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Article

Exchange rates, prices, monetary policy and competitiveness : = Taux de change, prix, politique monétaire et compétitivité

Exchange rates, prices, monetary policy and competitiveness

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Introduction

The relationship between prices and the exchange rate is particularly crucial for monetary authorities whose mandate is to ensure price stability. On the one hand, exchange rate fluctuations affect the pricing chain and are perceived as a source of disruption to which central banks should react, but on the other hand changes in the monetary stance also cause exchange rate variations. To understand these interactions that depend on the reasons behind the initial exchange rate movement, it is necessary to analyse both structural and cyclical elements.

The strength of the transmission of changes in the relative value of currencies to the various prices is usually covered by the generic term "exchange rate pass-through". Most of the time, this refers to a *ceteris paribus* elasticity that can be measured at several horizons through econometric regressions. Empirical facts regarding the exchange rate-prices relationship are set out in Section 1. In particular, exchange rate sensitivity declines sharply along the pricing chain, with consumer prices being about ten times less responsive than import prices. Also, in very open economies like Belgium, consumer prices are not much more sensitive to the exchange rate than prices in larger and less open euro area members.

Such a *ceteris paribus* concept for import prices can be related to structural elements characterising a country's international environment, such as its degree of trade openness, the fact of belonging to a currency union and/or of having a reference currency. When it comes to the structural pass-through to consumer prices, the distinction between imports for direct final consumption and imports for intermediate input in domestic production becomes crucial, especially with nominal rigidities lower at the border than in the domestic production sector. As the degree of trade openness measured by the import-to-GDP ratio displays a strong positive correlation with the import content of exports, this point is a key reason why the huge cross-country variation in trade openness does not result in a similar diversity in the measured exchange rate pass-through to consumer prices. These points are discussed in detail in Section 2.

In addition to the structural determinants, it is essential to take cyclical factors into account when analysing the exchange rate-prices relationship. Even though currency depreciations are always associated with imported inflationary pressures, the conditional correlation between consumer prices and the value of the currency may vary in intensity or may even switch sign, depending on the type of shock hitting the economy. For example, an unexpected increase in domestic productivity simultaneously depresses domestic producers' prices and the

domestic currency. As domestic prices account for a bigger share of the consumer price index than import prices, the imported inflation due to such a shock is not enough to trigger a rise in consumer price inflation. Conversely, a looser than expected monetary policy stance pushes domestic producers' prices upwards, reinforcing the imported inflation resulting from the associated currency depreciation. The strength and sign of the exchange rate-consumer price relationship is therefore both shock-dependent and state-dependent, preventing the use of a "one-size-fits-all" rule of thumb as further described in Section 3.

The expected (or endogenous) reaction of the monetary authorities with respect to nominal and real developments in the economy, as summarised by the so-called Taylor rule, exerts significant influence over the mechanisms outlined in the previous paragraph. According to the benchmark general equilibrium open economy New Keynesian model, the more aggressive the endogenous monetary policy reaction to inflation and growth deviating from their steady path, the less inflationary the impact of a depreciation. This first indicates that the exchange rate also constitutes a channel for the transmission of monetary policy, and second, that the relatively weak relationship between the exchange rate and consumer price inflation may also be attributable to the central bank's credibility in stabilising inflation, in addition to the structural elements mentioned above. This is developed in Section 4.

Finally, Section 5 tackles the link between the exchange rate and growth. Currency devaluations are often perceived as a quick and efficient way to improve the competitiveness of an economy in difficulty. However, this is only true where the increase in external demand outweighs the decrease in domestic demand resulting from the negative wealth effect. In other words, it depends on the strength of the expenditure switching effect, which is itself directly related to the structural features of the economy described earlier. These features include the purposes for which an economy imports: direct consumption or intermediate inputs. If it is harder for firms than for households to replace more expensive inputs with cheaper ones, that reduces the case for depreciation as a way of enhancing growth.

1. Empirical facts about the relationships between exchange rates and prices

Exchange rate sensitivity declines across the pricing chain…

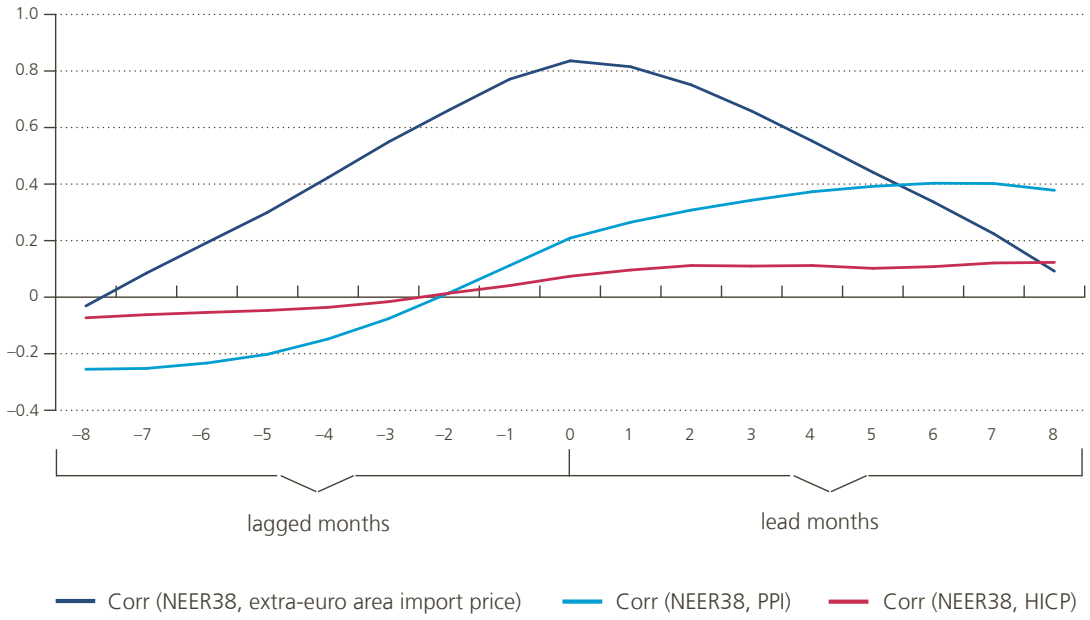
The transmission of exchange rate changes from import prices at the border to final consumer prices can first be assessed by looking at the time series co-movements. Chart 1 shows lead and lag correlations between the nominal effective exchange rate of the euro and, respectively, at-the-border extra-euro area import prices, producer prices and consumer prices for the period between 2010 and 2019. There is evidently a significant, though imperfect, contemporaneous co-movement between changes in the exchange rate and import prices, suggesting substantial transmission at the euro area border. However, the pass-through is weaker and delayed when it comes to domestic producer prices. Finally, the co-movement between currency fluctuations and consumer prices is hardly significant, suggesting that transmission to final prices is even weaker and further deferred.

More rigorous empirical approaches confirm the intuitive impression derived from observed co-movements. Econometricians have tried using various tools to formally assess the exchange rate sensitivity of prices. The most common one consists of a regression of price inflation (e.g. the import price or the consumer price) on exchange rate fluctuations and a series of control variables, as popularised by Campa and Goldberg (2005, 2010) and briefly described in Box 1. The outcome of such an exercise is an average elasticity, which is often interpreted as a *ceteris paribus* "exchange rate pass-through" in the literature. While point estimates may vary from one study to another, and may be surrounded by considerable uncertainty, an undisputed finding is that the exchange rate pass-through declines across the pricing chain. The ESCB Exchange Rate Pass-Through Expert Group recently reproduced this type of price regressions for

Chart 1

Lead and lag correlations of the euro Nominal Effective Exchange Rate (38 trade partners) with the Import Price, the Producer Price Index and the Consumer Price (HICP) in the euro area

(correlations computed on the year-on-year percentage changes, data observed on a monthly frequency)



Sources: ECB, Eurostat.

the countries of the European Union. Their report is summarised in an ECB occasional paper by Ortega *et al*. (2019). In line with the literature, it is found that a 1 % depreciation of the euro would on average increase euro area import prices within one year by about 0.35 %, and headline consumer price inflation (HICP) by about 0.03 % (ranging from 0.01 to 0.04 %, see right-hand panel of Chart 2 below)[1].

… with consumer prices displaying very low short-run sensitivity

According to these estimates, after one year the exchange rate pass-through to consumer prices is about one tenth of the transmission to import prices. Chart 2 also indicates that the low sensitivity of consumer prices to a change in the value of the euro does not only hold for the euro area as a whole but is also a robust finding across its members. What is particularly striking is that this order of magnitude does not seem to be directly related to the degree of trade openness of an economy (see left-hand panel of Chart 2). While countries such as Belgium or the Netherlands have an import-to-GDP ratio nearly twice as high as that of the largest euro area members (Germany, France, Spain and Italy), the measured exchange rate pass-through to consumer prices is not statistically different.

1 The "ranges" mentioned here and in chart 2 below refer to the extreme values of point estimates of a series of variants of the regression displayed in Box 1. Various specifications of this equation are tried with different control variables. More detail on this can be found in Rubene (2018). Due to the linear character of these regressions, the numbers also hold, mutatis mutandis, for a 1 % appreciation of the euro.

BOX 1

Econometricians have tried using various tools to formally assess the elasticity of prices to exchange rate movements. The most common method consists of a distributed lag regression of price inflation (Δp_t^z, with z indicating the price in question, e.g. the import price or the consumer price index) on the exchange rate fluctuations (Δs_t) and a series of control variables ($x_{r,t}$), as popularised by Campa and Goldberg (2005, 2010):

$$\Delta p_t^z = \alpha + \sum_{k=0}^{K} \beta_k \Delta s_{t-k} + \sum_{k=0}^{K_r} \sum_{r=1}^{R} \gamma x_{r,t-k} + \varepsilon_t$$

The outcome of such an exercise is an average elasticity, which is often interpreted as the structural (or ceteris paribus) exchange rate pass-through in the literature. It is computed at any horizon h as the (cumulative sum of) the coefficients of the change in the exchange rate: $ERPT_h^z = \sum_{k=0}^{h} \beta_k$. The ESCB Exchange rate Pass-Through Expert Group recently reproduced this type of price regressions for the countries of the European Union and compared their results with other published estimates (see Ortega *et al.*, 2019). The point estimates obtained are usually rather imprecise, with large standard deviations. Furthermore, they are sensitive to the specification of the equation and in particular to the choice of the control variables, as can be seen in Chart 2.

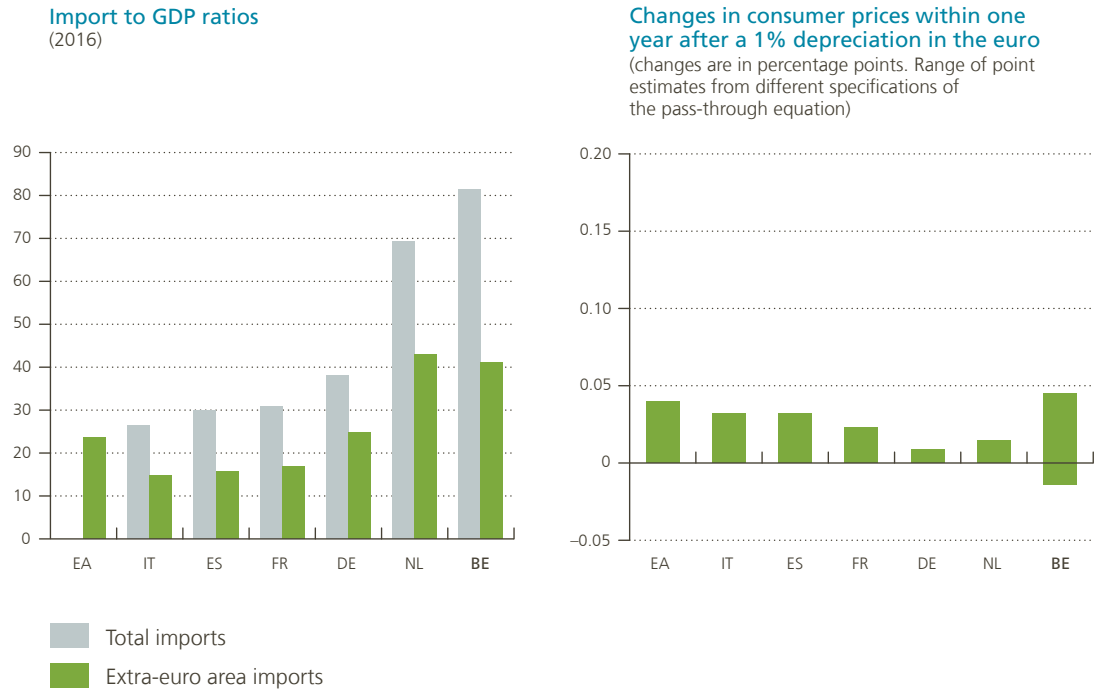
Greater trade openness does not necessarily mean increased consumer price sensitivity

This observation is interesting as it contradicts the natural intuition that a higher import-to-GDP ratio means more foreign content in final goods, and thus a higher consumer price elasticity to the relative value of the currency. Furthermore, Ortega *et al*. (2019) do not report any significant degree of increase in this elasticity across time. This again contradicts the above intuition, as trade openness has maintained an upward trend in most countries in recent decades, in accordance with the globalisation of economies. The next two sections aim to shed light on this apparent enigma by underlining the main factors behind the limited co-movement between exchange rates and consumer prices. These factors can be divided in two broad classes: structural and cyclical. Structural factors are directly related to the *ceteris paribus* view of the exchange rate pass-through as developed so far, and refer to various characteristics of an economy's international trade. However, macroeconomic series diverge from their steady growth path due to a variety of shocks that drive their respective dynamics during the business cycle. The link between the exchange rate and prices may differ greatly depending on the nature of the shock[1].

1 In the econometric approach described in Box 1, this dimension is taken into account through the control variables in order to isolate the structural component of the price-exchange rate relationship. In the general equilibrium approach that will be followed from here on, the structural factors consist of the constant parameters of the price equations, while the cyclical factors can be assessed through a shock-specific price-exchange rate co-movement.

Chart 2

Consumer price sensitivity and degree of trade openness



Sources: OECD, Ortega *et al.* (2019), right-hand chart is reproduced from Ortega *et al.* (2019).

2. Structural factors behind the exchange rate/prices relationship

What are the factors that potentially mitigate the direct link between trade openness and transmission of the exchange rate to the consumer price index? Let us start with the upper part of the pricing chain, i.e. the import price at the border, and then consider the channels through which this border price affects the consumer price index. Factors are first reviewed in a general perspective, while the case of Belgium is summarised in the last subsection.

2.1 Factors affecting the sensitivity of border prices

Price rigidity (at the exporting firm level)

Price stickiness means that exporting firms setting their optimum price in local currency do not necessarily adjust it immediately to reflect a change in the exchange rate but instead absorb the change in their profit margins. This behaviour can be justified by the cost of re-adjusting or re-negotiating the price contract, or it may be due to the degree of competition as explained in more detail below. Such nominal rigidities delay the transmission of exchange rate changes to import prices, and make it incomplete in the short run. Microeconomic empirical studies for the US and the euro area (see e.g. Dhyne *et al.*, 2006 and Nakamura and Steinsson, 2008) have revealed that firms re-optimise their prices with a median frequency of between 8 and 11 months. There is considerable heterogeneity across sectors and types of products, with goods sensitive to the business cycle, such as energy and unprocessed food, being associated with the lowest degree of rigidity, and services with the highest. These numbers have been compiled at the level of all firms and do not focus on exporting firms. Given the relatively high volatility of bilateral exchange rates, it might be the case that such firms reset their optimum price more often.

Extra-euro area trade

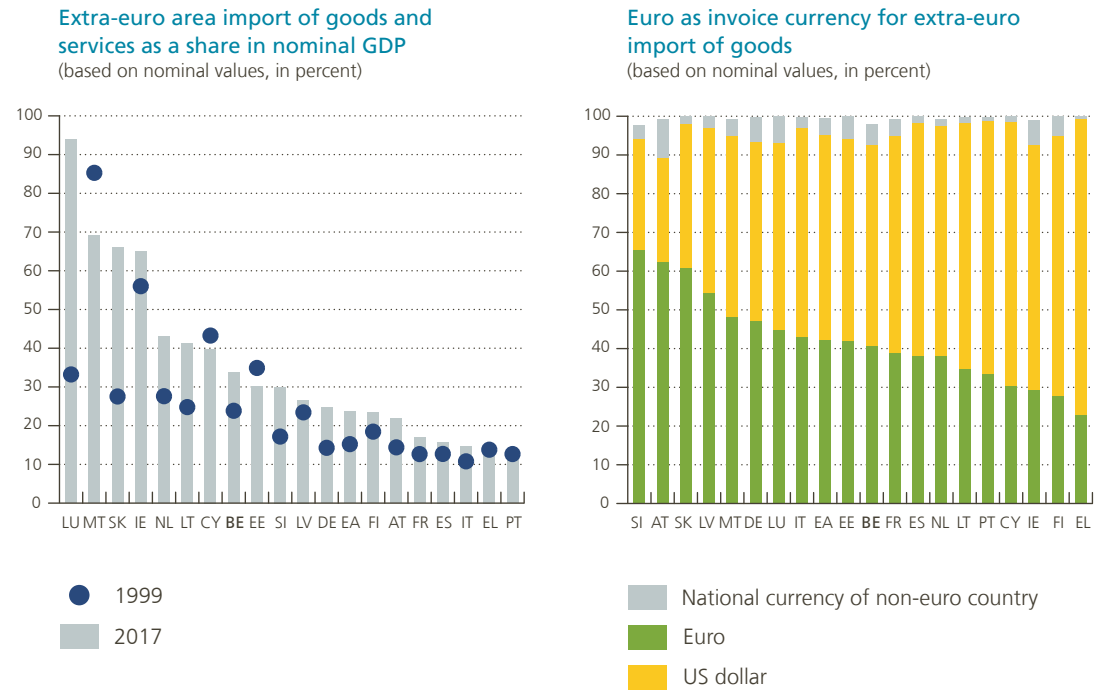
Trade among euro area partners, or intra-EA trade, is usually invoiced in euro. For the euro area countries, it is thus essential to distinguish between overall trade openness and the share of imports directly exposed to the exchange rate risk, i.e. imports coming from outside the euro area[1]. As indicated in Chart 3, trade with non-euro area partners has increased overall since 1999 for most members, most probably due to the internationalisation of the production system, the so-called global value chains[2]. However, it is still relatively limited compared to the overall import-to-GDP ratio for some countries (e.g. Austria, Belgium, the Netherlands, Portugal), and that significantly reduces the share of imports with a potentially high exchange rate pass-through.

Currency of invoicing

Furthermore, the euro has gained reference currency status, and increasing numbers of exporters from outside the euro area invoice their sales in euro. It is likely to further reduce the share of imports directly exposed to exchange rate fluctuations. When the value of their currency changes relative to the euro, these exporters do not necessarily pass on all the variation in their export prices in euro, which limits the exchange rate transmission to the prices of euro area imports from outside the zone[3,4].

Chart 3

Local and dominant currencies in international trade



Sources: Eurosystem projections database, Eurostat.
Note: Data for Malta and Croatia refer to 2000 instead of 1999. Note: Data refer to 2018, except for EE and EA to 2016.

1 Note, however, that even imports from a partner within the euro area are not totally immune to exchange rate variations, as the goods may only be transiting via that euro area partner or may include components from outside the currency union.

2 It has declined for a few countries, namely Malta, Cyprus and Estonia, reflecting increased trade with euro area members after joining.

3 This can be linked to the theoretical choice between local or producer currency pricing for an exporting firm. In the second case, the exporter is supposed to be indifferent t to exchange rate variations when setting its price on external markets, and the exchange rate pass-through is then complete and immediate for the importers. Conversely, if the exporter optimises its price in the currency of the destination market, nominal rigidities also apply to exchange rate variations, delaying their transmission to the import price.

4 For a microstudy on the role of a dominant currency, see the recent work by Amiti, Itskhoki and Konings (2018).

The internationalisation of the dollar makes it a dominant currency for invoicing trade between euro area members and extra-EA partners. The share of the greenback in a country's international transactions generally far exceeds its share of bilateral trade with the United States[1]. Such dominance influences the measured exchange rate pass-through. If trade between euro area countries and economies with volatile currencies is invoiced in US dollar, it makes their import prices less exposed to these unstable currencies and weakens the co-movement between the effective euro exchange rate and euro area import prices.

The combined effect of dominant currency and price stickiness

For instance, let us consider that euro area countries import sugar cane from Brazilian producers and that this transaction is denominated in US dollar. Table 1 gives two examples for which dominant currency pricing limits the transmission of a Brazilian real depreciation to euro area import prices. Example 1 considers a depreciation of the real vis-à-vis the dollar and the euro, while the parity of the last two currencies remains stable. If prices are fully sticky in US dollar, it means that Brazilian exporters absorb the exchange rate fluctuation into their margin. As the euro remains stable relative to the dollar, the sugar cane price converted to euro does not change. In this first example, a potential decline in the euro price would only follow if sugar cane producers decided to pass on part of the depreciation in their dollar price, e.g. 50 % in the partly-sticky case or 100 % in the fully-flexible case, and would not be due to the depreciation of the real compared to the euro. In Example 2, it is assumed that the euro depreciates relative to the dollar. If exporters do not adjust their price sufficiently, Brazilian sugar cane exports may become more expensive for euro area importers, even if the real depreciates versus the euro. In this case, the co-movement between the exchange rate and prices actually changes sign as compared to Example 1. These examples show that when prices are sticky in the dominant currency, what matters for the exchange rate transmission is the movement in a country's currency with respect to the dominant currency. Gopinath (2015) points out that international prices set in US dollar tend to be sticky, and the combination of the duration of this stickiness and the currency of invoicing therefore has a substantial impact on the exchange rate pass-through.

Table 1

Dominant currency pricing. Examples based on euro area imports of Brazilian sugarcane products priced in US dollar

	Exchange rates			Sugarcane price in USD			Sugarcane price in EUR		
	USD / BRL	EUR / USD	EUR / BRL	Fully sticky	Partly sticky	Fully-flexible	Fully sticky	Partly sticky	Fully-flexible
Initial conditions	0.27	0.89	0.24	100	100	100	89	89	89
Example 1	0.23	0.89	0.20	100	93	85	89	82	76
Example 2	0.23	0.98	0.23	100	93	85	98	91	83

Market power and local distribution services

Foreign exporters often face competition in the destination market from other producers, both domestic and foreign, who set prices in a local or a dominant currency. This competition may give them an incentive to adapt their margins so as to keep their price stable relative to competitors and avoid losing market share. The degree to which firms can adjust margins in response to the relative currency price depends on their market power and market conditions. Berman *et al*. (2012) and Amiti *et al*. (2014) find a negative relationship between import price pass-through and exporters' market share : firms with greater market power prefer to adjust mark-ups rather than prices in order to stabilise their market share. Auer and Schoenle (2016) offer complementary evidence :

1 This observation holds even when accounting for the share of oil in a country's imports, as oil is usually invoiced in US dollar.

at the extremities of the market power spectrum, very small and very large exporters tend to pass on the exchange rate fluctuations in full in their selling prices.

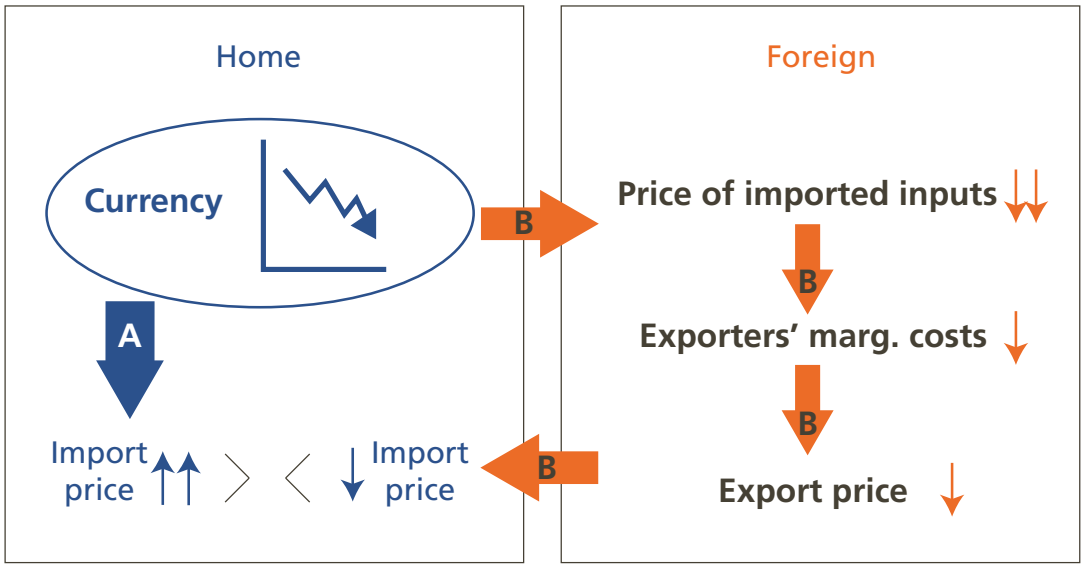
Moreover, exporters' goods are generally distributed to the destination consumers via domestic services (e.g. logistic, retail), further diluting the exchange rate sensitivity of the price of the distributed good at the retail level. If exporting firms take these local distribution costs into account when setting their prices, the distribution channel modifies the perceived mark-up of the foreign exporters on the home market, replacing the influence of their own marginal cost and exchange rate with the price of the local distribution services (see Burstein, Neves and Rebelo, 2003, Corsetti and Dedola, 2005, or Jeanfils, 2008). Consequently, higher distribution costs in the destination market decrease the exchange rate pass-through at the border.

Integration of home-country products into Global Value Chains

Finally, the expansion of international trade in intermediate goods corresponding to a decomposition of the production process into more intermediate stages also has an impact on the exchange rate sensitivity of import prices. Imagine a euro area country producing tyres and selling them to a car producer outside the euro area. All other things being equal, a depreciation in the euro leads to an increase in the price of euro area car imports. However, it also generates a decline in the marginal cost of the extra-EA car producer, as the prices of euro area tyres used in its production have decreased. When a euro area country imports cars from this external producer, the exchange rate effect is neutralised approximately in proportion to the share of the tyres in the total value of the imported car. In this sense, the more a country produces goods that are used as intermediate inputs in the production chain of its trading partners, the less its import price should react to relative currency prices. This effect weakens the influence of foreign costs on a country's inflation, and is particularly significant for the largest euro area economies like Germany, whose foreign imports include a substantial amount of their own value added. The invoicing currency also interacts with global value chains: If an exporter uses imported inputs priced in a local or a dominant currency, it has an incentive to sell its output in the same currency so as to make its mark-up less sensitive to exchange rate movements.

Chart 4

Global Value Chains: A high domestic content in foreign production weakens the exchange rate pass through



2.2 From border prices to consumer prices

While the exchange rate sensitivity of a country's import price is limited by the structural factors mentioned above, empirical evidence presented in Section 1 indicates that the exchange rate pass-through declines further down the pricing chain. We review here the structural factors that affect the transmission of exchange rate fluctuations from import prices at the border to final consumer prices.

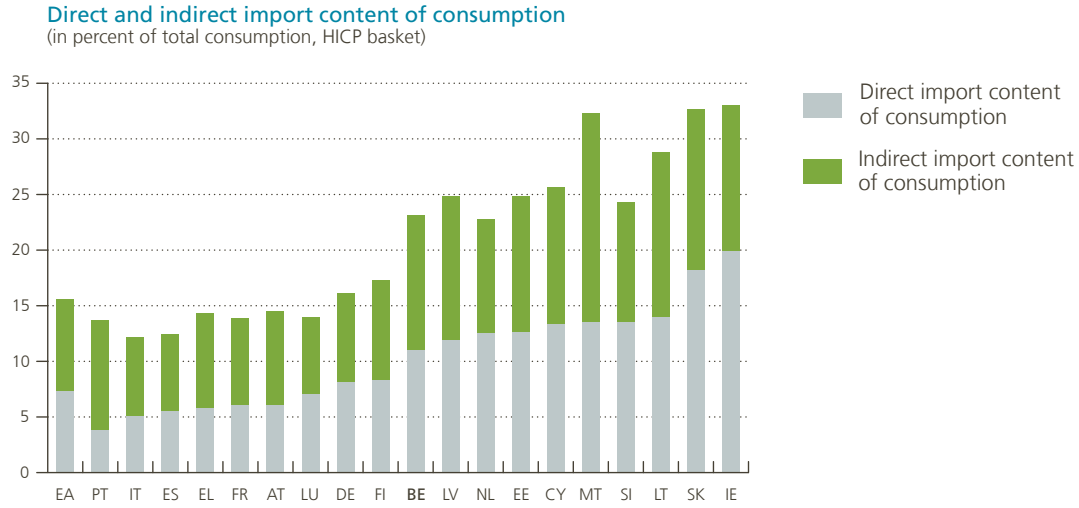
Higher input trade reduces the direct import content of consumption

Imported goods do not all end up directly in the consumer basket. Only a relatively small proportion of imports takes the form of finished products directly distributed to final users, for which the retail price is directly exposed to the exchange rate pass-through to border prices. According to the World Bank, the direct import content of goods consumed by euro area countries and originating from outside the currency union is rather small (WIOD database, 2016 release, see Chart 5). It has tended to increase somewhat over the last two decades at the aggregate euro area level, and it varies from country to country, ranging between 4 % (Portugal) and 20 % (Ireland).

Chart 5

Direct and indirect import content of consumption

(Extra-EA import content for EA members, in % of total consumption, HICP basket)



Sources: WIOD (2016 release), material drawn from Schaefer (2019).

The remaining imported goods may either be directly re-exported (transit goods) or may enter the domestic production process as intermediate inputs[1]. The domestically produced goods are then either exported or consumed locally. In the latter case, foreign intermediate inputs form the indirect import content of domestic consumption, and their (border) price affects final prices only indirectly, via the domestic producers' marginal cost.

In a world of perfect price flexibility, the distinction between the direct and indirect import content of consumption would be unimportant. However, in the presence of nominal rigidities, the difference becomes crucial as nominal

1 Examples are numerous: raw materials (metals, coke, petroleum products, rubber, plastics, chemicals), machinery and equipment, electrical equipment, intermediate components in the production of durable goods such as cars, houses, ingredients in the production of processed food (such as cacao beans), etc.

rigidities are reported to be lower at the import price level compared to the aggregate domestic producers' price level. Let us be more specific and consider, for example, that all firms, domestic and foreign, whatever the market they sell to, reset their price every *x* months. Most of the time, firms do not sell directly to end users (households or government). Instead, their customers are other participants in the production process, so that the nominal rigidities accumulate from one intermediary to the next until the final product is sold to the consumer. This explains why price rigidities measured at the end-users' level far exceed those observed at the firms' level. When a product – be it intermediate or final – crosses the border, that clearly identifies one production stage, with an associated stickiness of *x* months. Therefore, in the case of imports that reach the consumer basket indirectly, price changes are moderated twice before affecting the consumer price: first briefly, when crossing the border, and second more durably, when passing through the domestic production process. The indirect import component of final goods plus price rigidities at the domestic producer level together explain a fair share of the progressive flattening of the exchange rate transmission along the pricing chain as observed in Chart 1:

- low nominal rigidities at the border explain why import prices track exchange rate movements fairly closely;
- the producer price index (PPI) may be viewed as the average of the prices of all firms at the various stages of production, and therefore reflects the exchange rate transmission to the mean representative firm with average nominal rigidity (assessed at between 8 and 11 months by Dhyne *et al.*, 2006);
- the low exchange rate sensitivity of the consumer price index is explained by the small share of direct imports in consumption (7.3 % for the euro area, see Chart 5), and the accumulation of all the nominal rigidities across the production process for the indirect import content of consumption (8.2 % for the euro area, see Chart 5).

All other things being equal, trade openness increases in line with the import content of exports

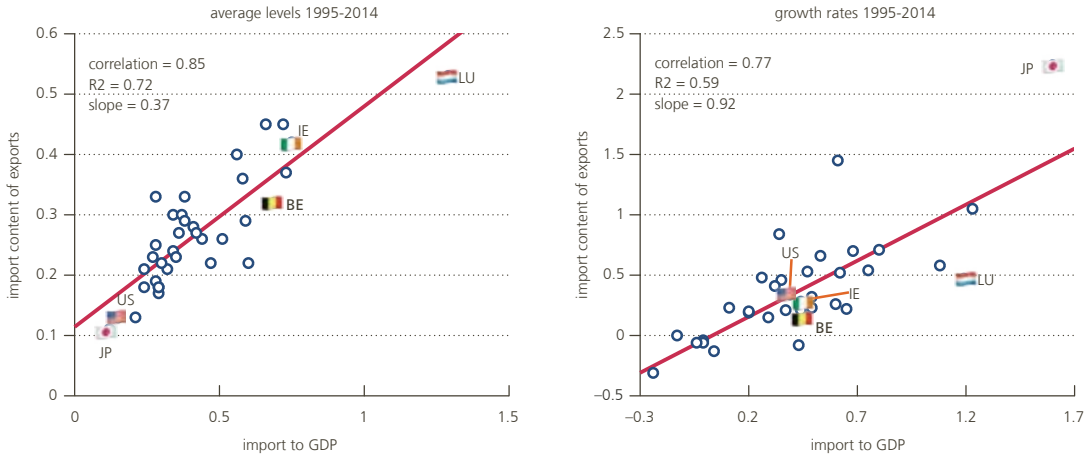
The import content of exports computed by the OECD helps to assess the importance of the indirect import content of consumption. Goods that are re-exported without any substantial domestic value added, defined as transit goods[1], are removed from OECD concept of the import content of exports. Therefore, assuming the domestic production process of goods for both domestic and foreign markets implies the same share of foreign intermediate inputs, the import content of exports can be a reasonable proxy for the import content of production, that is the share of foreign intermediate inputs in the domestic production process. Chart 6 (left-hand panel) highlights the positive and statistically significant cross-country relationship between trade openness and the import content of exports. Hence, the more open an economy, the larger the share of imports destined for the production sector rather than the consumption basket. Given the discussion of the previous point, this is key to explaining why larger import-to-GDP ratios do not necessarily mean that consumer prices are more sensitive to foreign factors.

The right-hand panel of Chart 6 displays the same cross-country scatter plot, but now shows the growth rates of each variable. The (close to) 45° regression line reveals a one-to-one relationship, meaning that, on average, all other things being equal, trade openness increases in line with the import content of exports. This might explain why the exchange rate pass-through to consumer prices has not been affected proportionally (if at all) by the general upward trend in trade openness.

1 These imports only "transit" through an economy and can be particularly substantial in countries with international sea ports, such as Belgium with Antwerp or the Netherlands with Rotterdam. Note that transit goods are meant to be excluded from the national account trade statistics. However, in economies with intensive transport activity and narrow borders, one can imagine that a share of imports is re-exported without any substantial domestic value added beyond the logistic services.

Chart 6

Import content of exports and trade openness



Sources: OECD, material drawn from de Walque *et al*. (2019).

2.3 The case of Belgium

Despite a high degree of trade openness as measured by an import-to-GDP ratio of around 80 %, empirical evidence in Section 1 suggests that the short-run exchange rate pass-through to consumer prices in Belgium is no greater than for larger and less open euro area countries. Let us review here the various structural factors affecting the pass-through from the Belgian perspective in order to explain this apparently counterintuitive observation.

First of all, the share of imports that are re-exported is significant for Belgium. According to Duprez (2014), the import content of Belgian exports is around 60 %, half of it being directly re-exported, mostly through major Belgian sea hubs (and especially the port of Antwerp). As a result, a large proportion of the imports comprised in the import-to-GDP ratio is diverted from domestic absorption (consumption and investment).

Second, Belgium mostly trades with euro area partners, with about 60 % of Belgian goods imports coming from other members of the euro area, and almost 80 % originating from the three largest neighbours: the Netherlands, Germany and France. As intra-EA transactions are essentially invoiced in euro, this significantly limits the share of imports exposed to exchange rate fluctuations, even allowing for the possibility that some of this intra-euro area trade may comprise components from outside the euro area. The principal countries of origin for Belgian imports from outside the monetary union are the United States (about 14 % of Belgian extra-EA imports), the United Kingdom (11 %), China (6 %), Russia (6 %), Japan (6 %) and Sweden (5 %)[1]. However, a large share of these trade flows is invoiced in reference currencies, as 41 % of imports from outside the European Union are denominated in euro, while 52 % are in US dollar, as indicated by Chart 3. As discussed above, this large proportion of euro-denominated trade and the dominance of the dollar in Belgian import pricing limits the exchange rate transmission at the border.

Moreover, the share of imported consumer products in Belgian consumer prices is rather low, at around 11 % of the Harmonised Index of Consumer Prices (see Chart 5). The NBB DSGE macro model estimates an aggregate Belgian domestic price rigidity about 4 times greater than the stickiness of Belgian border prices. Taking account of this high nominal rigidity and low direct exposure, the Belgian price structure is characterised by an important indirect channel which significantly delays the transmission of exchange rate effects to final consumer prices.

1 Source: NBB stat, 2018, national concept.

3. Cyclical factors behind the exchange rate/prices relationship

The exchange rate – price co-movement depends on the source of economic fluctuations…

While the above elements are necessary to determine the complex nexus between the exchange rate and prices, they are certainly not the whole story. As already pointed out, they form the structure of this interconnection, common to any kind of shocks that might hit the economy. However, the origin of the disturbances that push the economy away from its steady path implies potentially very different cross-correlations between the relative value of a currency and the various prices in the economy. First of all, nominal and real variables react in their own way to any shocks, be they domestic or foreign. It is the expected reactions of relative monetary policies and consumer price inflation – i.e. the combined domestic and foreign reactions – that, according to economic theory, cause movements in the exchange rate – the so-called uncovered interest rate parity. This contrasts strongly with the traditional view expressed earlier that there is a generic, rule-of-thumb, "exchange rate pass-through", and that a strict proportional computation suffices to assess the nominal consequences of exchange rate fluctuations. As emphasised earlier, this traditional single equation econometric measure should instead be linked to the structural nominal transmission channel of the exchange rate.

… which prevents the use of any "one-size-fits-all" rule of thumb

When the shock- and state-dependent exchange rate/prices relationship is considered, general equilibrium effects become extremely important, i.e. the way the nominal and real sides of the economy interact, under the rule of the monetary policy endogenised by the economic agents. Let us illustrate this case by means of the estimated two-country New-Keynesian model described in de Walque *et al*. (2017), simulating various shocks hitting the euro area such as to generate a 1 % devaluation of the euro with respect to all the other currencies in the first quarter. Table 2 shows the responses of the euro area consumer price and of the nominal euro exchange rate.

Co-movement between domestic prices and the exchange rate tends to be negative in the case of demand shocks…

In the first panel, an adverse demand shock affecting the whole euro area is considered. This shock drives consumers' and investors' preferences and may correspond, in practice, to a change in agents' confidence in the economy. For instance, in periods of uncertainty, a negative shock generally leads to a decline in consumption, a rise in saving, and the postponement of investment until economic conditions are more favourable. The decline in private demand generates deflationary pressures and a slowdown in output, which in turn triggers the easing of monetary conditions. The resulting decline in the real interest rate discourages savings in euro, leading to a depreciation of the currency. In our simulation, this depreciation produces an increase in the price of the import content of consumer prices such that it counteracts the initial deflationary pressures, and euro area consumer prices go up slightly. Consequently, consumer prices and the value of the euro display a negative co-movement after the demand shock.

… but positive when it comes to supply shocks

In contrast, this co-movement has the opposite sign when it comes to the simulation of a supply shock affecting the whole euro area. An example of such a supply disturbance is a total factor productivity shock. A technological innovation increases the productivity of the production factors and enables firms to produce identical or bigger quantities at lower cost. The productivity shock therefore leads to increased output and lower prices. Monetary policy reacts to these deflationary pressures by cutting its main interest rate so that real rates go down in the economy. This expansionary monetary policy generates a depreciation of the euro, and an increase in import prices. However, these effects are not enough to offset the initial deflationary pressures in the first year after the impact of the shock. As a result, consumer prices go down and display a positive co-movement with the exchange rate.

Relative response of consumer prices to exchange rates is strongest following a monetary policy shock…

The third panel reports the case of a monetary policy shock, which reflects the non-systematic part of monetary policy. In the model, economic agents assume that monetary policy sets the nominal interest rate according to the Taylor rule. Every deviation from that rule is a "surprise" in relation to the agents' expectations and is reflected by the monetary policy shock[1]. If policymakers reduce the interest rate below the level implied by the Taylor rule, they create an accommodative shock. As a consequence, real interest rates decline, generating a depreciation of the euro, while prices go up due to the expansionary effect of the shock. Moreover, foreign exporters react by increasing their prices invoiced in euro, exerting additional upward pressure on domestic prices. The increase in prices is gradual due to the presence of nominal rigidities. Compared to the effect of other shocks, the monetary policy shock is found to be associated with the largest exchange rate/price co-movement. This result is consistent with the literature (Comunale and Kunovac, 2017, and Ortega *et al.*, 2019). Indeed, in the case of monetary surprises, initial inflationary pressures are supplemented by the imported inflation resulting from depreciation. In the case of demand and productivity shocks, the direct effect is deflationary, so that prices move in the opposite direction compared to the movement triggered by inflationary pressures generated by the lower value of the currency.

… while endogenous monetary policy plays a key role in co-movements

Finally, the last panel presents the reaction of the exchange rate and consumer prices after an exogenous depreciation of the euro, that is one that cannot be related to any other fundamental sources of fluctuations. In the model, this simulation is obtained by increasing the international risk premium on the euro relative to other currencies. The higher risk premium may reflect weaker investor sentiment towards the euro, unconnected with either the euro area outlook or monetary policy. The subsequent depreciation of the euro leads to a sharp increase in the nominal value of the share of imports priced in foreign currencies. The mark-up of foreign exporters who invoice their goods in euro is compressed, and they also adjust their prices upwards, though only gradually due to nominal stickiness. The increase in aggregate foreign prices percolates down the pricing chain, affecting consumer prices in a more direct way for imported finished products than for foreign inputs. The central bank reacts to these inflationary pressures by raising the policy rate, which mitigates inflation and partly counteracts the initial depreciation of the euro. Monetary policy therefore dampens the co-movement between the exchange rate and prices, and itself plays a key role in this relationship. This role and the further implications for monetary policy are explained in more detail in the next section.

1 In practice, that surprise may be added deliberately by the monetary policymakers, e.g. because they have more information on economic developments and/or because their expectations differ from those of the markets, or because they want to change agents' expectations (see the disinflation policy in the early 1980s).

Table 2

Responses of the euro-dollar exchange rate and euro area import and consumer prices to different shocks hitting the euro area economy

(Responses are in basis point change with respect to a baseline economy not affected by any shock. Import prices are extra-euro area foreign prices. Shocks are calibrated such as to produce a 1 % depreciation of the euro in the first quarter.)

Shocks	Horizon	EUR / USD	Import price	Consumer price
Adverse demand shock				
	Q1	100.0	14.2	1.2
	Q4	143.0	25.1	2.2
	Q8	158.6	30.2	2.4
	Q12	161.2	31.7	2.6
Positive supply shock				
	Q1	100.0	13.2	–0.2
	Q4	142.4	23.0	–0.7
	Q8	158.0	27.2	–1.9
	Q12	161.5	28.1	–2.9
Expansionary monetary policy shock				
	Q1	100.0	14.6	2.6
	Q4	133.3	25.2	5.0
	Q8	136.0	29.5	6.5
	Q12	127.3	30.2	8.0
Exogenous depreciation (international risk premium shock)				
	Q1	100.0	12.7	1.6
	Q4	117.0	19.8	2.7
	Q8	104.1	20.3	2.8
	Q12	83.6	17.6	2.9

Sources: Simulations from the estimated NBB EA-US DSGE model described in de Walque *et al.* (2017).

4. Implications for monetary policy

Exchange rate movements have two-sided implications for the conduct of monetary policy. On the one hand, they are a source of price fluctuations to which monetary policy should react. On the other hand, changes in the monetary stance cause exchange rate variations, which may matter for the transmission of both conventional and unconventional monetary policies.

On the one hand, exchange rate movements are a source of fluctuations to which monetary policy should react…

To the extent that they create additional price fluctuations, exogenous exchange rate movements require the intervention of monetary policy to preserve its goal of price stability. The lower the sensitivity of end user prices to the exchange rate, the smaller the effort required from the monetary authorities. The latter is thus influenced by the various structural factors reviewed in Section 1. The dominance of a few currencies in international transactions is a telling example, as emphasised by Gopinath (2015). For the US, she reports that 93 % of their imports are priced in dollar, which greatly reduces the effect of a foreign currency appreciation vis-à-vis the greenback, and its transmission to US domestic prices. Consequently, US domestic inflation is better insulated

against external shocks than economies whose imports are priced in a foreign currency. Conversely, the exposure of economies to imports priced in dollar (see Chart 3 for an approximation for euro area countries) makes their inflation more sensitive to bilateral changes in relation to the American currency.

… on the other hand, monetary policy itself influences the exchange rate/price co-movements

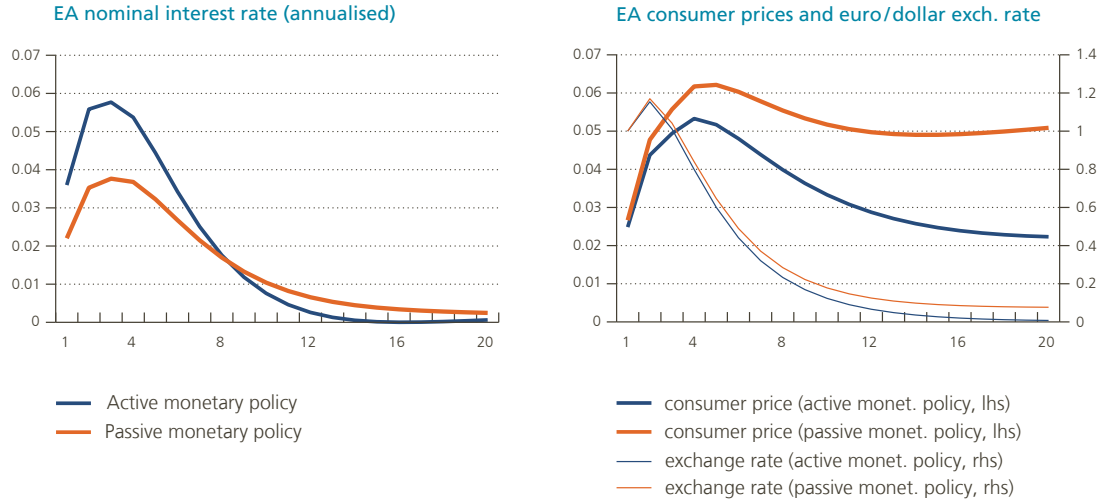
The monetary policy stance itself also influences the co-movement between exchange rates and prices. In particular, monetary policy may also be a factor in the amplitude of the co-movement : The more credible and aggressive the response of monetary policy in counteracting inflationary pressures, the lower the sensitivity of prices to exchange rate fluctuations. This is illustrated in Chart 7 which shows the changes in the EA consumer price and the EA short-term nominal interest rate after an exogenous 1 % depreciation of the euro. An active monetary policy (blue lines) reacts aggressively to the inflationary pressures generated by the depreciation. The interest rate is raised to higher levels than under a passive policy (red lines), and the response of consumer prices to the monetary tightening is more muted.

This example conveys an important policy message. It would not be wise to conclude that if consumer prices display low exchange rate sensitivity, monetary policy can simply disregard currency movements in monitoring inflation dynamics. In contrast, there is evidence that this low sensitivity can be a consequence of a monetary policy which internalises the exchange rate effects.

Chart 7

Changes in EA short-term nominal interest rate and consumer price after an exogenous 1 % depreciation of the euro

(percentage points deviation from steady state, absolute for the interest rate, relative for the other variables ; quarters on the horizontal axis)



Source : simulations from the estimated NBB EA-US DSGE model described in de Walque *et al.* (2017).

The exchange rate is a channel for monetary policy to stabilize inflation…

According to the expected uncovered interest rate parity, the exchange rate can also serve as a valuable ally in the conduct of monetary policy. An increase (decrease) in real interest rates after a restrictive (accommodative) policy leads to an appreciation (depreciation) of the domestic currency, which generates deflationary (inflationary) effects on import prices. Foreign components of consumer prices thus become cheaper (more expensive),

thereby helping monetary policy in steering domestic inflation downwards (upwards). This exchange rate channel is less powerful if the pass-through to end user prices is weak. In this regard, and referring again to the US dollar example, having a dominant currency in international transactions makes monetary policy less effective in stabilising prices, *ceteris paribus*.

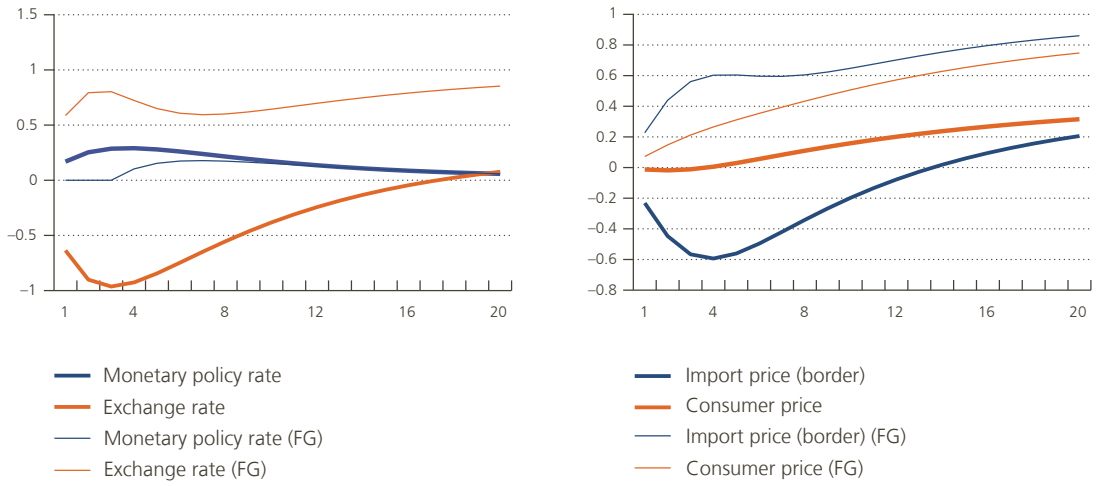
… which can be strongly influenced by forward guidance

Forward guidance aims to influence interest rate expectations via a strategy of communication on the future path of the central bank rate. If it is successful, agents' anticipations of the future monetary stance have implications for the exchange rate channel via the uncovered interest rate parity. Chart 8 illustrates these implications for an expansionary demand shock hitting the euro area. The shock stimulates aggregate consumption, exerting upward pressure on consumer prices. Following a conventional policy (solid lines), monetary authorities react to the inflationary pressure by raising the interest rate. More specifically, the monetary policy rate is raised by more than the expected change in inflation (according to the so-called Taylor principle), which means that the real interest rate increases. This causes the euro to appreciate. The appreciation in turn generates deflationary effects according to the channel described above, attenuating to some extent the initial influence of the shock on prices.

Chart 8

Changes in EA nominal variables after an expansionary aggregate demand shock

(percentage points deviation from steady state, absolute for the interest rate, relative for the other variables; quarters on the horizontal axis)



Source: simulations from the estimated NBB EA-US DSGE model described in de Walque *et al*. (2017).

In a counterfactual scenario (dashed lines), monetary policymakers commit to keeping the nominal interest rate unchanged for three quarters under a forward guidance strategy. Now the real interest rate drops, triggering a depreciation of the currency. As a result, the exchange rate channel adds extra inflationary pressures, as the foreign content of consumer goods gets more expensive. The co-movement between the exchange rate and consumer prices is now reversed compared to what happens under conventional monetary policy. The more credible the central bank's commitment, the stronger the forward guidance effects on the exchange rate channel. These results suggest that careful consideration should be given to the exchange rate channel in the design of a forward guidance strategy.

5. Exchange rates and competitiveness

Apart from the relationship between the exchange rate and prices detailed so far, exchange rate movements are also often perceived as favouring (hindering) an economy's growth prospects in the event of a depreciation (appreciation). In this sense, the manipulation of the relative value of currencies becomes part of the arsenal of available policy instruments and it is one of the elements often advocated by some EU countries reluctant to enter the currency union. Similarly, many observers commented that the Greek situation would have been much less critical during the sovereign debt crisis if Greece had retained the option of improving its competitiveness by engineering a devaluation of the drachma. However, improvements in the trade balance do not systematically outweigh the decrease in domestic demand caused by the impoverishment of the population.

Let us now extend the previous discussion about the structural determinants of the transmission of exchange rate movements from the nominal side to the real side of the economy and examine under what circumstances the common intuition that devaluations are growth-enhancing is indeed verified. General equilibrium models are de facto the most appropriate tool to generate and analyse the interactions between the real and nominal sides of an economy. For the purpose of the discussion, we build this exercise on a calibrated symmetric version of the two-country New Keynesian macroeconomic model described in de Walque *et al*. (2017)[1]. In Section 3 we state that the origin of the shock hitting the economy is an essential factor in understanding how prices interact with the value of the currency. As a result, the source of the exchange rate variation is also crucial in assessing how real variables evolve after an observed depreciation. However, for illustrative purposes, we now focus on the interactions triggered by an international risk premium shock (i.e. an exogenous depreciation). Throughout the exercise we consider a shock such that the domestic currency loses 1 percent of its value on impact. This is a more neutral way of studying the potentially growth-enhancing effect of a depreciation, as any other shock would activate the exchange rate channel in addition to other mechanisms, depending on the actual nature of the disturbance in question. Such exogenous change could moreover represent a devaluation policy. The shock is simulated so as to slowly decay through time, which means that the depreciation is long lasting.

5.1 Importance of the structural characteristics of the economy

As outlined earlier, an exogenous and unexpected devaluation is inflationary via its impact on import prices. This rise in prices and the ensuing monetary policy tightening lead to a negative wealth effect that decreases private demand and hence domestic private absorption. This is translated into lower demand for foreign goods while domestic goods become cheaper for the trading partners. From this we can deduce that the devaluation may boost growth if the reactions of import/export prices provoke a sufficiently strong expenditure switching effect, away from foreign goods and towards domestically produced ones, that dominates the negative wealth effect.

Elements limiting import price sensitivity to the exchange rate and Armington trade elasticity

This condition is directly related to all the elements reviewed in Section 2.1, i.e. the role of dominant currencies, nominal rigidities, distribution services and global value chains, that all reduce the sensitivity of international prices to the exchange rate. The strength of the expenditure switching effect traditionally depends on the Armington trade elasticity of substitution between domestic or foreign produced goods: the greater the substitutability, the larger the trade balance benefits of a devaluation. The simulations displayed in Chart 9 clearly show that the overall degree of substitutability does indeed matter for developments in the real economy. Regarding the nominal dynamics, Chart 9 also confirms the key importance of the stage of the production process at which home-produced and foreign goods/inputs are combined. Let us examine those results in more detail.

1 A much more detailed version of this debate can be found in de Walque *et al.* (2019).

A model where only final goods are internationally traded

The thin red lines representing the variables' reactions after a 1 percent devaluation for the home economy (calibrated on the euro area's characteristics) are obtained from a traditional open economy macro model where only final goods are traded. In other words, and in relation with Section 2.2, we first consider the case where only the direct channelling of imports to final consumption is activated (no indirect channel). Given the chosen high trade elasticity (set at 3), the increase in the domestic import price causes a strong switch in global demand away from foreign goods towards home-produced goods. The increase in the home economy's net exports more than offsets the decrease in its domestic demand (not plotted) and real GDP improves. Decreasing the trade elasticity would have the direct effect of mitigating this conclusion. Despite the evidence regarding the importance of trade in intermediate inputs and the expanding role of global value chains, it is noteworthy that this type of simplistic model is still the one most commonly used in open macroeconomics.

A model with international trade in intermediate inputs (the pure complementarity case)

If the model is modified to take into account that not only final goods are traded, but that production requires imported intermediate inputs, the calibration of the trade elasticity between home-produced and foreign goods becomes critical at these two different levels. Let us consider first that this substitution elasticity is still high for the final goods but that there is no substitution at the intermediate good level (i.e. perfect complementarity prevails between domestic and foreign inputs of production)[1]. The responses of macro variables for this model are the dark blue lines in Chart 9. As discussed earlier in Section 2.2, owing to trade in intermediate inputs, the total import content of consumption differs from the direct import content of consumption. The latter is valued at the import price in the consumer price index, while for imports that arrive indirectly in the consumption basket via the domestic production process, the transmission of the currency devaluation is much more attenuated by the stronger nominal rigidity prevailing all the way through the domestic production process.

The impact of the devaluation on the consumer price is thus lowered, and that has several consequences. First, the central bank has less need to react via its policy rate to fight inflationary pressures. Second, the combination of lower price reaction and less restrictive monetary conditions tends to attenuate the decline in domestic demand, and therefore the demand for foreign goods. The latter effect is supplemented by the perfect complementarity assumption whereby domestic firms now require a fixed proportion of foreign inputs in order to produce. As the model is fully symmetric and since the shock to the relative value of the two currencies is common to both economies, though in reverse directions, the responses of the foreign economy variables to the shock exactly mirror those of the home economy. Foreign households' demand for home-produced goods is therefore lower compared to the first (red) simulation. Perfect complementarity in production implies that the expenditure switching effect applies only to a proportion of the traded goods so that net exports improve much less in this simulation. Expenditure switching effects are now not enough to compensate for the depressed domestic demand (negative wealth effect) and real economic activity slows down.

A model with international trade in intermediate inputs with some substitutability

Let us now be less drastic regarding the trade elasticity for intermediate goods and consider that some substitutability is also allowed at this level, though less than for final goods (say 0.5 instead of 3). The outcome of this simulation is given by the green lines shown in Chart 9. As the substitutability is also allowed to play at the level of the firms' demand for inputs, the expenditure switching effect is somewhat stronger, with not only households but also firms on both sides of the border substituting cheaper home-produced goods for relatively expensive foreign goods. This improves the home economy's trade balance, and that improvement again outweighs the decline in domestic demand so that real GDP increases in the first two years[2]. More substitutability in inputs at the firms' level implies

1 Foreign inputs are assumed to make up 12 % of the total production inputs, while the total import content of exports for the euro area is estimated by van der Helm and Hoekstra (2009) at about 20 %.

2 This result is perfectly in line with previous work on the topic by Burstein, Kurz and Tesar (2008) in a real business cycle open economy model.

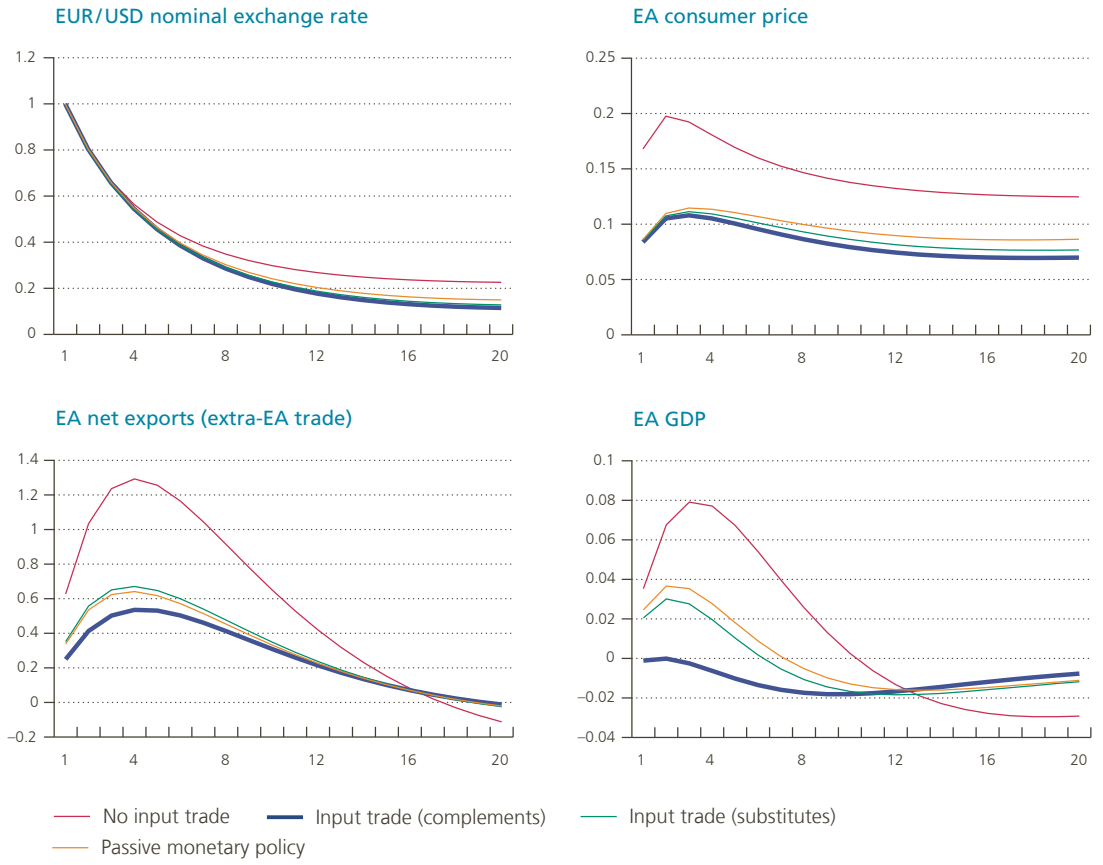
a greater expenditure switching effect and results in more real economic activity. The reason is that a higher global demand for home-produced goods exerts upward pressure on the price of domestic inputs (labour and capital), which more than offsets the substitution of cheaper foreign inputs in the marginal cost of domestic firms.

If we used the same value for the Armington trade elasticity for both inputs and final goods, the reaction of real GDP would be very similar to that obtained in the model with international trade in final goods only. Hence, the relative levels of the two substitution elasticities are key and influence the overall elasticity of substitution, which is determinant to obtain growth after a depreciation. The parameter driving the size of the input trade is important in determining the transmission of exchange rates to the price chain; that transmission is strong at the border and weak for the end-users. This suggests that the two substitution elasticities can be individually identified. In preliminary model estimates for the euro area, we obtain values that are close to those used in the green lines' simulation, i.e. trade elasticities around 3 for final goods and around 0.5 for intermediate inputs. These estimates suggest a dampened growth-enhancing effect of a devaluation at the overall euro area level[1]. This finding is consistent with a recent econometric study by Lane and Stracca (2018) who document that expenditure switching effects of a change in the euro exchange rate are limited for most euro area countries.

Chart 9

Reactions to an unexpected 1 % depreciation in a two-country symmetric model: on the role of input trade and trade elasticities

(percentage point deviation from steady state, absolute for the interest rate, relative for the other variables; quarters on the horizontal axis)



Sources: simulations from the estimated NBB EA-US DSGE model described in de Walque *et al*. (2017).

1 Not that these results are illustrative for the euro area as a whole and may not necessarily hold in the same proportion for all individual members or for other advanced countries or emerging countries.

5.2 Monetary policy

Apart from the elements discussed in the previous section, it is useful to remember the point made in Section 4 and illustrated in Chart 7 : the more active the systematic monetary policy as perceived by the economic agents, i.e. the stronger its reaction to deviations from long-run equilibrium inflation and GDP, the less volatile these two macroeconomic indicators. In an economy with a relatively passive monetary policy, the central bank reaction to the inflationary pressures resulting from depreciation is weaker ; for a given shock, that produces a stronger devaluation through the uncovered interest rate parity. The combination of these two elements leads to a larger deterioration in the terms of trade, and concurrently to stronger foreign demand for home-produced goods. At the same time, the weaker reaction of the real interest rate means that domestic private demand is less depressed. This results in a more positive reaction by real economic activity, domestic producers' prices, and consumer price inflation. Therefore, a trade-off appears between price stability and growth perspectives after an unexpected (and long-lasting) depreciation.

Conclusion

In this article we brought together elements that have recently been debated in the literature concerning the generic question of the transmission of exchange rate fluctuations to the pricing chain of an economy. For euro area members, for example, the exchange rate sensitivity of border prices is attenuated through the combination of a series of structural factors, such as (weak) nominal rigidities, the share of trade with countries in the currency union, the share of the remaining trade that is invoiced in euro, and the role of the dollar as a dominant currency. The multiple cross-border movements of intermediate products due to the internationalization of the production process may also help in understanding mitigated border prices co-movement with exchange rate.

It is worth noting that international trade in intermediate inputs tends to increase with the degree of trade openness, an observation which is valid both over time and across countries. We stress that, combined with nominal rigidities that are observed to be stronger in the domestic production process than at the border, trade in intermediate products is a very good candidate for explaining why the exchange rate sensitivity of consumer prices does not vary across OECD countries in proportion to differences in trade openness.

Apart from these structural factors, the unconditional (or average) correlation between exchange rates and prices is also very dependent on the types of shocks behind the business cycle dynamics of an economy. This important point has been widely discussed in recent years and should prevent policy makers from using any sort of one-size-fits-all rule of thumb to assess the way prices reflect exchange rate fluctuations. The systematic reaction of the monetary authorities to departures from the steady path of inflation and GDP is also identified as an important factor shaping the exchange rate-prices nexus.

All the above-mentioned items potentially play a role in the relationship between the exchange rate and real economic activity through competitiveness. However, before drawing any definitive conclusion on this, a careful estimation of the Armington trade elasticities pertaining to the final goods and the intermediate inputs respectively is still needed. Preliminary exercises tend to indicate that substitutability is lower for intermediate products than for finished goods, reducing to some extent the overall trade elasticity and the expenditure switching effect resulting from exchange rate fluctuations.

Bibliography

Amiti M., O. Itskhoki and J. Konings (2014), "Importers, exporters, and exchange rate disconnect", *American Economic Review*, 104(7), 1942-1978.

Amiti M., O. Itskhoki and J. Konings (2018), *Dominant currencies: how firms choose currency invoicing and why it matters*, NBB, Working Paper 353.

Auer R. and R. Schoenle (2016), "Market structure and exchange rate pass-through", *Journal of International Economics*, 98, 60-77.

Berman N., P. Martin and T. Mayer (2012), "How do different exporters react to exchange rate changes", *The Quarterly Journal of Economics*, 127(1), 437-492.

Burstein A., J. Neves and S. Rebelo (2003), "Distribution costs and real exchange rate dynamics during exchange-rate-based stabilizations", *Journal of Monetary Economics*, 50(6), 1189-1214.

Campa J. M. and L. Goldberg (2005), "Exchange rate pass-through into import prices", *The Review of Economics and Statistics*, 87(4), 679-690.

Campa J. M. and L. Goldberg (2010), "The sensitivity of the CPI to exchange rates: distribution margins, imported inputs, and trade exposure", *The Review of Economics and Statistics*, 92(2), 392-407.

Corsetti G. and L. Dedola (2005), "A macroeconomic model of international price discrimination", *Journal of International Economics*, 67(1), 129-155.

Comunale M. and D. Kunovac (2017), *Exchange rate pass-through in the euro area*, ECB, Working paper 2003.

de Walque G., Ph. Jeanfils, Th. Lejeune, J. Rychalovska and R. Wouters (2017), *An estimated two-country EA-US model with limited exchange rate pass-through*, NBB, Working Paper 317.

de Walque G., Th. Lejeune, A. Rannenberg and R. Wouters (2019), *Low pass-through and high spillovers in NOEM: what does help and what does not*, NBB, Working Paper (forthcomming).

Dhyne E., L. Alvarez, H. Le Bihan, G. Veronese, D. Dias, J. Hoffmann, N. Jonker, P. Lunnemann, F. Rumler and J. Vilmunen (2006), "Price changes in the euro area and the United States: some facts from individual consumer price data", *Journal of Economic Perspectives*, 20(2), 171-192.

Duprez C. (2014), "Creating export value. An analysis of Belgium", NBB, *Economic Review*, issue ii, 23-38.

Gopinath G. (2015), *The international price system*, NBER WP 21646.

Jeanfils Ph. (2008), *Imperfect exchange rate pass-through: the role of distribution services and variable demand elasticity*, NBB, Working Paper 135.

Lane Ph. and L. Stracca (2018), "Can appreciation be expansionary? Evidence from the euro area", *Economic Policy*, 33(1), 225-264.

Nakamura E. and J. Steinsson (2008), "Five facts about prices: a reevaluation of menu costs models", *The Quarterly Journal of Economics*, 123(4), 1415-1464.

Ortega E., C. Osbat, I. Rubene, V. Gunnella, M. Pisani, M. Comunale, J. Bruha and K. Mavromatis (2019), *Exchange rate pass-through in the euro area and EU countries*, ECB, Occasional Paper (forthcoming).

van der Helm R. and R. Hoekstra (2009), "Attributing GDP growth of the euro area to final demand categories", Paper prepared for the 17th international input-output conference, July 13-17th, Sao Paulo, Brazil, Statistics Netherlands.