.51	2.57	13.15	13.42	12.14	12.46
Plastic	4.00	4.28	2.13	2.01	4.46	4.39	3.34	3.21	0.38	0.38	3.90	3.92	2.31	2.32
Minerals	1.50	1.58	0.32	0.27	1.56	1.36	0.59	0.44	0.15	0.15	1.34	1.33	0.83	0.78
Basic metals	7.21	7.01	10.20	9.36	16.21	15.53	10.58	9.95	11.97	11.26	11.91	11.88	7.30	6.95
Machinery nec	8.04	8.62	7.92	6.60	13.14	11.50	6.65	5.41	2.18	2.03	14.47	13.44	11.29	10.81
Transport	40.34	40.03	30.21	28.29	23.60	23.19	46.77	44.19	1.28	1.28	14.55	14.70	18.39	18.38
Electrical eq.	5.43	5.24	23.04	23.02	25.28	26.03	3.82	3.97	1.76	1.75	22.20	22.16	16.45	16.40
Other	4.09	4.25	0.49	0.50	1.16	1.27	2.24	2.35	0.66	0.69	1.92	1.97	3.32	3.51
Electricity	0.10	0.10	0.02	0.02	0.10	0.11	0.00	0.00	0.06	0.06	1.22	1.25	0.06	0.06
Normalized Herfindahl	0.181	0.180	0.160	0.155	0.149	0.147	0.236	0.217	0.416	0.431	0.104	0.102	0.085	0.084

Values in percentage points. Source: author's calculations.

Table A7. Change in key outcomes for all economies in "Traded to nontraded productivity shock"

	Income				Real	Total	Exports
	Total	ToT	VoT	Direct	wage	Exports	to China
Australia	-0.04	0.00	0.00	-0.03	-0.04	-0.50	-4.19
Austria	-0.01	0.01	0.00	-0.02	0.00	0.29	-0.60
Belgium	-0.01	0.02	0.00	-0.02	-0.01	0.21	-0.55
Bulgaria	-0.04	-0.03	0.00	-0.02	-0.01	0.36	-1.58
Brazil	-0.02	0.00	-0.01	-0.02	-0.02	-0.34	-7.13
Canada	-0.01	0.02	0.00	-0.03	-0.02	0.18	-3.64
China	-0.62	-0.15	-0.01	-0.46	-0.58	-1.67	n.a.
Cyprus	-0.06	-0.04	0.00	-0.01	-0.02	0.56	-0.64
Czech Rep.	0.01	0.10	0.00	-0.09	-0.01	0.25	-0.89
Germany	0.02	0.06	0.00	-0.04	-0.01	0.26	-0.41
Denmark	0.00	0.01	0.00	-0.01	-0.01	0.19	-4.82
Spain	-0.01	0.01	0.00	-0.02	0.00	0.36	-1.19
Estonia	-0.01	0.02	0.00	-0.03	-0.01	0.34	0.07
Finland	0.01	0.03	0.00	-0.01	0.00	0.22	-1.18
France	-0.01	0.01	0.00	-0.02	-0.01	0.30	-0.72
UK	-0.02	0.00	0.00	-0.02	-0.01	0.35	-0.20
Greece	-0.05	-0.04	0.00	-0.01	-0.01	0.57	-7.42
Hungary	0.01	0.05	0.00	-0.04	0.00	0.37	-0.12
Indonesia	-0.01	0.03	0.00	-0.04	-0.02	0.06	-3.55
India	-0.02	0.02	0.00	-0.04	-0.01	0.17	-3.86
Ireland	0.13	0.15	0.00	-0.02	0.00	0.20	-0.88
Italy	0.00	0.02	0.00	-0.02	0.00	0.28	-0.98
Japan	0.00	0.02	0.00	-0.03	0.00	0.19	-0.24
Korea	0.04	0.11	0.01	-0.09	0.01	0.33	0.34
Lithuania	-0.03	-0.02	0.00	-0.01	0.00	0.39	-2.16
Luxembour	-0.02	-0.02	0.00	0.00	0.00	0.40	-0.76
Latvia	-0.04	-0.03	0.00	-0.01	-0.01	0.37	-2.04
Mexico	-0.02	0.02	0.00	-0.04	-0.01	0.29	-2.23
Malta	-0.06	-0.05	0.00	-0.02	-0.01	0.66	0.52
Netherland	0.03	0.06	0.00	-0.03	0.00	0.25	-1.38
Poland	-0.01	0.02	0.00	-0.03	-0.01	0.33	-0.97
Portugal	-0.03	-0.02	0.00	-0.01	0.00	0.44	-0.50
Romania	-0.04	-0.02	0.00	-0.01	-0.01	0.46	-1.41
Russia	-0.03	0.01	0.00	-0.04	-0.02	0.04	-4.04
ROW	-0.02	0.03	0.00	-0.04	-0.02	-0.01	-2.90
Slovak	0.00	0.04	0.00	-0.04	0.00	0.36	0.45
Slovenia	-0.01	0.02	0.00	-0.02	0.00	0.34	-0.77
Sweden	0.02	0.03	0.00	-0.01	0.00	0.24	-0.82
Turkey	-0.03	0.01	0.00	-0.04	-0.01	0.34	-3.09
Taiwan PO(	0.04	0.15	0.00	-0.10	0.00	0.29	-0.07
USA	-0.02	0.00	0.00	-0.02	-0.01	0.18	-1.86

Values in percentage points. Source: author's calculations.

Table A8. Change in export share for major economies for "Traded to nontraded productivity shock"

	China		Korea		Japan		Taiwan POC		Australia		Germany		USA	
sector	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Agriculture	0.99	1.19	0.14	0.13	0.12	0.12	1.41	1.39	5.13	4.96	1.05	1.04	4.58	4.40
Mining	0.60	0.64	0.00	0.00	0.46	0.45	0.05	0.04	64.00	63.65	0.53	0.52	2.81	2.79
Food	2.82	2.92	1.23	1.22	0.58	0.57	0.61	0.60	6.96	7.01	5.38	5.38	5.60	5.58
Textile	13.53	13.56	2.24	2.24	0.93	0.93	3.15	3.16	0.53	0.55	2.03	2.04	1.34	1.35
Leather	2.88	2.91	0.20	0.20	0.03	0.03	0.37	0.37	0.14	0.14	0.30	0.30	0.07	0.07
Wood	0.61	0.62	0.01	0.01	0.17	0.17	0.06	0.06	0.31	0.32	0.66	0.66	0.48	0.48
Paper	0.51	0.51	0.61	0.60	0.53	0.53	1.34	1.33	0.57	0.59	3.50	3.49	3.76	3.76
Petroleum	0.80	0.72	10.59	10.84	2.90	2.90	7.03	7.14	1.38	1.49	1.88	1.84	9.28	9.23
Chemicals	6.55	6.64	10.64	10.53	8.78	8.74	12.00	11.87	2.51	2.53	13.15	13.13	12.14	12.13
Plastic	4.00	4.05	2.13	2.12	4.46	4.44	3.34	3.33	0.38	0.39	3.90	3.90	2.31	2.32
Minerals	1.50	1.53	0.32	0.31	1.56	1.55	0.59	0.58	0.15	0.16	1.34	1.34	0.83	0.83
Basic metals	7.21	7.16	10.20	10.17	16.21	16.21	10.58	10.56	11.97	12.18	11.91	11.92	7.30	7.31
Machinery nec	8.04	8.16	7.92	7.86	13.14	13.06	6.65	6.59	2.18	2.20	14.47	14.42	11.29	11.28
Transport	40.34	39.80	30.21	30.27	23.60	23.76	46.77	46.91	1.28	1.32	14.55	14.67	18.39	18.62
Electrical eq.	5.43	5.33	23.04	22.98	25.28	25.29	3.82	3.82	1.76	1.80	22.20	22.22	16.45	16.49
Other	4.09	4.18	0.49	0.49	1.16	1.15	2.24	2.23	0.66	0.67	1.92	1.92	3.32	3.32
Electricity	0.10	0.10	0.02	0.02	0.10	0.10	0.00	0.00	0.06	0.06	1.22	1.21	0.06	0.06
Normalized Herfindahl	0.181	0.177	0.160	0.160	0.149	0.150	0.236	0.237	0.416	0.412	0.104	0.104	0.085	0.085

Values in percentage points. Source: author's calculations.

Table A9. Change in key outcomes for all economies in "China move up the value chain shock"

	Income				Real	Total	Exports
	Total	ToT	VoT	Direct	wage	Exports	to China
Australia	0.06	0.05	0.00	0.01	0.05	1.05	5.45
Austria	-0.01	-0.01	0.00	0.01	0.00	-0.13	-1.24
Belgium	0.01	0.00	0.00	0.01	0.01	0.11	1.14
Bulgaria	0.03	0.02	0.00	0.01	0.03	-0.02	3.98
Brazil	0.03	0.01	0.00	0.01	0.02	0.47	5.57
Canada	0.02	0.01	0.00	0.01	0.02	0.01	6.85
China	0.11	0.00	-0.01	0.11	0.11	1.58	n.a.
Cyprus	0.00	0.00	0.00	0.00	0.01	-0.22	-2.71
Czech Rep.	0.02	-0.05	-0.01	0.07	0.03	-0.13	-1.39
Germany	-0.02	-0.03	0.00	0.02	0.00	-0.24	-2.70
Denmark	0.00	0.00	0.00	0.00	0.00	-0.15	-0.29
Spain	-0.01	-0.01	0.00	0.00	-0.01	-0.22	1.95
Estonia	-0.01	0.00	-0.01	0.00	0.00	-0.13	0.52
Finland	-0.01	-0.01	0.00	0.01	0.00	-0.08	0.58
France	0.00	-0.01	0.00	0.01	0.00	-0.18	-1.15
UK	0.00	0.00	0.00	0.00	0.00	-0.28	-2.43
Greece	0.01	0.01	0.00	0.00	0.01	0.03	1.99
Hungary	0.00	-0.04	0.00	0.04	0.00	-0.41	-4.12
Indonesia	0.04	0.03	0.00	0.01	0.03	0.37	6.12
India	-0.01	0.00	-0.01	0.00	0.00	0.10	2.55
Ireland	-0.05	-0.06	0.00	0.01	-0.01	-0.15	1.96
Italy	0.00	0.00	0.00	0.00	0.01	-0.01	1.31
Japan	-0.02	-0.02	0.00	0.01	-0.02	-0.26	-0.78
Korea	-0.08	-0.10	-0.02	0.04	-0.05	0.24	1.13
Lithuania	0.00	0.00	0.00	0.00	0.00	-0.09	1.50
Luxembour	0.01	0.01	0.00	0.00	0.01	0.01	4.07
Latvia	0.01	0.01	0.00	0.00	0.01	0.11	4.08
Mexico	0.03	0.00	0.00	0.03	0.03	-0.19	1.71
Malta	-0.02	-0.02	0.00	0.01	-0.06	-1.41	-4.32
Netherland	-0.01	-0.02	0.00	0.01	0.00	-0.15	0.68
Poland	0.01	0.00	0.00	0.01	0.02	-0.15	2.00
Portugal	0.01	0.01	0.00	0.00	0.02	-0.04	1.37
Romania	0.01	0.01	0.00	0.00	0.01	0.00	1.02
Russia	-0.01	0.00	0.00	-0.01	0.00	0.39	8.45
ROW	0.05	0.03	0.00	0.02	0.05	0.35	3.48
Slovak	-0.02	-0.03	-0.01	0.02	-0.01	-0.40	-6.39
Slovenia	-0.01	-0.01	0.00	0.01	0.00	-0.17	-1.36
Sweden	-0.01	-0.01	0.00	0.00	0.00	-0.12	0.81
Turkey	-0.04	-0.01	-0.01	-0.02	-0.02	-0.05	4.89
Taiwan PO(	-0.08	-0.15	0.00	0.07	-0.04	-0.30	-0.79
USA	0.01	0.00	0.00	0.01	0.00	-0.07	-0.06

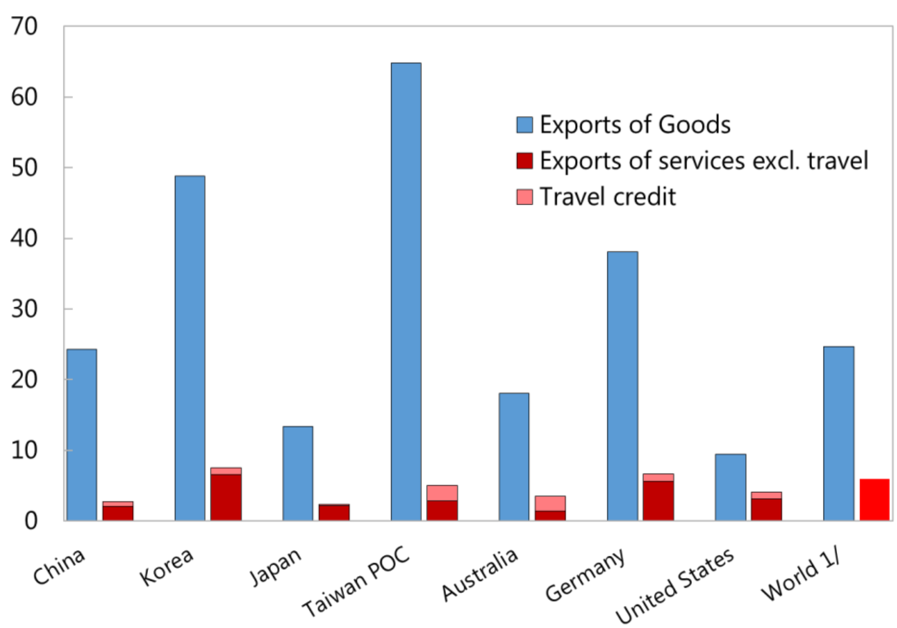
Values in percentage points. Source: author's calculations.

Table A10. Change in export share for major economies for "China move up the value chain shock"

sector	China		Korea		Japan		Taiwan POC		Australia		Germany		USA	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Agriculture	0.99	0.96	0.14	0.14	0.12	0.12	1.41	1.43	5.13	5.00	1.05	1.06	4.58	4.62
Mining	0.60	0.52	0.00	0.00	0.46	0.48	0.05	0.05	64.00	64.93	0.53	0.54	2.81	2.87
Food	2.82	2.68	1.23	1.24	0.58	0.59	0.61	0.61	6.96	6.87	5.38	5.41	5.60	5.63
Textile	13.53	12.03	2.24	2.39	0.93	1.02	3.15	3.46	0.53	0.54	2.03	2.12	1.34	1.40
Leather	2.88	2.59	0.20	0.22	0.03	0.04	0.37	0.41	0.14	0.14	0.30	0.32	0.07	0.07
Wood	0.61	0.50	0.01	0.01	0.17	0.18	0.06	0.06	0.31	0.31	0.66	0.67	0.48	0.51
Paper	0.51	0.39	0.61	0.65	0.53	0.58	1.34	1.43	0.57	0.56	3.50	3.58	3.76	3.89
Petroleum	0.80	0.58	10.59	11.33	2.90	3.23	7.03	7.55	1.38	1.23	1.88	2.02	9.28	9.66
Chemicals	6.55	6.64	10.64	10.51	8.78	8.76	12.00	11.92	2.51	2.45	13.15	13.17	12.14	12.11
Plastic	4.00	3.94	2.13	2.13	4.46	4.48	3.34	3.37	0.38	0.38	3.90	3.91	2.31	2.31
Minerals	1.50	1.47	0.32	0.32	1.56	1.57	0.59	0.59	0.15	0.15	1.34	1.35	0.83	0.83
Basic metals	7.21	6.96	10.20	10.29	16.21	16.46	10.58	10.74	11.97	11.70	11.91	11.98	7.30	7.35
Machinery nec	8.04	8.02	7.92	7.89	13.14	13.14	6.65	6.65	2.18	2.15	14.47	14.48	11.29	11.27
Transport	40.34	42.84	30.21	29.37	23.60	22.89	46.77	45.61	1.28	1.20	14.55	14.19	18.39	17.73
Electrical eq.	5.43	5.96	23.04	22.99	25.28	25.19	3.82	3.84	1.76	1.69	22.20	22.04	16.45	16.31
Other	4.09	3.83	0.49	0.50	1.16	1.18	2.24	2.27	0.66	0.65	1.92	1.93	3.32	3.36
Electricity	0.10	0.10	0.02	0.02	0.10	0.10	0.00	0.00	0.06	0.06	1.22	1.23	0.06	0.06
Normalized Herfindahl	0.181	0.199	0.160	0.156	0.149	0.146	0.236	0.226	0.416	0.427	0.104	0.102	0.085	0.083

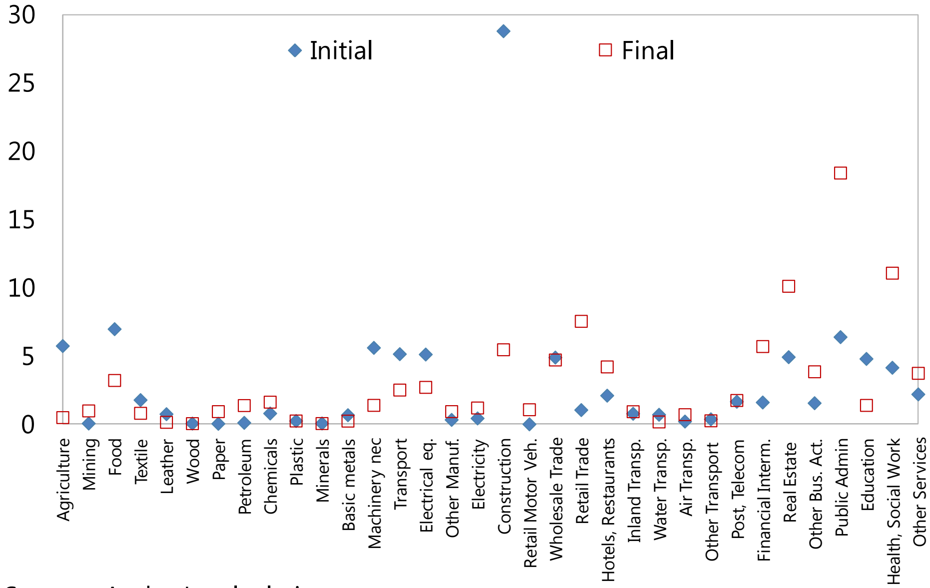
Values in percentage points. Source: author's calculations.

Figure A1. Exports of goods and services across major economies in 2011 in percentage points of GDP



1/ Total exports of services shown. Sources: Haver, WEO.

Figure A2. Shock to final demand shares in China: Initial and Final



Sources: Author's calculations.

Figure A3: Productivity shock to oversupply sectors in China