Real globalisation and price spillovers in Asia and the Pacific[1]

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Abstract

In economies and sectors tightly connected by trade linkages, the increased use of intermediate imported inputs could be expected to lead to greater transmission of cross-border cost shocks. This paper presents some results from on-going research investigating cross-border price spillovers to sectoral producer prices within the Asian manufacturing supply chain (Auer and Mehrotra, 2014). Our results suggest that real integration through the supply chain matters for domestic price dynamics.

Keywords: globalisation, inflation, Asian manufacturing supply chain, price spillovers

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Recent research shows that inflation is increasingly a global phenomenon, whereby an important share of the dynamics of domestic inflation are common across economies (eg Borio and Filardo, 2007; Ciccarelli and Mojon, 2010; Monacelli and Sala, 2009; Auer and Sauré, 2013a). In general, inflation co-movement could stem from common shocks to inflation, such as commodity price fluctuations, productivity shocks or simultaneous changes in the conduct of monetary policy (see eg Henriksen et al, 2008; Rogoff, 2003).

The increasingly global nature of inflation has occurred at the same time as economies have become progressively more integrated through international trade in goods and services. Most of the literature on the effects of globalisation on inflation has focused on implications for the advanced economies, treating Asian economies as low-cost exporters that may potentially cause downward pressure on prices in the developed markets (Auer and Fischer, 2010; Auer et al, 2013; Holz and Mehrotra, 2013; Lipińska and Millard, 2012). Such an impact could arise directly through lower import prices, but also through a competitive effect whereby increased openness reduces mark-ups (see, for example, Melitz and Ottaviano, 2008, Atkeson and Burstein, 2008; Chen et al, 2009).

When economies are already closely integrated, the disinflationary consequences of further integration are probably limited. For eight out of 12 economies in Asia and the Pacific, intra-regional trade now accounts for over half of the total international trade.[4] In economies and sectors tightly connected by trade linkages, the increased use of intermediate imported inputs could be expected to lead to greater pass-through of cross-border cost shocks and possibly to more co-movement of inflation rates.[5] This provides another perspective as to how globalisation affects inflation, beyond the impact that arises from more intense import competition.

In ongoing work, we evaluate the cross-border price spillovers to and within the manufacturing supply chains in the Asia-Pacific region (Auer and Mehrotra, 2014), where multi-jurisdiction production structures are particularly important. These supply chains have become a topic of increasing research interest. For example, Baldwin and Lopez-Gonzalez (2013) discuss the global patterns in supply-chain trade, and IMF (2013) finds a positive correlation between participation in global supply chain networks and economic growth. However, the implications for price spillovers, or inflation developments more generally, have not been investigated.

An important source of data for our study is the novel World Input-Output Database that provides detailed information on trade linkages at the sectoral level (WIOD, 2012). Our research builds on the framework by Auer and Sauré (2013b), who construct a theoretical model of the global supply network capturing the channels through which spillovers occur and then estimate equilibrium price spillovers in this network. We document the magnitude of regional price spillovers. More specifically, we quantify the importance of cross-border cost shocks on sectoral producer prices in the manufacturing supply chains in the Asia-Pacific

[4] These are the 12 economies in the region that are members of the BIS: Australia, China, Hong Kong SAR, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand.

[5] The importance of imported intermediate inputs in affecting consumer prices is also highlighted by Goldberg and Campa (2010).

region. Our findings highlight the importance of imported intermediate inputs in driving the price changes that arise from supply chain linkages.

This paper motivates and describes our ongoing research work on the topic and related studies. In Section 1, we present the modelling framework and discuss some pertinent data issues. Section 2 presents selected results from our empirical analysis, and Section 3 closes the paper with policy implications.

1. Empirical framework and data issues

The impact of trade linkages on inflation co-movement could in principle be investigated in a cross section of countries, using only aggregate data, thus abstracting from any supply chain linkages. One possibility would be to follow the approach by Mumtaz and Surico (2012). These authors use a factor model to identify the global and country-specific factors driving the inflation process. They then regress these factors on variables such as trade openness.[6]

Indeed, there are theoretical arguments suggesting that trade linkages matter for inflation co-movement. Consider, for example, the two-country open-economy New-Keynesian model by Engel (2011). Home CPI inflation is defined as the weighted average of inflation of home-produced goods and that of foreign-produced goods, with the weights determined by the utility that consumers derive from the consumption of home versus foreign goods (a proxy for openness).[7] Then, under producer currency pricing, there is a mechanical link between foreign consumer price inflation and home inflation, and this link is stronger the more open the home economy is to trade.

But capturing such channels empirically with country-level data is challenging, given the importance of controlling for other factors that could potentially matter for price co-movements, such as monetary policy. There could also be concerns about reverse causality. Such considerations motivate the use of sectoral data. Sectoral data allow us to evaluate the importance of real integration in a *relative* sense, by comparing how price spillovers depend on the intensity with which different sectors use imported intermediate inputs, other things constant. Moreover, the use of sectoral data highlights one possible mechanism through which real integration matters for price spillovers.

While a larger pass-through of shocks is an intuitive outcome for a sector that intensively uses intermediate imports, some elements of the supply chain may actually limit the pass-through. Amiti et al (2012) show, using data for Belgian firms, that large exporters are simultaneously large importers. This diminishes the impact of exchange rate shocks on profits, as import prices move in an opposite direction to that of export revenues. Moreover, the large exporters appear to be the most profitable firms, setting high mark-ups and moving these mark-ups actively in response to cost shocks. Using this argument in a tightly connected supply chain, if external shocks affect import costs and export revenues by roughly similar

[6] In their analysis, money growth emerges as a particularly important explanatory variable for the global inflation factor.

[7] Dynamics of home-produced goods inflation are determined by the excess of real wages over the marginal product of labour, together with an expectations term.

magnitudes, the pass-through to domestic prices may be limited. This ultimately renders the extent of pass-through in a supply chain an empirical question.

An important source of data for our project is the World Input-Output Database that became public in April 2012 (WIOD, 2012; see also Timmer et al, 2013 a and b). The WIOD is basically an extension of the national input-output tables. Its construction was motivated, inter alia, by the aim of analysing the impact of globalisation on trade patterns. Importantly for our purposes, the WIOD specifies the foreign industry in which an imported input was produced. As an example, the database tells us how large a share of the intermediate imports in China's automobile industry originates from the machinery industry in Thailand. Similarly, the WIOD documents how the exports of a country are used, by which foreign industry or by a final end user.

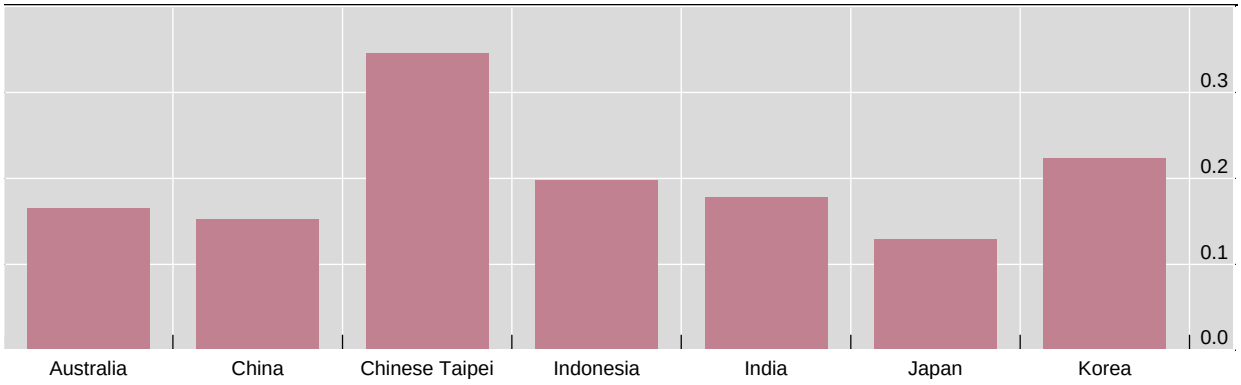
The WIOD covers a total of 40 economies, 27 of which are member states of the European Union, with the sample running from 1995 to the end of 2009. Our focus is on those seven economies in the Asia-Pacific region that are included in the database: Australia, China, Chinese Taipei, India, Indonesia, Japan and Korea.[8] Despite this regional focus, all the WIOD's economies are included in the analysis as trading partners, and their exchange rates affect trade-weighted exchange rate movements of economies in the Asia-Pacific region. This is important, as exchange rate movements are potentially a very important source of cost shocks.

The WIOD data allow us to compute the share of intermediate inputs in the total output of a sector. In addition, using import prices, as well as information on domestic production costs collected by Auer and Sauré (2013b), we can then calculate the cost shares of intermediate imported inputs in a sector's total variable costs. For the mean sector in our data, this cost share is 17%. Computed as averages across the economies, the sectoral intermediate import cost shares are in most cases close to 20%. This means that roughly one fifth of the sectors' variable costs are accounted for by costs of imported inputs. To provide just two examples, the cost share of intermediate imported goods is 16% in the textile and 27% in the computer industry.

Graph 1 shows the intermediate input cost shares in 2008 for the seven economies in the Asia-Pacific region that are included in the WIOD. These are computed as simple averages of the sectoral cost shares, for each economy. The intermediate input cost share in our sample is highest in Chinese Taipei, at 35%. The share of China, at 15%, may at first sight appear relatively low, given the importance commonly attributed to China in the Asian supply chains. However, it is consistent with large economies producing a significant share of intermediate inputs themselves. Indeed, Goldberg and Campa (2010) show evidence for industrialised economies, where the share of intermediate inputs in costs of tradable goods production is lowest for the United States (10%), but exceeds 40% in Austria, Belgium and Estonia, for example.

[8] In WIOD (2012), "Asia and Pacific" is defined as also comprising Russia and Turkey.

Average imported input cost share, 2008 Graph 1



Source: Authors' calculations based on WIOD (2012).

In our framework, as in Amiti et al (2012), the presence of intermediate goods implies that the exchange rate affects the domestic costs of production. Importantly, as in Auer and Schoenle (2013), we allow for variable mark-ups, so domestic prices need not respond fully to cost shocks.

Our empirical framework essentially links changes in costs of production to changes in producer prices in the different sectors. We assume that costs that a firm n faces are comprised of local costs paid in local currencies ($c^L_{n,t}$) and imported intermediate inputs ($c^I_{n,t}$):

$$c^D_{n,t} = c^I_{n,t} + c^L_{n,t} \,. \quad (1)$$

Denoting percentage changes with a hat, and assuming no changes in quantities, costs change if the prices of imported ($p^I_{n,t}$) or local inputs ($p^L_{n,t}$) change:

$$\hat{c}^D_{n,t} = \theta^I_{n,t} * \hat{p}^I_{n,t} + \left(1 - \theta^I_{n,t}\right) * \hat{p}^L_{n,t} + \hat{\epsilon}_{n,t} \,, \quad (2)$$

where $\epsilon^C_{n,t}$ are firm-specific cost shocks and $\theta^I_{n,t}$ is the imported-input cost share, $\theta^I_{n,t} = \frac{c^I_{n,t}}{c^D_{n,t}}$. It is intuitive that the price changes of imported inputs more strongly affect the firms that more intensively use imported inputs. Thus, $\theta^I_{n,t} * \hat{p}^I_{n,t}$ assumes an important role in our results.

$\theta^I_{n,t}$ is constructed using data from the WIOD and other sources. The price index for intermediate imported inputs, $\hat{p}^I_{n,t}$, is from Auer and Sauré (2013b), who construct it using import price indices and information on the sectoral composition of inputs.

2. Some results

Our econometric exercise documents the extent to which domestic producer prices react to changes in the costs of intermediate inputs. The estimated panel specifications include sector fixed effects (k^D_s below) in order to capture any sector-specific changes, such as structural transformation. A specification that is illustrative of our analysis can be written as:

$$\hat{p}^D_{s,t,t-1} = k^D_s + \alpha \widehat{IIPI}_{s,t,t-1} + \beta \theta^I_{s,t} \widehat{IIPI}_{s,t,t-1} + \gamma \theta^I_{s,t} + \hat{\epsilon}_{s,t} \,. \quad (3)$$

The dependent variable, $\hat{p}^{D}_{s,t,t-1}$, is defined as the monthly change in the (log of the) sectoral producer price index of the importer, with *s* denoting the sector. $\widehat{IIPI}$ denotes the change in the intermediate imports price index, and θ^{I} is the intermediate input cost share. Note that in this specification, we interact the sectoral import price index with the sector-importer-specific cost share.

Estimating (3) across the available 40 sector-economy combinations, and 5,996 monthly observations, we obtain an estimate for the interaction coefficient β of 0.34, while α is estimated to be 0.13. What do these coefficient estimates imply? Consider two sectors with input intensities of 0.04 and 0.49, respectively. These correspond to the 5th and 95th percentiles of the imported intermediate input cost share in our sample. When the input intensity amounts to 0.04, a 1% increase in the $IIPI$ will lead to a 0.14% increase in domestic producer prices (0.14% = 0.13% + 0.04*0.34%). But for the sector where roughly half of variable costs stem from imported intermediate inputs, the same increase in the $IIPI$ will lead to a 0.30% increase in domestic producer prices (0.30% = 0.13% + 0.49*0.34%). Therefore, the spillover to domestic prices is over twice as large for the sector that intensively uses imported intermediate inputs.

We also consider specifications where the imported intermediate price index is replaced by the trade-weighted exchange rate, computed for each sector. Such a specification is of interest, as it implicitly takes into account the fact that inputs are priced to market and thus do not co-move one-to-one with the exchange rate (as documented in Fauceglia et al, 2013). It also allows us to extend the sample. Indeed, not all the Asia-Pacific economies included in the WIOD publish sectoral import price indices, but they all publish sectoral producer prices. Moreover, from an economic perspective, these specifications capture the notion that it is exchange rate fluctuations that are largely behind movements in the intermediate import prices, and those changes then lead to fluctuations in sectoral producer prices.

The results with the exchange rate variable are generally consistent with those presented with the $IIPI$ as in equation (3) above. In particular, the interaction between the exchange rate and the input cost share again appears with an economically and statistically significant coefficient. This implies that external shocks that affect the trade-weighted exchange rate have the strongest impact on producer prices in those sectors that more intensively use imported intermediate inputs in production.

Note also that the model presented in (3) does not contain any lagged variables on the right-hand side. But if there is nominal price stickiness of any sort, such as that resulting from menu costs, it is likely that any changes in costs only have a lagged impact on sectoral producer prices. Then, a better representation of the interaction between the variables is likely one where lags of the right-hand variables are included. In Auer and Mehrotra (2014), we document for example that when six months of lags are considered, imported input use can explain over half of the estimated correlation between exchange rate changes and producer price movements for the mean sector in our data.

In general, our results should be regarded as approximating the first-round impacts of external cost shocks on domestic producer prices. At the same time, we are able to control for some second-round effects that are important, such as firms switching the sources of imports when intermediate goods originating from a trading partner become more expensive. We do not, however, capture the second-round network effects with our empirical approach.

3. Conclusion and policy implications

In ongoing research, we examine the evidence for cross-border price spillovers among economies participating in the Asian manufacturing supply chain (Auer and Mehrotra, 2014). In our framework, the presence of imported intermediate goods implies that the exchange rate affects domestic costs of production. Moreover, mark-ups are variable, so firms may not fully pass cost shocks through to prices. In the empirical analysis, we evaluate the extent to which domestic producer prices react to changes in costs of imported intermediate inputs.

In the sectoral analysis, we draw on the novel World Input-Output Database that provides detailed data on sectoral trade linkages in the region. We show that the share of imported intermediate inputs in total variable costs is roughly 17% on average for the seven Asia-Pacific economies for which data are available in the WIOD database. We also show that the impacts through higher costs of imported intermediate inputs on domestic producer prices are statistically and economically significant for economies participating in the supply chain. A crucial role is played by the importance of imported inputs as a fraction of a sector's total variable costs.

But a focus on sectoral prices could also be seen to limit the applicability of the results, as the implications for aggregate inflation are not explicitly investigated. Do the cross-border spillovers on *sectoral* producer prices matter for policymakers? If only relative prices are affected, there need not be any impact on aggregate inflation. In the presence of menu costs, Ball and Mankiw (1995) argue that if the relative price shocks are large and affect the distribution of relative price changes, they will have an impact on aggregate inflation.[9] On the other hand, Bryan and Cecchetti (1999) provide evidence that the sample mean-skewness correlation suffers from small sample bias.

An interesting question is whether supply chains have led to greater inflation volatility in the Asia-Pacific region. We provide some first evidence for this in Auer and Mehrotra (2014), as we find that it is large cost shocks that matter for producer prices, whereas small shocks do not. This would imply that during times when the cross-border shocks are large, perhaps during periods of great exchange rate volatility, supply chains could act as shock amplifiers in the region. A related issue is the implication of exchange rate volatility for trade within the supply chain. Using data for Asia, Tang (2011) finds that exchange rate volatility is particularly harmful for trade in intermediate goods. But further research is needed to investigate these questions.

In sum, our results suggest that real integration through the supply chain matters for domestic price dynamics in the Asia-Pacific region.

[9] Sekine (2009) and Auer and Fischer (2010) provide evidence about the disinflationary influence of large relative price shocks as a result of globalisation.

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