The Exchange Rate and Consumer Prices

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This article reviews the empirical evidence on exchange rate pass-through to consumer prices in Australia over the inflation-targeting period. It finds that pass-through is relatively low at the aggregate level but is faster and larger for the prices of manufactured goods, which are often imported. There is some evidence that over the past decade exchange rate movements have been flowing through more quickly to retail prices for this subset of highly tradable goods. Looking ahead, the growth of the internet with the greater ability of households to compare prices and to buy from overseas are likely to result in smaller cross-country price differentials and more rapid pass-through from the exchange rate to prices.

Introduction

With the recent large movements in the Australian-dollar exchange rate and almost two decades of inflation targeting, it is timely to revisit the effects of exchange rate movements on domestic consumer prices. This article examines the pass-through of changes in the exchange rate to consumer prices over this period.

While first-stage pass-through – from the exchange rate to import prices – is found to be high and rapid, the effect of exchange rate changes on overall consumer price inflation is smaller and slower: a 10 per cent appreciation of the Australian dollar is estimated to lower the level of overall consumer prices by around 1 per cent over a period of around three years. Although pass-through is larger for some highly tradable goods, exchange rate movements still have a less than one-to-one effect on these prices, reflecting the significant domestic component of the retail price of these goods. However, pass-through for these highly tradable goods appears to have become quicker in the past decade.

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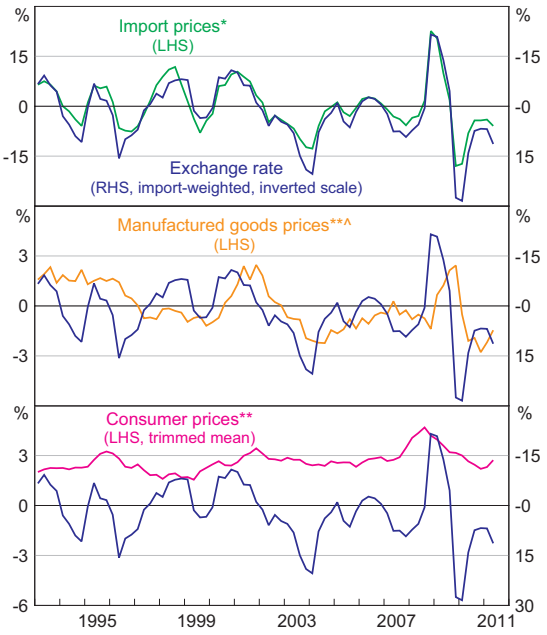
Estimating the Effect of Exchange Rate Movements on Consumer Prices

The effect of changes in the exchange rate on consumer prices can be divided into different stages (Graph 1). The first stage is the effect of exchange rate movements on the Australian-dollar cost of imports when they arrive in the country. The second stage is the effect that changes in the prices of imported goods have on overall consumer prices. The transmission may be fairly direct, for example when consumers buy imported goods, or it may be indirect, where the prices of domestically produced goods and services are affected by changes in the cost of imported inputs.

Researchers typically estimate the first and second stages of exchange rate pass-through using econometric regressions which attribute changes in domestic prices to contemporaneous and prior changes in the exchange rate or import prices and to other variables. The two stages are generally estimated separately, that is, by estimating the effect of exchange rate changes on import prices and then the effect of import prices changes on overall consumer prices.[1] Further details of some standard regressions are shown in Appendix A.

1 As a cross-check, models linking inflation directly to exchange rate changes were also estimated. The results were very similar to those from the two-stage models, although they tend to be econometrically less robust.

Graph 1
Exchange Rate and Consumer Prices
Year-ended percentage change



* Excludes large lumpy items, lubricants & oils, and automatic data processing equipment
** Adjusted for the tax changes of 1999–2000
^ Manufactured goods here refers to clothing, footwear, furniture & floor coverings, motor vehicles, audio, visual & computing equipment and similar items
Sources: ABS; RBA

Estimates of first-stage pass-through show that changes in the Australian-dollar prices of imports can be explained well by changes in the exchange rate and by changes in world prices. The econometric estimates in Table 1 indicate that exchange rate changes are usually passed through quickly and to a large extent to import prices, confirming the close relationship between exchange rate movements and import price inflation apparent in the top panel of Graph 1. The point estimates suggest that a 10 per cent appreciation in the exchange rate typically lowers import prices by around 8 per cent. However, the proposition that the effect is 10 per cent – that there is 'full pass-through' – is sometimes not rejected in statistical tests.

The second stage relates movements in overall consumer price inflation to changes in import prices.[2] The results for the second stage presented here are based on two of the frameworks used at the Bank for modelling inflation. The mark-up framework models consumer prices as a mark-up over costs and therefore usually includes unit labour costs (average labour cost per unit of output) and import prices. The other framework is the Phillips curve model, which relates inflation to resource utilisation, in particular the unemployment rate, with inflation typically expected to rise as the level of spare capacity is reduced. This framework also incorporates a role for inflation expectations and for the exchange rate, through import prices.[3]

The results indicate that the pass-through of exchange rate changes to overall consumer prices occurs gradually over an extended period. The estimates shown here suggest that a 10 per cent exchange rate appreciation can typically be expected to result in a reduction in overall consumer prices (modelled in underlying terms) of around 1 per cent, spread over around three years. This result is consistent with previous research (Heath, Roberts and Bulman 2004; Norman and Richards 2010).

The effect of exchange rate changes on consumer prices is stronger for manufactured consumer goods, which are often either imported or exposed to import competition so that their prices have a high degree of co-movement with the exchange rate (Norman and Richards 2010). These goods include clothing, footwear, household appliances, furniture, motor vehicles, books and recreational equipment.[4] For these goods, the estimates suggest that a 10 per cent appreciation of the exchange rate lowers retail prices by around 2–3 per cent, over around 2½ years.

2 If first-stage pass-through is very high, the effect of changes in import prices on consumer prices will be broadly equivalent to the effect of changes in the exchange rate.

3 These frameworks are single-equation models that potentially omit other channels that might be captured in a systems approach. For example, in addition to the direct effect of the exchange rate on prices through the cost of imported goods, there may be indirect effects via the effect on economic activity or inflation expectations.

4 Here we focus on the subset of manufactured goods with prices linked most closely to world prices rather than the broader group of 'tradable' goods included as an analytical series in the Consumer Price Index release. Items such as automotive fuel, food, pharmaceuticals, alcohol, tobacco and overseas travel & accommodation are excluded from 'manufactured goods'.

Table 1: Exchange Rate Pass-through to Prices
Estimated response to a 10 per cent appreciation, per cent[a]

	Total exchange rate pass-through	Pass-through after first year	Number of quarters for 75 per cent of total effect
First-stage pass-through to import prices	–8	–8	1
Second-stage pass-through of import prices to:			
Consumer prices[b]	–1	–0.2	10
Manufactured goods prices	–2 to –3	–2	5

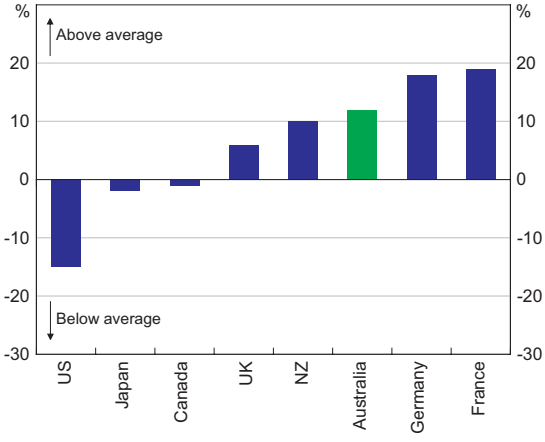
(a) For expositional reasons, the effect of a 10 per cent change in the exchange rate is shown, multiplying the model coefficient by the factor 10; the log function used in the models yields a good approximation of percentage changes for small changes of the exchange rate; the sample period is 1992:Q1–2011:Q1
(b) Measured using trimmed mean inflation
Source: RBA

Understanding Exchange Rate Pass-through

The results summarised above suggest that first-stage pass-through in Australia is very high, which is not surprising since import prices largely reflect the domestic-currency cost of the good from the foreign supplier, which can be expected to vary in line with the exchange rate. However, first-stage pass-through need not be 'full' – that is, a 10 per cent appreciation of the exchange rate might not lead to a 10 per cent reduction in import prices – if there is 'pricing to market' or 'price discrimination'. Pricing-to-market means a foreign supplier adjusts its export prices depending on the national market to which it exports. This might occur if foreign suppliers perceive that consumers in different economies are willing to pay different prices because they have different preferences or income levels (Krugman 1987). Another reason is that foreign suppliers might judge that the intensity of competition for their product differed across economies. Moreover, foreign suppliers may choose to smooth the effect of fluctuations in the exchange rate that are perceived to be temporary.

There is indeed a significant amount of evidence showing persistent differences in prices of tradable goods across economies (Rogoff 1996; Goldberg and Knetter 1997). While there are a number of difficulties associated with comparing prices across economies, the OECD has constructed cross-country comparisons of price levels for some types of highly tradable consumer goods, including clothing & footwear, furnishings & equipment, and transport equipment. These data show significant differences in prices across economies in 2005 and 2008, with the price levels of a range of consumer durable items in Australia estimated to be higher than those in a number of other developed economies, including the United States, although below those in many European economies (Graph 2).

Graph 2
Consumer Durables Price Levels in 2008
Relative to OECD average*



* Weighted by GDP at PPP exchange rates
Source: OECD

There are a number of reasons for such differences in prices across economies, including differences in shipping costs.[5] The Productivity Commission (2011) finds evidence that pricing-to-market by international producers also causes Australian prices for some goods to be higher than those in other countries. To the extent that such differences for traded goods represent pricing-to-market, they suggest foreign suppliers might choose to absorb some fluctuations in the exchange rate in their pricing. This could explain the fact that the estimates above suggest that first-stage pass-through for Australia has been a little less than complete over the past two decades.

The evidence on second-stage pass-through for manufactured goods indicates that the effect of the exchange rate on final retail prices is considerably smaller than the effect on import prices at the dock.[6] The main reason for this is that the retail prices of imported goods include a significant domestic component, including transport costs, labour inputs, rents and profit margins for distributors and retailers. Estimates from liaison and from data sources such as the input-output tables from the national accounts suggest that these domestic costs typically account for around half of the final prices of retail goods. This factor, together with the choice of some domestic distributors and retailers to (partially) absorb currency fluctuations in their margins – especially when they judge them to be temporary – can explain why the average pass-through for manufactured goods is estimated at only 2 to 3 per cent following a 10 per cent appreciation.

The effect of exchange rate movements on the overall level of consumer prices is smaller again, with a 10 per cent exchange rate appreciation estimated to typically reduce overall consumer prices by around 1 per cent, over a period of up to three years. The bulk of this effect comes from manufactured goods, which have represented around one quarter of the CPI basket during the inflation-targeting period.[7] There is also some pass-through to goods and services that are produced domestically, which account for the majority of prices in the CPI. This arises through the use of imported capital goods and intermediate inputs, although domestically sourced goods and services, including labour, make up a larger share of inputs in their production. Accordingly, modelling based on data for the past two decades suggests that movements in import prices or the exchange rate have had only modest impacts on inflation for domestically produced goods and services.

Changes in Pass-through over Time

One fairly common finding for Australia and other economies has been that econometric estimates of the overall pass-through to consumer prices have been lower over the past two decades than in earlier years. Recent Australian studies have suggested a significantly lower pass-through than studies using data over the 1980s and early 1990s. Indeed, a decline in pass-through starting in the 1990s has been documented for a number of developed economies, including the United States, United Kingdom and Canada (see, for example, Bailliu, Dong and Murray (2010)). Taylor (2000) suggests that the adoption of inflation targeting may have contributed to this outturn. In particular, a stronger anchor for inflation expectations should make it less likely that temporary shocks to inflation – that could result, for example, from a change in the exchange rate – feed through to higher inflation expectations and thus become entrenched in higher inflation for a wider range of goods.

While estimates of pass-through in Australia have declined since the 1980s, the evidence suggests that pass-through to overall consumer prices in the 1990s was similar to that in the 2000s (Table 2). For manufactured goods, while there is little evidence that the overall degree of pass-through has changed,

5 Price differentials at the retail level also reflect distribution and retailing costs that differ across economies. These include local transport costs, taxes, and non-tradable costs such as the costs of a retail shopfront, local taxes, labour and insurance.

6 Second-stage pass-through is also slower than first-stage pass-through, which can be partly explained by the use of currency hedging by wholesalers and retailers.

7 Part of the exchange rate effect on consumer prices will also reflect the impact on goods, including some foods, which can be exported and sold internationally at world prices, as well as sold domestically. In this case, changes in the exchange rate are reflected in their export prices and therefore will also affect their prices domestically.

Table 2: Changes to Second-stage Pass-through
Estimated response to a 10 per cent fall in import prices[a]

	Full sample 1992:Q1 to 2011:Q1	1992:Q1 to 2001:Q1	2001:Q2 to 2011:Q1
Consumer prices[b]			
Estimate of pass-through (per cent)	–1	–1	–1
Adjusted R-squared	0.38	0.17	0.29
Manufactured goods prices			
Estimate of pass-through (per cent)	–2[c]	–2	–2
Share within first year	0.9	0.7	1.0
Adjusted R-squared	0.44	0.21	0.48

(a) Estimates are from the Phillips curve models detailed in Appendix A
(b) Measured using trimmed mean inflation
(c) Results from the Phillips curve model; the range of estimates in Table 1 includes the mark-up model
Source: RBA

there is some evidence that pass-through has become faster in the past decade, compared with the 1990s. Estimates from a Phillips curve model suggest that after four quarters almost all of the exchange rate effect will have passed through to final prices of manufactured goods, compared with around two-thirds in the 1990s. Moreover, the models fit the data much better in the most recent decade, although the standard errors are still fairly large, so it is too soon to establish that the difference is statistically significant.

Faster pass-through of exchange rate movements to the retail prices of manufactured goods is consistent with a number of possible explanations. One is that the trend appreciation in the exchange rate over most of the 2000s has led to a perception that exchange rate shocks are more likely to be permanent. In this case, pass-through is likely to be faster, with wholesalers and retailers less likely to absorb exchange rate fluctuations if they perceive them to be permanent. A second possible explanation is that advances in technology have reduced the cost of changing prices for retailers. This means that exchange rate changes would be passed on faster, even if they may have to be reversed later on if the change in the exchange rate turns out to be temporary. A third possible explanation is that there has been reduced scope for pricing-to-market by domestic distributors and retailers due to the greater ability of consumers to observe and take advantage of cheaper prices in both domestic and foreign markets, for example via the internet.

While it is unlikely that the latter explanation can fully explain the trend towards faster exchange rate pass-through seen between the 1990s and 2000s, it could be a significant factor in coming years. In particular, the growth of the internet has made differences in consumer prices across countries much more visible to consumers, while developments in the areas of payments and package forwarding have made it more feasible to shop internationally. Accordingly, it is possible that for a wide range of goods there will be reduced scope for significant differences in prices across economies. To date, the domestic online shopping market is estimated to comprise only around 4 per cent of the domestic retail market, with international online purchases likely to be equivalent to roughly 2 per cent of domestic retail sales (Productivity Commission 2011). As internet sales increase, it is possible that price differentials across economies will narrow, with reduced scope for pricing-to-market by foreign suppliers and domestic distributors and retailers. If this occurs, one consequence is likely to be a further increase in the pass-through from exchange rate changes to the prices of goods and services that are internationally tradable.

Appendix A

Given the large changes in the Australian-dollar exchange rate that have occurred since the float of the currency in 1983, and the importance of the exchange rate in influencing domestic consumer prices and activity, there is a long history of research at the Reserve Bank examining the effect of exchange rate changes on consumer prices (see, for instance, Richards and Stevens (1987); Dwyer and Lam (1994); Dwyer and Leong (2001); Heath *et al* (2004); Norman and Richards (2010)). The models used in this article draw on this earlier work and are detailed below. Pass-through is modelled both as a two-stage process – from the exchange rate to import prices and from import prices to consumer prices – and as a direct relationship between the exchange rate and consumer prices.

First-stage pass-through

Estimates of first-stage pass-through can be obtained from regressions where changes in import prices are assumed to be a function of contemporaneous and prior changes in the exchange rate and export prices:

$$\Delta pm_t = \sum_{i=0}^{I} \beta_i \Delta wep_{t-i} + \sum_{j=0}^{J} \gamma_j \Delta e_{t-j} + \varepsilon_t$$

where pm is domestic import prices, wep is world export prices, e is an import-weighted exchange rate index and ε is an error term. All variables are in logarithmic form and Δ denotes the change in a variable (the change in the log of a variable is – for small changes – approximately equal to the percentage change in the variable). Similar estimates for the long-run effect of the exchange rate can be obtained from autoregressive distributed-lag models (which include lagged changes in import prices) and from error-correction models, which assume a stable long-run cointegrating relationship between the variables.

Second-stage pass-through

Two of the frameworks used for modelling inflation at the Bank are the mark-up and the Phillips curve approaches.[8] The mark-up model expresses underlying inflation as a function of domestic labour costs, inflation expectations and import prices. The Phillips curve controls for capacity utilisation through the unemployment rate and speed-limit term (how fast the unemployment rate changes), in addition to inflation expectations, and can be extended to include import prices (Gruen, Pagan and Thompson 1999). Specifically:

Mark-up model:

$$\pi_t = \alpha_0 + \sum_{i=1}^{I} \alpha_i \Delta ulc_{t-i} + \gamma_0 bond_{t-1} + \sum_{j=1}^{J} \beta_j \Delta pm_{t-j} + \theta_0 output_{t-1} + \varepsilon_t$$

Phillips curve model:

$$\pi_t = \alpha_0 + \alpha_1 \frac{1}{U_{t-i}} + \alpha_2 \Delta U_{t-j} + \gamma_0 bond_{t-1} + \sum_{k=1}^{K} \beta_k \Delta pm_{t-k} + \varepsilon_t$$

where π is inflation (trimmed mean or manufactured goods prices), ulc is nominal unit labour costs (in log form), $bond$ is a measure of inflation expectations derived from indexed bonds, $output$ is the output gap, U is the unemployment rate, and pm is tariff-adjusted import prices (in log form). The exact specifications of models and variables used for the estimates in Table A1 are based on Norman and Richards (2010).

8 The models outlined here use a measure of underlying inflation (the trimmed mean), rather than headline CPI inflation, as the dependent variable. The former gives a lower weight to the effect of noise and other temporary changes in headline inflation and yields equations that fit better than regressions for headline inflation.

Table A1: Second-stage Pass-through

	Trimmed mean inflation		Manufactured goods inflation	
	Mark-up model	Phillips curve model	Mark-up model	Phillips curve model
Constant	0.00***	–0.00	–0.00**	–0.00
Δ import prices	**0.11*** **	**0.08****	**0.26*** **	**0.23*** **
Bond market inflation expectations	0.00	0.00**	0.00**	0.00**
Δ unit labour costs	0.22**	na	0.05	na
Output gap	0.04**	na	na	na
1/unemployment rate	na	0.03***	na	–0.01
Δ unemployment rate	na	–0.00***	na	–0.00
Adjusted R-squared	0.30	0.38	0.43	0.44

Notes: ***, ** and * denote significance levels at 1, 5 and 10 per cent, respectively; sample period is 1992:Q1–2011:Q1; where multiple lags are included, coefficients shown are the sum of the lags
Source: RBA

Direct pass-through

In addition, the pass-through from exchange rate changes to inflation can be estimated directly by using the mark-up model and the Phillips curve. In these models, we replace import price inflation with lags of exchange rate changes and world export price inflation (Table A2).

Table A2: Direct Pass-through

	Trimmed mean inflation		Manufactured goods inflation	
	Mark-up model	Phillips curve model	Mark-up model	Phillips curve model
Constant	0.00***	0.00	–0.00*	–0.00
Δ exchange rate	**–0.09*** **	**–0.08*** **	**–0.22*** **	**–0.19*** **
Δ world export prices	0.15**	0.16**	0.02	0.01
Bond market inflation expectations	0.00	0.00	0.00*	0.00*
Δ unit labour costs	0.18*	na	0.10	na
Output gap	0.04**	na	na	na
1/unemployment rate	na	0.03***	na	–0.01
Δ unemployment rate	na	–0.00	na	–0.00
Adjusted R-squared	0.36	0.44	0.33	0.35

Notes: ***, ** and * denote significance levels at 1, 5 and 10 per cent, respectively; sample period is 1992:Q1–2011:Q1; where multiple lags are included, coefficients shown are the sum of the lags
Source: RBA

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